Part 1 General

1.1 General and Related Work

.1 All work of this Division shall be coordinated and provided by the single Building Management System (BMS) Contractor.

.2 If the Contractor believes there are conflicts or missing information in the Contract Documents then the Contractor shall promptly request clarification and instruction from the Contract Administrator before proceeding.

.3 No LON protocols are accepted.

.4 The Contractor to supply all drawings/graphics/sequence of operations in both a hard and soft copy. Drawings and graphics to be able to be read and modified by City of Winnipeg Staff using Microsoft Visio software.

.5 The Contractor to provide commissioning sheets for all points on field devices as well as head end equipment.

.6 The Contractor shall meet with City of Winnipeg Tech Shop staff to go over naming conventions, graphics, alarms etc. at the start of project. Controller addresses to be coordinated with the Tech Shop.

.7 The work of this Division shall be scheduled, coordinated, and interfaced with the associated work of other trades. Reference the Mechanical Division Sections for details.

.8 The Contractor shall have visited the Project site and obtained information as necessary prior to submittal of the bid to ensure that prevailing physical conditions and Project arrangements that may be material to the performance of the Work have been ascertained and accommodated in the bid. No claims for additional payments will be accepted due to the Contractor's failure to complete this survey.

.9 If, in order to complete the Work of the Controls Contract, private and/or public telephone lines and connections, including ISDN lines and/or LAN/WAN support and connections, are required then these shall be provided by the City to the Contractor, at the City's direct cost, in a timely manner.

.10 There is an existing central monitoring system in place. The Contractor shall visit the City of Winnipeg tech shop for a walk through of the existing controls prior to bid closing date. Where DDC points are identified as centrally monitored points, the Contractor shall provide and install required hardware and software to interface to the existing Johnson Controls Metasys EA servers and workstations. These are located at the Central Control Offices, 510 Main Street, Winnipeg, Manitoba.

.11 This facility has existing Johnson Controls DDC systems using N2 open communication bus technology. Controls contractor to supply all drawings/graphics/sequence of operations in both a hard and soft copy. Drawings and graphics to be able to be read and modified by City of Winnipeg Staff using Microsoft Visio software.

.12 Provide all required assistance to Section 23 05 93 during TAB and commissioning.

1.2 Control Systems Description

.1 The Building Management System (BMS) shall be a complete system designed for use with the enterprise IT systems in place at the City of Winnipeg. This functionality shall extend into the equipment rooms. Devices residing on the automation network located in equipment rooms and similar shall be fully IT compatible devices that mount and communicate directly on the IT infrastructure in the facility. Contractor shall be responsible for coordination with the Contract Administrator's IT staff to ensure that the FMS will perform in the Contract Administrator's environment without disruption to any of the other activities taking place on that LAN.

.2 All points of user interface shall be on standard PCs that do not require the purchase of any special software from the BMS manufacturer for use as a building operations terminal. The primary point of interface on these PCs will be a standard Web Browser.

.3 Where necessary and as dictated elsewhere in these Specifications, the City of Winnipeg's existing ADX Server shall be used for the purpose of providing a location for extensive archiving of system configuration data, and historical data such as trend data and operator transactions.

.4 The work of the single BMS Contractor shall be as defined individually and collectively in all Sections of this Division specification together with the associated Point Sheets and Drawings and the associated interfacing work as referenced in the related documents.

.5 The BMS work shall consist of the provision of all labor, materials, tools, equipment, software, software licenses, software configurations and database entries, interfaces, wiring, tubing, installation, labeling, engineering, calibration, documentation, samples, submittals, testing, commissioning, training services, permits and licenses, transportation, shipping, handling, administration, supervision, management, insurance, temporary protection, cleaning, cutting and patching, warranties, services, and items, even though these may not be specifically mentioned in these Division documents which are required for the complete, fully functional and commissioned BMS.

.6 Provide a complete, neat and workmanlike installation. Use only manufacturer employees who are skilled, experienced, trained, and familiar with the specific equipment, software, standards and configurations to be provided for this Project.

.7 Manage and coordinate the BMS work in a timely manner in consideration of the Project schedules. Coordinate with the associated work of other trades so as to not impede or delay the work of associated trades.

.8 The Controls System as provided shall comprise, at a minimum, the following primary elements:

.1 Network and application nodes.

.2 Field devices.

.3 Control wiring.

.2 Submittals

.1 Shop Drawings, Product Data, and Samples

.1 The BMS contractor shall submit a list of all shop drawings with submittals dates within 30 days of contract award.

.2 Submittals shall be in defined packages. Each package shall be complete and shall only reference itself and previously submitted packages. The packages shall be as approved by the Contract Administrator for Contract compliance.

.3 Allow 15 working days for the review of each package by the Contract Administrator in the scheduling of the total BMS work.

.4 Equipment and systems requiring approval of local authorities must comply with such regulations and be approved. Filing shall be at the expense of the BMS Contractor where filing is necessary. Provide a copy of all related correspondence and permits to the Contract Administrator.

.5 Prepare an index of all submittals and shop drawings for the installation. Index shall include a shop drawing identification number, Contract Documents reference and item description.

.6 The BMS Contractor shall correct any errors or omissions noted in the first review.

.7 At a minimum, submit the following:

.1 BMS network architecture diagrams including all nodes and interconnections.

.2 Systems schematics, sequences and flow diagrams.

.3 Points schedule for each point in the BMS, including: Point Type, Object Name, Expanded ID, Display Units, Controller type, and Address.

.4 Samples of Graphic Display screen types and associated menus.

.5 Detailed Bill of Material list for each system

Part 2 Products

2.1 N2 DDC System Controllers.

.1 Digital Controller w/ extension capability (DX)

.1 Each DX shall operate as a standalone controller capable of performing its specified control responsibilities independently of other controllers in the network. Each DCX shall be a microprocessor-Based, multi-tasking, real-time digital control processor.

.2 DX controllers shall support, but not be limited to, the following configurations of systems to address current requirements described in the “Execution” portion of this Specification, and to address future expansion.

.1 Single boiler or chiller plants with pump logic.

.2 Cooling towers.

.3 Large, built-up Air Handling Units for special applications.

.4 Generic system interlocking through hardware.

.3 Point types – Each DX shall support the following types of point inputs and outputs:

.1 Analog inputs shall monitor the following analog signals:

.1 4-20 mA Sensors

.2 0-10 VDC Sensors

.3 1000ohm RTDs

.2 Binary inputs shall monitor dry contact closures. Input shall provide filtering to eliminate false signals resulting from input "bouncing."

.3 Counter inputs shall monitor dry contact pulses with an input resolution of one HZ minimum.

.1 Analog outputs shall provide the following control outputs:

.1 4.20 mA – Sink or Source

.2 0-10 VDC

.2 Binary outputs shall provide SPDT output contacts rated for 2 amps at 24 VAC. Surge and noise suppression shall be provided on all pilot relays. Inductive loads (i.e. solenoids) shall be controlled by pilot relays.

.3 Tri-state outputs shall be paired binary outputs for use as Power Close/Power Open control output contacts rated for 2 amps at 24 VAC. Surge and noise suppression shall be provided on all pilot relays.

.4 Controllers shall have a built-in status, and adjust panel interface to allow for the local adjustment of all setpoints, temporary override of any input or output points, and status of any points in alarm.

.5 Power fail Protection – All system setpoints, proportional bands, control algorithms, and any other programmable parameters shall be stored such that a power failure of any duration does not necessitate reprogramming the DX-9100.

.6 The capability to extend the input and output capacity of the DX via Point Expansion Modules shall be provided.

.1 The Point Expansion Modules shall communicate to the DX controller over a local RS-485 expansion bus.

.2 The Point Expansion Modules shall have available a range of configurations of 4, 8, 12, or 16 data points:

.1 Analog Inputs – 0-10V, 4-20mA, 1000 ohm RTD

.2 Analog Outputs – 0-10V, 4-20mA

.3 Digital Inputs w/ digital counter

.4 Digital Outputs – triacs or relay contacts

.3 Expansion module data points shall be available for inclusion in all DX control strategies.

.2 Application Specific Controllers

.1 Air Handling Unit Controllers (AHU)

.1 Each Air Handling Unit controller shall operate as a standalone controller capable of performing its specified control responsibilities independently of other controllers in the network. Each AHU controller shall be a microprocessor-Based, multi-tasking, real-time digital control processor

.2 AHU controllers shall support, but not be limited to, the following configurations of systems to address current requirements as described in the "Execution" portion of this Specification, and to address future expansion:

.1 Air Handling Units:

.1 Mixed Air-Single Path
.2 Mixed Air-Dual Path
.3 100% Single Path
.4 100% Dual Path

.3 Each AHU controller shall have sufficient memory to support its own operating system and databases, including:

.1 Control Processes
.2 Energy Management Applications
.3 Operator I/O (Portable Service Terminal)

.4 Point types – Each AHU controller shall support the following types of point inputs and outputs:

.1 Analog inputs shall monitor the following analog signals:

.1 4-20 mA Sensors
.2 0-10 VDC Sensors
.3 1000ohm RTDs

.2 Binary inputs shall monitor dry contact closures. Input shall provide filtering to eliminate false signals resulting from input "bouncing."

.3 Counter inputs shall monitor dry contact pulses with an input resolution of one HZ minimum.

.4 Analog outputs shall provide the following control outputs:

.1 4.20 mA – Sink or Source
.2 0-10 VDC

.5 Binary outputs shall provide SPDT output contacts rated for 2 amps at 24 VAC. Surge and noise suppression shall be provided on all pilot relays. Inductive loads (i.e. solenoids) shall be controlled by pilot relays.

.6 Tri-state outputs shall be paired binary outputs for use as Power Close/Power Open control output contacts rated for 2 amps at 24 VAC. Surge and noise suppression shall be provided on all pilot relays.

.5 AHU controllers shall have a library of control routines and program logic to perform the sequence of operations specified in the "Execution" portion of this Specification.

.6 AHU controllers shall directly support the temporary use of a portable service terminal that can be connected to the AHU via zone temperature or directly at the controller.

.7 Power fail Protection – All system setpoints, proportional bands, control algorithms, and any other programmable parameters shall be stored such that a power failure of any duration does not necessitate reprogramming the AHU.

.2 Unitary Controllers (UNT)

.1 Each Unitary Controller shall operate as a standalone controller capable of performing its specified control responsibilities independently of other controllers in the network. Each Unitary Controller shall be a microprocessor-Based, multi-tasking, real-time digital control processor.

.2 Unitary Controllers shall support, but not be limited to, the following types of systems to address specific applications described in the "Execution" portion of this Specification, and to address future expansion:

.1 Unit Vents (ASHRAE Cycle, I, II, III, or W).
.2 Heat Pumps (Air-to-Air, Water-to-Air).
.3 Packaged Rooftops.
.4 Fan Coils (Two-Pipe, Four-Pipe).

.3 Point types – Each Unitary Controller shall support the following types of point inputs and outputs:

.1 Analog inputs shall monitor the following analog signals:
.1 0-10 VDC Sensors
.2 1000ohm RTDs

.2 Binary inputs shall monitor dry contact closures. Input shall provide filtering to eliminate false signals resulting from input "bouncing."

.3 Counter inputs shall monitor dry contact pulses with an input resolution of one HZ minimum.

.4 Analog outputs shall provide the following control outputs:
.1 0-10 VDC

.5 Binary outputs shall provide SPDT output contacts rated for 2 amps at 24 VAC. Surge and noise suppression shall be provided on all pilot relays. Inductive loads (i.e. solenoids) shall be controlled by pilot relays.

.6 Tri-state outputs shall be paired binary outputs for use as Power Close/Power Open control output contacts rated for 2 amps at 24 VAC. Surge and noise suppression shall be provided on all pilot relays.

.7 Pneumatic outputs shall provide a 3-15 PSI pneumatic output. Gradual override capability and output pressure gauge shall be provided.

.4 Unitary Controllers shall have a library of control routines and program logic to perform the sequence of operations specified in the "Execution" portion of this Specification.

.5 Unitary Controllers shall directly support the temporary use of a portable service terminal that can be connected to the UNT via zone temperature or directly at the controller.

.6 Power fail Protection – All system setpoints, proportional bands, control algorithms, and any other programmable parameters shall be stored such that a power failure of any duration does not necessitate reprogramming the UNT.

.3 VAV Modular Assembly (VMA)

.1 The VAV Modular Assembly shall provide both standalone and networked direct digital control of pressure-independent, variable air volume terminal units. It shall address both single and dual duct applications.

.2 The VAV Modular Assembly shall be a configurable digital controller with integral differential pressure transducer and damper actuator. All components shall be connected and mounted as a single assembly that can be removed as one piece.

.3 The integral damper actuator shall be a fast response stepper motor capable of stroking 90 degrees in 30 seconds for quick damper positioning to speed commissioning and troubleshooting tasks.

.4 The controller shall determine airflow by dynamic pressure measurement using an integral dead-ended differential pressure transducer. The transducer shall be maintenance-free and shall not require air filters.

.5 Each controller shall have the ability to automatically calibrate the flow sensor to eliminate pressure transducer offset error due to ambient temperature / humidity effects.

.6 The controller shall utilize a proportional plus integration (PI) algorithm for the space temperature control loops.

.7 Each controller shall continuously, adaptively tune the control algorithms to improve control and controller reliability through reduced actuator duty cycle. In addition, this tuning reduces commissioning costs, and eliminates the maintenance costs of manually re-tuning loops to compensate for seasonal or other load changes.

.8 The controller shall provide the ability to download and upload VMA configuration files, both locally and via the communications network. Controllers shall be able to be loaded individually or as a group using a zone schedule generated spreadsheet of controller parameters.

.9 Control setpoint changes initiated over the network shall be written to VMA non-volatile memory to prevent loss of setpoint changes and to provide consistent operation in the event of communication failure.

.10 The controller firmware shall be flash-upgradeable remotely via the communications bus to minimize costs of feature enhancements.

.11 The VMA shall include troubleshooting LED indicators to identify the following conditions:

.1 Power On
.2 Power Off
.3 VMA Off Line
.4 VMA Replacement
.5 VMA Corrupted Memory

.12 The controller shall provide fail-soft operation if the airflow signal becomes unreliable, by automatically reverting to a pressure-dependent control mode.

.13 The controller shall interface with balancer tools that allow automatic recalculation of box flow pickup gain (“K” factor), and the ability to directly command the airflow control loop to the box minimum and maximum airflow setpoints.

.14 Controller performance shall be self-documenting via on-board diagnostics. These diagnostics shall consist of control loop performance measurements executing at each control loop’s sample interval, which may be used to continuously monitor and document system performance. The VMA shall calculate exponentially weighted moving averages (EWMA) for each of the following. These metrics shall be available to the end user for efficient management of the VAV terminals.

.1 Absolute temperature loop error.
.2 Signed temperature loop error.
.3 Absolute airflow loop error.
.4 Signed airflow loop error.
.5 Average damper actuator duty cycle.

.15 The controller shall detect system error conditions to assist in managing the VAV zones. The error conditions shall consist of:

.1 Unreliable space temperature sensor.
.2 Unreliable differential pressure sensor.
.3 Starved box.
.4 Actuator stall
.5 Insufficient cooling.
.6 Insufficient heating.

The controller shall provide a flow test function to view damper position vs. flow in a graphical format. The information would alert the user to check damper position. The VMA would also provide a

method to calculate actuator duty cycle as an indicator of damper actuator runtime.

.16 The controller shall provide a compliant interface for ASHRAE Standard 62-1989 (indoor air quality), and shall be capable of resetting the box minimum airflow Based on the percent of outdoor air in the primary air stream.

.17 The controller shall comply with ASHRAE Standard 90.1 (energy efficiency) by preventing simultaneous heating and cooling, and where the control strategy requires reset of airflow while in reheat, by modulating the box reheat device fully open prior to increasing the airflow in the heating sequence.

.18 Inputs:

.1 Analog inputs with user defined ranges shall monitor the following analog signals, without the addition of equipment outside the terminal controller cabinet:

.1 0-10 VDC Sensors
.2 1000ohm RTDs
.3 NTC Thermistors

.2 Binary inputs shall monitor dry contact closures. Input shall provide filtering to eliminate false signals resulting from input “bouncing.”

.3 For noise immunity, the inputs shall be internally isolated from power, communications, and output circuits.

.4 Provide side loop application for humidity control.

.19 Outputs

.1 Analog outputs shall provide the following control outputs:

.1 0-10 VDC

.2 Binary outputs shall provide a SPST Triac output rated for 500mA at 24 VAC.

.3 For noise immunity, the outputs shall be internally isolated from power, communications, and other output circuits.

.20 Application Configuration

.1 The VAV Modular Assembly shall be configured with a software tool that provides a simple Question/Answer format for developing applications and downloading.

.21 Sensor Support

.1 The VMA shall support an LCD display room sensor.

.2 The VMA shall also support standard room sensors as defined by analog input requirements.

.3 The VMA shall support humidity sensors defined by the AI side loop.

Part 3 Execution

3.1 Installation

.1 General

.1 The project plans shall be thoroughly examined for control device and equipment locations. Any discrepancies, conflicts, or omissions shall be reported to the Contract Administrator for resolution before rough-in work is started.

.2 The contractor shall inspect the site to verify that equipment may be installed as shown. Any discrepancies, conflicts, or omissions shall be reported to the Contract Administrator for resolution before rough-in work is started.

.3 The contractor shall examine the drawings and specifications for other parts of the work. If head room or space conditions appear inadequate or if any discrepancies occur between the plans and the contractor's work and the plans and the work of others the contractor shall report these discrepancies to the Contract Administrator and shall obtain written instructions for any changes necessary to accommodate the contractor's work with the work of others. Any changes in the work covered by this specification made necessary by the failure or neglect of the contractor to report such discrepancies shall be made by—and at the expense of—this contractor.

.4 All items shall be installed in accordance with manufacturer's instructions. All conduit shall be independently supported from the structure in an approved manner.

.5 The control equipment and connecting conduit and wire shall be installed in a neat and workmanlike manner by personnel skilled in this type of installation. All tubing, conduit and plenum rated cable shall be run in an approved manner; conduit shall be run parallel to or at right angles to the building structure. All conduit, tubing, and plenum cable shall be concealed in all finished spaces. Conduit containing wire or non-metallic tubing may be installed exposed in mechanical rooms or areas where other piping is run exposed.

.6 Non-metallic tubing and plenum cable may be used in concealed accessible spaces provided such installation is allowed by local codes.

.7 All electrical work shall be installed by experienced personnel and conform to CEC and all local codes. Where requirements of Division 26 differ from those contained herein, Division 26 section shall take precedence.

.2 General Workmanship

.1 Install equipment, piping, and wiring/raceway parallel to building lines (i.e., horizontal, vertical, and parallel to walls) wherever possible.

.2 Provide sufficient slack and flexible connections to allow for vibration of piping and equipment.

.3 Verify integrity of all wiring to ensure continuity and freedom from shorts and grounds.

.4 All equipment, installation, and wiring shall comply with acceptable industry specifications and standards for performance, reliability, and compatibility and be executed in strict adherence to local codes and standard practices.

3.2 Cleaning

.1 The contractor shall clean up all debris resulting from his/her activities daily. The contractor shall remove all cartons, containers, crates, etc., under his/her control as soon as their contents have been removed. Waste shall be collected and placed in a designated location.

.2 At the completion of work in any area, the contractor shall clean all work, equipment, etc., keeping it free from dust, dirt, and debris, etc.

.3 At the completion of work, all equipment furnished under this section shall be checked for paint damage, and any factory-finished paint that has been damaged shall be repaired to match the adjacent areas. Any cabinet or enclosure that has been deformed shall be replaced with new material and repainted to match the adjacent areas.

3.3 Training

.1 Provide training sessions for personnel designated by the Contract Administrator.

.2 Train the designated staff of owner's representative and owner to enable them to do the following:

.1 Day-to-day Operators:

.1 Proficiently operate the system

.2 Understand system operation, including DDC system control and optimizing routines (algorithms)

.3 Operate the workstation and peripherals

.4 Log on and off the system

.5 Access graphics, point reports, and logs

.6 Adjust and change system set points, time schedules, and holiday schedules

.7 Recognize malfunctions of the system by observation of the printed copy and graphical visual signals

.8 Understand system drawings and Operation and Maintenance manual

.9 Understand the job layout and location of control components

.10 Access data from DDC controllers and ASCs

.2 Advanced Operators:

.1 Make and change graphics on the workstation

.2 Create, delete, and modify alarms, including annunciation and routing of these

.3 Create, delete, and modify point trend logs and graph or print these both on an ad-hoc basis and at user-definable time intervals
.4 Create, delete, and modify reports
.5 Add, remove, and modify system's physical points
.6 Create, modify, and delete programming
.7 Add panels when required
.8 Add operator interface stations
.9 Create, delete, and modify system displays, both graphical and others
.10 Perform DDC system field checkout procedures
.11 Perform DDC controller unit operation and maintenance procedures
.12 Perform workstation and peripheral operation and maintenance procedures
.13 Perform DDC system diagnostic procedures
.14 Configure hardware including PC boards, switches, communication, and I/O points
.15 Maintain, calibrate, troubleshoot, diagnose, and repair hardware
.16 Adjust, calibrate, and replace system components System

.3 Managers/Administrators:

.1 Maintain software and prepare backups
.2 Interface with job-specific, third-party operator software
.3 Add new users and understand password security procedures

.3 These objectives will be divided into three logical groupings. Participants may attend one or more of these, depending on level of knowledge required.

.1 Day-to-day Operators
.2 Advanced Operators
.3 System Managers/Administrators
.4 Provide course outline and materials. The instructor(s) shall provide one copy of training material per student.
.5 The instructor(s) shall be factory-trained instructors experienced in presenting this material.
.6 Classroom training shall be done using a network of working controllers representative of the installed hardware.

3.4 DDC Controls Sequence Of Operation (Refer to Control Schematics)

.1 DDC system shall control and monitor the air handling units as follows:

.1 New Air Handling Units (AHU-3, and AHU-4): Each air handling unit shall operate on its' own 7 day schedule capable of minimum 4 schedule changes per day.

.1 Occupied Winter Mode – (Below 15 deg. C)

.1 Blowers to operate continuously
.2 Outside air damper and exhaust damper set to minimum position. Outdoor damper minimum setting to be over ridden by CO2 control on return air to bring in more outdoor air as required.
.3 Modulate control valve to maintain discharge air temperature at set point.
.4 Supply air low limit shall close fresh air damper based on low discharge air temperature and after time delay shut down unit and alarm.

.2 Occupied Summer Mode – (15 deg. C and above)

.1 Blowers to operate continuously
.2 Modulate mixed air dampers to maintain discharge air at set temperature for free cooling where outdoor temperatures permit. (When return air temperature is lower than outside air temperature, set outside air damper and exhaust damper to minimum position and the return air damper to maximum position and initiate DX cooling).
.3 Outdoor damper minimum setting to be over ridden by CO2 control on return air to bring in more outdoor air as required.

.3 Un-occupied Winter Mode – (Below 15 deg. C)

.1 Units shall operate to maintain space temperature at set-back point. Blowers to operate as required.
.2 Outside air damper and exhaust damper closed, return damper fully open.
.3 Modulate control valve to maintain discharge air temperature at set point.

.4 Un-occupied Summer Mode – (15 deg. C and above)

.1 Units shall operate to maintain space temperature at set-up point. Blowers to operate as required.
.2 Modulate mixed air dampers to maintain discharge air at set temperature for free cooling where outdoor temperatures permit.
.3 Outside air damper and exhaust damper closed, return damper fully open, when DX cooling is enabled.

.5 AHU supply and return fans shall be VFD controlled. The DDC System shall maintain supply air pressure at set point. (Co-ordinate set point with the Section 23 05 93 and provide all required assistance.)

.6 DDC system shall monitor the following:

.1 AHU blower (supply and return fans) status
.2 Clogged filter
.3 Return Air temperature
.4 Outdoor air temperature
.5 Mixed Air temperature
.6 Supply Air temperature.
.7 Damper positions
.8 CO2 Levels.

.2 Boilers

.1 Boilers B-1 and B-2 shall be enabled/disabled by the DDC system. Once enabled, the boilers shall operate under their own controls to maintain loop temperature at set point. DDC System shall send temperature re-set signal to the boiler based on outdoor air temperature. DDC System to receive boiler alarms generated by the boilers and alarm through the DDC system. Co-ordinate with boiler manufacturer's installation instructions. DDC system shall duty cycle the boilers.

.3 Pumps

.1 PU-1 and PU-2

.1 Enable ONE pump during winter mode. (Outdoor temperature below 15 deg. C) The other pump to remain on standby.
.2 In event of a pump failure, the standby pump shall start automatically. An alarm shall be generated to indicate pump failure.
.3 Pumps shall be VFD controlled. The DDC System shall maintain discharge pressure at set point. (Co-ordinate set point with the Section 23 05 93 and provide all required assistance.)
.4 DDC system shall provide automatic duty cycling of the pumps.
.5 DDC System shall monitor pump status.
.6 DDC System shall monitor differential pressure across the pumps.

.4 Glycol Fill Packages:

.1 DDC System shall monitor each glycol fill package level and pressure.

.5 Control Valves (all control valves supplied by 230933 and installed by mechanical).

.1 The control valves shall control glycol flow supplied to the air handler heating coils and re-heat coils.

.6 Zone Control

.1 When in heating mode, the DDC system shall modulate flow to re-heat coils to maintain space temperature at set point. In rooms where supplemental electric baseboard heaters exist (Specific Skills Room, Craft Room, Game Room, Senior Citizen Lounge), the DDC shall turn on the baseboard heaters if the re-heat coil is unable to maintain space temperature set-point. (The existing baseboard heater thermostats shall be removed.)

.2 When in cooling mode, the DDC system shall modulate the VAV boxes to maintain space temperature at set point. VAV operating range shall be set during commissioning in co-ordination with section 230593. Provide low voltage VAV actuators.

3.5 Alarms and Monitoring

.1 DDC System shall monitor,

.1 Glycol supply temperature

.2 Glycol return temperature

.2 Alarms shall be generated on the DDC system for the following events:

.1 Clogged filters on air handling units (non critical)

.2 Freeze stat on air handling units (critical)

.3 Fan failure on air handling units (critical)

.4 Damper failure on air handling units (critical).

.5 Pump Failures (critical)

.6 Glycol fill package low level and low pressure (critical)

.7 Boiler failure (Critical).

3.6 Thermostats and Temperature Sensors

.1 Provide duct mounted DDC temperature sensors suitable for specified operation.