1. GENERAL

1.1 Summary

.1 Section Includes:

.1 Materials and installation procedures for electric heating and cooling controls.

.2 Related Sections:

.1 20 09 93 – Sequence of Operations for HVAC Controls.

1.2 References

.1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

1.3 Submittals

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.

.1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures.

.2 Provide Shop Drawings including complete operating data, system drawings, wiring diagrams and written detailed operational description of sequences and engineering data on each control system component. Include sizing and arrangements as requested.

.3 Submit reviewed Shop Drawings for inclusion in operating and maintenance manuals.

1.4 Quality Assurance

.1 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.

.1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.2 Instructions: submit manufacturer's installation instructions.

.1 Contractor will make available 1 copy of systems supplier's installation instructions.

1.5 Delivery, Storage, and Handling

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

1.6 Scope

.1 Complete and fully operational system of automatic controls, including Control devices, components, wiring and all materials and labour.

.2 Submissions of technical system data.

.3 Demonstration of proposed installed controls system to the City**.**

1.7 Work by Other Trades

.1 **Division 26** shall provide 600V power for Controls Panels, SCU's and Central Computer Equipment.

.2 **Division 22** shall install thermal wells, control valves and devices on piping, furnished by the HVAC controls contractor.

.3

1.8 Renovation or Addition Projects

.1 Control work involves renovations to an existing control system. The Contractor shall inspect the systems prior to tender close and include in the submission all interlocks and relays required to provide a fully operational controls system.

.2 The Contractor shall ensure that the installation and commissioning of the automation system shall not disrupt the use of the facilities.

.3 Prior to close of tender the Contractor shall inspect the system and include for replacement of defective control equipment and components.

1.9 City Orientation

.1 Contractor to provide three (3) weeks written notice to the Contract Administrator and City prior to commencing formal training sessions.

.2 Formal training sessions shall commence only after "As-built" Drawings have been completed, reviewed and approved by the Contract Administrator and shall be in addition to Section 01 33 00 - Submittal Procedures requirements.

.3 Provide for operator training according to the following schedule.

.1 A seminar/workshop covering all aspects of system use as follows:

.1 Operation of hardware components

.2 System software configuration

.3 User/system interaction

.4 Calibration of sensors and system

.5 Trouble shooting of system and components

.6 Preventative maintenance

.2 A review workshop at one (1) month after system acceptance.

.3 A seminar after six (6) months of operation for clarification of system operating techniques for building operators.

.4 Allow for two (2) additional one day training seminars in addition to the above seminars, within the first year of operation. These seminars are to be scheduled at City selected dates and times.

.5 Coordinate above seminars/workshops to occur during peak cooling and heating season as well as during one shoulder season.

.6 Controls contractor to provide three (3) complete sets of training manuals to the City prior to commencing of the training session, plus one (1) manual to the Contract Administrator.

1.10 Warranty

.1 The warranty provisions shall commence for one year from the date of final acceptance and shall include at no cost all material and labour required to correct control system equipment failures that occur during the one year period.

.2 In addition to warranty call backs provide two (2) service and calibration inspections of a minimum eight (8) hours duration each.

.3 The Contractor shall supply and install at no cost all system software and hardware updates and upgrades occurring prior to the expiration of the warranty period.

1.11 System Activation

.1 Submit control calibration check sheet prior to system acceptance. Check sheets to include unit identification, controller/transmitter tag numbers, device controlled, controller PID settings, interlock devices and wire tag numbers.

.2 Set damper linkages, static pressure/volume controls as required by the Balancing Trade.

.3 Adjust and calibrate all room thermostats thirty (30) days prior to system acceptance.

1.12 Acceptance Testing

.1 A final operational acceptance test of seven (7) consecutive days shall be conducted on the complete and total installed and operational control system to demonstrate that it is functioning properly in accordance with the Specifications.

.2 The correct operation of all monitored and controlled points shall be demonstrated as well as the operation and capabilities of all sequences, reports, specialized control programs and algorithms, diagnostics and all other software.

.3 In the event of the failure of function, during the test, of any of the hardware components or software application or routines, the test will recommence and run until seven (7) failure-free test days have occurred.

.4 After successful completion of the acceptance test, the Contract Administrator will issue written acceptance of the control system.

.5 Prior to acceptance of the work, submit hard copy and electronic copy on CD of final data base listings.

1.13 Demonstrations

.1 The controls contractor shall arrange for a demonstration of an operating system that meets the technical submittal and Specification requirements within twenty (20) calendar days of the selection of Contract.

.2 The demonstration shall include representative(s) from the Contract Administrator and representative(s) from the City.

.3 The controls contractor shall submit to the Contract Administrator a demonstration plan prior to conducting the demonstration.

.4 The controls contractor shall demonstrate to the Contract Administrator that the equipment, networks, installation programs and services as proposed for this Contract meet the requirements of the Contract Documents.

.5 The Contractor shall complete all necessary documentation and testing forms prior to scheduling any tests, of the operating system being demonstrated.

.6 The Contract Administrator reserves the right to call a halt to any demonstration if the equipment/controls programming being demonstrated are found to be faulty. In this event the Contractor shall be responsible for any cost incurred from the aborted demonstration and any future demonstration at no additional cost to the Contract.

.7 The Contract Administrator shall have the option of additional special testing to ensure the proper functioning of the control system at no extra cost to this Contract.

1.14 Costs

.1 All costs incurred in testing the controls system, including City and Contract Administrator demonstration cost shall be included for under this Contract. No additional charges will be entertained.

.2 All equipment, software, consumable items, personnel and facilities as required to reasonably execute the factory or site acceptance tests, including any signal simulation equipment shall be made available under the terms of this Contract at no further cost.

2. PRODUCTS

2.1 General

.1 Controls must be able to interface to MSEA technology on the field device network using either the N2Open or BACnet Protocols. See note 2.

.2 No LON protocols are to be accepted.

.3 Controls contractor to provide commissioning sheets for all points on field devices as well as head end equipment.

.4 Controls contractor to communicate with equipment provider to ensure proper field point integration as well as controllability of the equipment, if not package controls.

.5 If not a Metasys product installed, the controls contractor must show seamless integration into the exiting Metasys Extended Architecture Operator Interface that is acceptable to City Staff prior to the award of the contract. See note 2.

.6 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.

.7 The use of either N2Open or BACnet to be determined based on type of building where the work is being performed. If the construction is a brand new facility, then BACnet can be used. The term BACnet should then be defined properly in its use, see note 1 below. If the work is an addition to and the new work is to be tied into the existing controls, then the contractor should contact the Contract Administrator to determine the best protocol to use based on existing equipment.

.8 The controls contractor performing the supervisory controller installation should confirm that all devices specified are able to communicate to the proposed devices using the BACnet PIC statement and then supply documentation such that all devices supplied will communicate to each other as required for proper operation of the system. This includes integration into the ADX server.

.9 If Metasys Network Automation Engines (NAE/NIE/NCE) are to be installed on the project then the version of these devices and their software must be such that the City of Winnipeg will not be required to update/upgrade the existing ADX server in order for all user views, alarms, and point monitoring to occur. The contractor must co-ordinate with Contract Administrator to determine the correct version to be installed. All user views and graphics must not be installed in the local supervisory controller (NAE/NIE/NCE). All such items must be programmed into the existing ADX server. User views and graphics must be approved for use by City staff before implementation of such items.

.10 All monitored points that have alarms must have operating instructions and alarm messages. These will be co-ordinated with the tech shop and operations supervisor.

2.2 Acceptable Manufacturer's

.1 Johnson Controls Metasys BMS system

2.3 Building Automated Control Hardware

.1 Stand-Alone Digital Controllers

.1 Provide digital controllers that operate in environmental conditions between 0 and 50°C.

.2 Provide a clock with each stand-alone controller. Each controller shall have its clock backed up by a capacitor with sufficient capacity to maintain clock operation for a minimum of seventy-two (72) hours during power outage.

.3 Memory

.1 Provide sufficient memory for each controller to support required control, communication, trends, alarms, and messages

.2 Programs residing in memory shall be protected by using EEPROM, flash memory. Battery back-up systems are not acceptable.

.2 Inputs

.1 Provide input function integral to the direct digital controller. Provide input type(s) as required by the systems design. For each type of input used on high-level controllers, provide at least one similar spare input point per controller.

.2 Analog Inputs: Allowable input types are 100 ohm (or higher) platinum RTDs, 4 to 20 mA, and 0-10 VDC. Direct RTD inputs must have appropriate conversion curves stored in controller software or firmware. Analog to digital (A/D) conversion shall have 16-bit minimum resolution.

.3 Digital Inputs: Digital inputs shall sense open/close, on/off, or other two state indications.

.3 Outputs

.1 Provide output function integral to the direct digital controller. Provide output type(s) as required by the systems design. For each type of output used on high-level controllers, provide at least one (1) similar spare output point per controller.

.2 Analog Outputs: Provide controllers with 16 bit minimum output resolution. Output shall be 4 to 20 mA or 0 to 10 VDC.

.3 Digital Outputs: Provide contacts rated at a minimum of 1 ampere at 24 V.

.4 PID Control

.1 Provide controllers with proportional integral and derivative control capability.

.2 The upper level digital controllers shall be capable of networking with other similar upper level controllers. Upper level controllers shall also be capable of communicating over a network between buildings.

.5 Communications Ports

.1 Controller-to-Controller LAN Communications Ports: Controllers in the building BMS system shall be connected on a communications network. Controllers shall have controller to controller communication ports to both peer controllers (upper level controllers) and terminal controllers (lower level controllers). Network may consist of more than one level of local area network and one level may have multiple drops. Communications network shall permit sharing information between controllers, allowing execution of dynamic control strategies, and coordinated response to alarm conditions. Minimum speed for all LAN's is 100 Mbps. Provide all communications support and protocols for BACNet systems.

.2 Interface Ports: Provide a RS-232 communications port for each digital controller that allows direct connection of a computer or hand held terminal and through which the controller may be fully accessed. Controller access shall not be limited to access through another controller. Interface communication ports shall be in addition to the communications port(s) supporting controller to controller communications. Communication rate is 9600 Baud minimum. Every controller on the highest level LAN shall have a communications port supporting direct connection of a computer; a hand held terminal port is not sufficient. By connecting a computer to this port, every controller in the direct digital control system shall be accessible and programmable. The following operations shall be available: downloading and uploading control programs, modifying programs and program data base, and retrieving or accepting trend reports, status reports, messages, and alarms.

.3 Remote Work Station Interface Port: Provide one (1) additional direct connect computer port in each BMS system for permanent connection of a remote operator's work station, unless the workstation is a node on the LAN. All operations possible by directly connecting a computer to a controller at the highest level LAN shall be available through this port.

.6 Modem

.1 Provide two (2) modems per BMS system to communicate between the digital control system and the computer workstation. Minimum modem baud rate is 56 Kbaud with v.90 communication standard.

.7 Ethernet NIC

.1 Provide two (2) Ethernet NIC's per BMS system to communicate between the digital control system and the computer workstation. Minimum Ethernet transmission rate is 100 GHz.

.8 Digital Controller Cabinet

.1 Each indoor digital controller cabinet shall protect the controller from dust and rated NEMA 1, unless specified otherwise. Each outdoor digital controller cabinet shall protect the controller from all outside conditions and rated NEMA 4x. Cabinets for high level controllers shall be hinged door, lockable, and have offset removable metal back plate.

.9 Main Power Switch

.1 Each controller on the highest level LAN or each control cabinet shall have a main external power switch for isolation of the controller from AC power. The switch shall be located in the BMS cabinet.

.10 Terminal Control Units

.1 The same company as the digital controllers shall manufacture TCUs.

.2 TCUs shall automatically start-up on return of power after a failure, and previous operating parameters shall exist or shall be automatically downloaded from a digital controller on a higher level LAN.

.3 TCUs do not require an internal clock if they get time information from a higher level digital controller.

.11 BMS Software

.1 Provide, in the digital controllers, software to execute the sequence of control. Provide one (1) registered copy of all software used to program control sequences in all direct digital controllers and LAN controllers on the computer workstation. Provide any access keys which restrict programming language software functions or the ability to compile or prepare programming for download to controllers. Provide final copy of each program used in the system in both compiled and editable formats. Where specially programmed factory configured smart controllers are used in the system, provide minimum factory programming tools and specialized controller programs ready for download to replacement controllers. At minimum, controllers must be capable of performing programming functions outlined in the following "Parameter Modification" section. All software must be compatible with the existing controllers and operator software already in use on the site.

.2 Provide software to modify control parameters. Parameter modification for all controllers (high level and low level application specific) is through the main workstation computer and with laptop computer or keypad terminal directly at each controller. Modifications are to be accomplished without having to make changes directly in line-by-line programming. When the control program is of the line-by-line type, database parameters in the following list that take real number values require assignment of variable names so parameters can be changed without modifying programming. Alternatively, block programming languages shall provide for modification of these database parameters in fill-in-the-blank screens. Parameters of like type, including those in different high level and low level controllers, may be grouped together for a single, global change. For example, an operator may group all second floor space temperature setpoints into a group and raise the setpoint by two degrees with a single command. The following parameters shall be modifiable in this way:

.1 Setpoints

.2 Dead band limits and spans

.3 Reset schedules

.4 Switch over points

.5 PID gains and time between control output changes

.6 Time

.7 Timed local override time

.8 Occupancy schedules

.9 Holidays

.10 Alarm points, alarm limits, and alarm messages

.11 Point definition database

.12 Point enable, disable, and override

.13 Trend points, trend intervals, trend reports

.14 Analog input default values

.15 Passwords

.16 Communications parameters including network and telephone communications setups

.3 All software will be fully licensed copies. Trial or demonstration versions are not acceptable.

.12 Differential

.1 Where setpoint is in response to some analog input such as temperature, pressure, or humidity, include a setpoint differential to prevent short cycling of control devices.

.13 Motor and Flow Status Delay

.1 Provide an adjustable delay between when a motor is commanded on or off and when the control program looks to the motor or flow status input for confirmation of successful command execution.

.14 Run time Accumulation

.1 Provide resettable run time accumulation for each controlled digital output.

.15 Time Programs

.1 Provide programs to automatically adjust for leap years, daylight savings time, and operator time adjustments.

.16 Scheduling

.1 Individual controlled equipment shall be schedulable with schedule based on time of day, day of week, and day of year. Equipment may be associated into groups. Each

group may be associated with a different schedule. Changing the schedule of a group shall change the schedule of all equipment in the group. Groups may be modified, created and deleted by the operator.

.2 Provide capability to view and modify schedules in a seven-day week format. When control program does not automatically compute holidays, provide capability to enter holiday schedules one full year at a time.

.17 Point Override

.1 I/O and virtual points shall accept software overrides to any possible value.

.18 Alarming

.1 I/O points and software points shall be alarmable. Alarms may be enabled and disabled for every point. Alarm limits shall be adjustable on analog points. Controllers connected to an external communications device such as a printer, terminal, or computer, shall download alarm and alarm message when alarm occurs. When a computer workstation is connected to the BMS system with a LAN or modem, operator selected alarm conditions will initiate a call and report to the computer or an alphanumeric pager. Otherwise alarms will be stored and automatically downloaded when a communications link occurs. In addition to those described in Section 23 09 93 – Control Sequences, the following conditions shall generate alarms:

.1 An analog input takes a value indicating sensor failure

.2 A module is not communicating on the LAN

.3 A power outage occurs

.19 Messages

.1 Messages shall consist of the device tag number, the device/associated equipment description and fault, and be assigned to alarm or status conditions. An example of a message for the activation of a pressure switch would be, “PDS-200A, - Make-up Air Unit MAU-200A - Summer Filter Dirty”. Messages shall be displayed on the workstation and be capable of bring printed when these conditions occur.

.20 Trending

.1 BMS system shall have the capability to trend all I/O and virtual points. Points may be associated into groups. A trend report may be set up for each group. The period between logging consecutive trend values shall range from 15 seconds to 60 minutes at a minimum. The minimum number of consecutive trend values stored at one time shall be 6000 per variable. Trend data shall be uploaded to workstation computer automatically for archiving and processing prior to controller storage being exceeded, maximum once per day. Trend data shall be available on a real time or archived basis; trend data shall appear numerically and graphically on a connected computer's screen as the data is processed from the BMS system. Workstation software will process the data into user defined reports. The system must be able to show single or multiple values in multiple ranges on a single graph, including the ability to mix analog and digital signals. The time scale must be user definable. The line types must be able to be

displayed in a variety of formats including column, line, symbol, scatter or area. The user must be able to zoom and scroll on the trend. The trend should be capable of displaying a user selected point value. Database for storing of archived data and reports shall be in ASCII format compatible for export to common database manipulation programs (e.g. Microsoft Access, Microsoft Excel). Archived data and reports shall be kept and be retrievable for a minimum of two (2) years.

.21 Status Display

.1 Current status of I/O and virtual points shall be displayed on command. Points shall be associated into functional groups, such as all the I/O and virtual points associated with control of a make-up air unit, and displayed as a group, so the status of a single mechanical system can be readily checked. A group shall be selectable from a menu of groups having meaningful names; such as MAU-200A, Membrane Building, Heat Reclaim System, and other such names.

.22 Diagnostics

.1 Each controller shall perform self-diagnostic routines and provide messages to an operator when errors are detected. The BMS system shall be capable of recognizing a non-responsive module on a LAN. The remaining, responsive modules on a LAN shall not operate in a degraded mode.

.23 Power Loss

.1 During a power outage, each controller shall assume a disabled status and outputs shall go to a user definable state. Upon restoration of power, BMS system shall perform an orderly restart, with sequencing of outputs.

.24 Program Transfer

.1 Provide software for download of control programs and database from a computer to controllers and upload of same to a computer from controllers. Every digital controller in the BMS system shall be capable of being downloaded and uploaded to through a single controller on the highest level LAN.

.25 System Backup and Restoration

.1 The entire control system shall be capable of being backed-up or restored to or from a single back-up storage media.

2.4 Control Panels

.1 Provide control panel of unitised cabinet type construction. Mount digital controllers, relays, switches, pilot lights, hand-off-auto switches, and push buttons, flush on cabinet panel face.

.2 Fabricate panels from 2.5 mm rolled sheet metal sheet with baked enamel finish, flush fitting, gasketted doors hung on piano type hinges and three point latches and locking handles. CSA approved for line voltage applications.

.3 Panels located outdoors shall be NEMA 4x rated.

.4 Mount panels on vibration free wall or free standing angle iron supports. Provide engraved plastic nameplates for instruments and controls inside cabinet and on cabinet face.

.5 Provide pans and rails for mounting terminal blocks, relays, wiring and other necessary devices.

.6 Provide an individual switch for disconnection and a fuse for isolation of all panel mounted instruments requiring a 120 VAC supply.

.7 Make all wiring connections in the shop from the equipment mounted on the panel to numbered terminal blocks conveniently located in the panel, including the power supply for all instruments.

.8 Identify all wiring by means of stamped markings on heat shrinkable tubing. Install all wiring neatly and laced or bunched into cable form using plastic wire clips, where practical, contained in plastic wiring channels with covers. Maximum twenty-five (25) conductors to each wire bundle.

.9 Provide terminal blocks, tabular clamp, 300 V, complete with track. Each terminal shall be clearly indelibly marked with the wire number connection to it. Each field connecting conductor shall be served by one terminal. Provide 20% spare unit terminals, with a minimum of two (2) spare terminals. Provide all necessary terminal block accessories such as manufacturer jumpers and marking tape.

.10 Install "Hand-Off-Auto" selector switches such that safety controls and electrical over current protection are not overridden when selector switch is in the "Hand" position. Step down transformers shall be utilized where control equipment operates at lower than line circuit voltage. Transformers, other than transformers in bridge circuits, shall have primaries wound for the voltage available and secondaries wound for the correct control circuit voltage. Transformer shall be sized so that the connected load is 80% of the rated capacity or less. Transformers shall conform to UL 508 and NEMA ST 1.

2.5 Wire

.1 Standards for wiring and standards of installation for wiring shall be as **Division 26**.

.2 Control wiring for digital functions shall be 18 AWG minimum with 300 V insulation.

.3 Control wiring for analog functions shall be 18 AWG minimum with 300 V insulation, twisted and shielded, 2 or 3 wire to match analog function hardware.

.4 Sensor wiring shall be 18 AWG minimum twisted and shielded, 2 or 3 wire to match analog function hardware or 16 AWG as required by code.

.5 Transformer current wiring shall be 16 AWG minimum.

2.6 Power-Line Surge Protection

.1 Equipment connected to ac circuits shall be protected from power-line surges. Equipment protection shall meet the requirements of IEEE C62.41. Fuses shall not be used for surge protection.

2.7 Surge Protection for Transmitter and Control Wiring

.1 BMS system control-panel equipment shall be protected against surges induced on control and transmitter wiring installed outside. The equipment protection shall be tested in the normal mode and in the common mode, using the following two waveforms:

.1 A 10-microsecond by 1,000-microsecond waveform with a peak voltage of 1,500 V and a peak current of 60 amperes

.2 An eight microsecond by 20-microsecond waveform with a peak voltage of 1,000 V and a peak current of 500 amperes

2.8 Conduits and Cables

.1 All wiring shall be in conduit or trays. Conform to **Division 26** requirements for conduit and tray specifications.

.2 Seal conduit where such conduit leaves heated areas and enters unheated area.

.3 Run low level signal lines in separate conduit from high level signal and power transmission lines.

.4 Identify each cable and wire at every termination point.

.5 Where applicable, mount field interface equipment (i.e. relays, transducers, etc.) in local device cabinets adjacent to field interface panels.

.6 Colour code all conductors and conduits by permanently applied colour bands on maximum 10 m intervals. Colour code shall follow base building schedule.

2.9 Related Accessories

.1 Provide and install all necessary transformers, transducers, interposing relays, interface devices, contractors, starters and EP's to perform control functions required.

.2 It is the responsibility of the Contractor to identify, at the time of tender submission, all additional items not specified that are required to meet the operational intent specified.

.3 Items required but not identified at the time of tender acceptance shall be the Contractor's responsibility.

2.10 Flow Meter

.1 Insertion type flow meters shall be provided complete with all installation hardware necessary to enable insertion and removal of the meter without system shutdown, and be hand-insertable up to 2700 kPa.

.2 Turbine rotation shall be detected by electronic impedance-based sensing (non-magnetic). Each flow meter shall be individually wet-calibrated against a primary volumetric standard that is accurate to within 0.1% and traceable to NIST.

.3 A certificate of calibration shall be provided with each flow meter. Accuracy shall be within ± 0.5% of rate at the calibrated velocity, within ± 1% of rate over a 10:1 turndown (from 0.91 to 9.1 m/s) and within ± 2% of rate over a 50:1 turndown (from 0.12 to 6 m/s).

.4 Provide display module for local or remote indication of flow rate and/or total.

.5 Standard of Acceptance: Onicon Model F-1311 flow meter and D-1200 remote display module

2.11 Pipe and Duct Mounted Temperature Sensor

.1 The sensor shall be thermistor type providing the following minimum performance requirements are met:

.1 Accuracy: ±0.5ºC or better

.2 Operating Range: -46ºC to 104ºC

.2 Diameter and length shall be as required for the application

2.12 Thermowells

.1 Provide brass wells for water and glycol applications.

3. EXECUTION

3.1 Manufacturer's Instructions

.1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 Installation

.1 Install control devices.

.2 Install remote sensing device and capillary tube in metallic conduit. Conduit enclosing capillary tube must not touch heater or heating cable.

.3 Inline insertion type flow meters shall be installed with isolation valves to allow installation or removal of the flow meter without a system shutdown.

3.3 Cleaning

.1 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

3.4 Commissioning

.1 Fully commission all aspects of the Building Management System work.

.2 Carry out point to point testing of the system

.3 Acceptance Check Sheet

.1 Prepare a check sheet that includes all points for all functions of the BMS as indicated on the point list included in this specification.

.2 Submit the check sheet to the Contract Administrator for approval

.3 The Contract Administrator will use the check sheet as the basis for acceptance with the BMS Contractor.

.4 Promptly rectify all listed deficiencies and submit to the Contract Administrator that this has been done.

END OF SECTION