Building Automation System Upgrade Specifications

Issued for Tender v4

Prepared for: Environment and Climate Change Canada (ECCC)
ECCC Project #: 1849
Site: Pacific Wildlife Research Centre, 5421 Robertson Road, Delta BC

Prism Engineering Project #: 2017402
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Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 01 11 00 – Summary of Work

.2 Section 01 78 00 – Closeout Submittal

.3 Section 25 05 01 – ECMS General Requirements.

1.2 ADMINISTRATIVE

.1 Submit to the Consultant an electronic version in Adobe pdf of submittals for review. Submit promptly and in orderly sequence to not cause delay in Work. Failure to submit in ample time is not considered sufficient reason for extension of Contract Time and no claim for extension by reason of such default will be allowed.

.2 Do not proceed with Work affected by submittal until review is complete. No factory or field fabrication work shall commence, nor shall any materials be delivered to the site(s) until the Shop Drawings have been reviewed by Prism for conformity with the plan and specifications.

.3 Present shop drawings, product data in SI Metric units. Where items or information is not produced in SI Metric units converted values are acceptable.

.4 Review submittals prior to submission to Consultant. This review represents that necessary requirements have been determined and verified, or will be, and that each submittal has been checked and co-ordinated with requirements of Work and Contract Documents. Submittals not stamped, signed, dated and identified as to specific project will be returned without being examined and considered rejected.

.5 Notify Consultant, in writing at time of submission, identifying deviations from requirements of Contract Documents stating reasons for deviations.

.6 Contractor's responsibility for deviations in submission from requirements of Contract Documents is not relieved by Consultant review.

.7 The location of all devices shall be reviewed with the Owner’s Representative prior to installation.

.8 Contractor's responsibility for errors and omissions in submission is not relieved by Consultant's review of submittals.

.9 Keep one reviewed copy of each submission on site.

.10 All major component shop drawings must be received within 1 week of contract award.

1.3 SHOP DRAWINGS AND PRODUCT DATA

.1 The term "shop drawings" means drawings, diagrams, illustrations, schedules, performance charts, brochures and other data which are to be provided by Contractor to illustrate details of a portion of Work.

.2 Allow 7 business days for Consultant's review of each submission.

.3 Adjustments made on shop drawings by Consultant are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Consultant prior to proceeding with Work.

.4 Make changes in shop drawings as Consultant may require, consistent with Contract Documents. When resubmitting, notify Consultant in writing of revisions other than those requested.

.5 Accompany submissions with transmittal letter, containing:

.1 Date.
.2 Project title and number.
.3 Contractor's name and address.
.4 Identification and quantity of each shop drawing, product data and sample.
.5 Other pertinent data.

.6 Note each shop drawing as applicable with the following information:

.1 Manufacturer’s and Supplier’s name
.2 Catalogue model number
.3 Project identification number
.4 Number identifying item on Contract Drawings and/or in Specifications
.5 Contractor's stamp, signed by Contractor's authorized representative certifying approval of submissions, verification of field measurements and compliance with Contract Documents.
.6 Details of appropriate portions of Work as applicable:

.7 Shop Drawings for each controlled system shall consist of detailed descriptions of the system(s) including:

.1 Network drawing showing system configuration, for the new and existing controllers including name, model, address, location as well as network cable layout, operator workstation, modem, hub / switches, external access devices, type of network and cabling, etc.

.2 Points Lists for all controllers including controller name, controller address, system name, point name, point description, point type (AI, AO, DI, DO), device type and part number. Spare points shall be shown for each controller.

.3 Schematic diagrams containing the system name, description and location; name and panel/point address of all monitored and controlled devices; all required field and factory terminations and cable/wire identifiers.

.4 Floor plan schematics showing the location of the radiant panels/radiator valves; temperature sensors; DDC control panels; control devices; and network.

.5 The written sequence of operation shall be specific for the use of the Control System being provided for this project.

.6 Identically controlled subsystems (i.e. VAV boxes, reheats, fan coil units, etc.) shall be grouped by system and indexed.

.7 Proposed graphic screen(s) including all navigational links, points, variables and labels

.8 Complete bill of materials of equipment to be used indicating quantity, manufacturer and model number.

.9 Manufacturers cut sheets for all system components including controllers, sensors, valves, dampers, actuators, relays and auxiliary control devices. When manufacturer's cut sheets apply to a product series rather than a specific product, the data specifically applicable to the project shall be highlighted or clearly indicated by other means. Each piece of literature and drawings shall clearly reference the specification and/or drawing that the submittal is being referenced.

.10 Each shop drawing shall be checked and stamped as being correct, by trade purchasing item, and by the Contractor, before drawing is submitted. If above requirements are not complied with, shop drawings will be rejected and returned forthwith.

.11 Wiring diagrams with cable type and identification including terminal numbers shall be included in the as built drawings.

.8 Delete information not applicable to project.

.9 Supplement standard information to provide details applicable to project.

.10 If upon review by Consultant, no errors or omissions are discovered or if only minor corrections are made, one copy will be returned and fabrication and installation of Work may proceed. If shop drawings are rejected, noted copy will be returned and resubmission of corrected shop drawings, through same procedure indicated above, must be performed before fabrication and installation of Work may proceed.

.11 Review of shop drawings is for sole purpose of ascertaining conformance with general concept. This review shall not mean that the Engineer approves detail design inherent in shop drawings, responsibility for which shall remain with Contractor submitting same, and such review shall not relieve Contractor of responsibility for errors or omissions in shop drawings or of responsibility for meeting all requirements of construction and Contract Documents. Without restricting generality of foregoing, Contractor is responsible for dimensions to be confirmed and correlated at job site, for information that pertains solely to fabrication processes or to techniques of construction and installation and for co-ordination of Work of all sub-trades.

.12 Do not have equipment delivered to site until a shop drawing for the item has been reviewed, stamped as accepted or modified by Consultant and returned to Contractor.

1.4 EQUIVALENCY

.1 Manufacturer products listed in these specifications are provided as materials or equipment already reviewed and accepted for inclusion in the Work. These listed materials or equipment demonstrate the minimum quality and performance of materials and equipment that manufacturers offerings and requests for equivalency must demonstrate in order to be considered for inclusion in the project.

.2 Unless stated ‘no equivalent’, manufacturers, their agents or representatives may and are invited to submit materials or equipment for consideration as equivalent to listed materials or equipment by submitting written request to the Consultant and providing information for submittals as detailed within these specifications.

.3 All requests for equivalency must be submitted no later than three days prior to the close of tender or request for pricing.

1.5 DETAIL DRAWINGS AND INSTRUCTIONS

.1 Submit notification of locations where installation of equipment would interfere with interior treatment and use of building. Detail drawings or instructions exactly locating these items will then be issued.

.2 Submit all the drawings respecting the work to the Consultant, upon request, for acceptance before using them. Contractor is responsible for performing the work properly notwithstanding such acceptance.

.3 Perform the work in accordance with drawings and instructions supplied by the Consultant but do not use such drawings for construction, manufacture or installation unless the Consultant has released them for such use.

.4 Inform the Consultant of any instructions given by any parties that would affect the equipment, quantities, locations, price, or any modification to the work as outlined in this Contract. Failure to comply may result in the rejection of the work or any associated costs.

1.6 CERTIFICATES AND TRANSCRIPTS

.1 Immediately after award of Contract, submit Workers' Compensation Board status.

Part 2 Products - NOT USED

Part 3 Execution - NOT USED

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 25 05 01 – ECMS General Requirements.

.2 Section 25 05 02 – EMCS Summary of Work

.3 Section 01 33 00 - Submittal Procedures

1.2 SUBMITTALS

.1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.

.2 Prepare instructions and data using personnel experienced in maintenance and operation of described products.

.3 Revise content of submittal documents as required prior to final submittal.

.4 Two weeks prior to Substantial Performance of the Work, submit to the Engineer, three final copies of operating and maintenance manuals.

1.3 AS-BUILT DRAWINGS

.1 Changes made during installation and before completion of the Work shall be documented by the Contractor to ensure that the changes are recorded as they occur; they are to be indicated by use of coloured lines and suitable notations on one complete set of Drawings set aside exclusively for this purpose.

.2 The Contractor shall submit an electronic copy of the As-Built Drawings in Adobe pdf format to the Owner's Representative after completely incorporating the revisions as above. These Drawings shall be clearly identified with the notation "Revised As-built" imprinted adjacent to the title block.

1.4 OPERATING AND MAINTENANCE MANUALS

.1 Operating and Maintenance manual shall be provided and form a complete document for the Owner.

.2 All existing documentation for the re-used control devices such as valve and damper schedules, applicable technical information, wiring diagrams, parts and bill of materials revised as applicable, shall be incorporated to the O&M manual to form a complete and comprehensive document.

.3 One copy of the Operating and Maintenance Manuals for the Control Systems shall be submitted in electronic format (Adobe pdf) to the Engineer for acceptance before Substantial Completion.

1.5 CONTENTS - EACH VOLUME

.1 The O & M manual shall include as-built versions of the submittal product data.

.2 In addition to that required for the submittals, the O & M manual shall also include:

.1 Names, address and 24-hour telephone numbers of Contractors installing equipment, and the control systems and service representative of each.

.2 A listing and documentation of all custom software created using the programming language including the point database. One set of electronic media containing files of the software and database shall also be provided

.3 One set of electronic media containing files of all color-graphic screens created for the project.

.4 Complete original issue documentation, installation and maintenance information for all third party hardware provided including computer equipment and sensors.

.5 Complete original issue of all software provided including operating systems, programming language, operator workstation software, and graphics software.

.6 Licenses, Guarantee, and Warrantee documents for all equipment and systems.

.7 Testing and Commissioning Reports and Checklists.

.8 Project Record Drawings - These shall be as-built versions of the submittal shop drawings.

.9 Description of systems controlled, system drawings, sequence of operation and schedules.

.10 Panel riser and panel by panel points list.

.11 Reduced floor plans showing equipment and sensor locations.

.12 Shop drawings including wiring diagrams showing hardware interlocks.

.13 Record of Training.

.3 Review manual with the Engineer's operating staff or representatives to ensure a thorough understanding of each item of equipment and its operation.

.4 Should the Contractor thereafter amend the manuals, he shall promptly provide one copy of any such amendments to the Engineer's Representative for acceptance. Upon acceptance by the Engineer, the Contractor shall provide three copies of such amendments.

.5 Engineering, Installation and Maintenance Manual(s), which shall include descriptions on how to design and install new points, panels, and other hardware; preventative maintenance and calibration procedures; how to debug hardware problems; and how to repair or replace hardware.

.6 Operators Manual, which shall include Procedures for operating the control systems including logging on/off, alarm handling, producing point reports, trending data, overriding computer control, and changing set points and other variables.

1.6 FORMAT

.1 Organize data as instructional manual.

.2 Following acceptance by the Engineer, submit three (3) complete sets of operating and maintenance instructions, bound in vinyl covered hard backed binder, 8 1/2" x 11" (210 mm x 297 mm) size, three-ring covers at completion, and before Substantial Completion of the Work. Contents of books shall not include hand-written data.

.3 When multiple binders are used, correlate the data into related consistent groupings. Identify contents of each binder on spine.

.4 Cover: identify each binder with type or printed title 'Project Record Documents'; list title of project and identify subject matter of contents.

.5 Arrange content by systems under Section numbers and sequence of Table of Contents.

.6 Provide tabbed fly leaf for each separate product and system, with typed description of product and major component parts of equipment.

.7 Text: manufacturer's printed data, or typewritten data.

.8 Drawings: provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.

.9 CD/DVDs with a copy of the Operating and Maintenance Manuals shall be provided in electronic format (Adobe pdf) and inserted in each of the O&M binders.

.10 A copy of the Operating and Maintenance Manual in Adobe pdf format shall be saved in the hard drive of the Operator Workstation.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 25 05 02 – EMCS Summary of Work

.2 Section 01 33 00 - Submittal Procedures

.3 Section 01 78 00 - Closeout Submittals

1.2 GENERAL

.1 This Project Specification, including all appendices, shall be deemed to cover the complete installation ready for operation. Consequently, minor details not necessarily shown or specified but necessary for the proper functioning of the installation, including equipment serviceability, shall be included in the Work, the same as if shown in the Project Specification.

.2 The Work shall include but not be limited to the supply of all labour, materials, equipment and supervision to complete the Work as required by the Contract Documents.

.3 Existing security, smoke control, fire alarms and monitoring shall be uninterrupted by the installation.

.4 Carefully examine the existing building, local conditions affecting the Work and building site, together with all other trades to make sure that Work under this Specification can be satisfactorily carried out without changes. Work of all trade Divisions shall be examined, before commencing Work, and any defect or interference affecting Work shall be reported at once.

.5 The Contractor, when estimating, shall visit the site and make himself familiar with all existing conditions and allow for same in his tender.

1.3 INTENT

.1 Work shall be in accordance with the specifications and their intent, complete with all necessary components, including those not normally shown or called for, and shall be ready for operation before acceptance.

.2 Any reference to the “engineer” or "consultant" shall mean Prism Engineering Ltd.

.3 The work "provide" shall mean "supply and install" unless otherwise indicated.

.4 The new installation shall meet the existing building standards in all aspects.

1.4 INTEROPERABILITY REQUIREMENTS

.1 The **existing DDC systems** in all three buildings shall be **replaced** with a **totally new BACnet DDC** system of the following manufacturers: **Johnson, Delta, Reliable, Schneider, Distech, or Siemens**.

1.5 CONTROLS CONTRACTOR REQUIREMENTS

.1 The Controls Contractor shall have an established working relationship with the Control System Manufacturer of not less than three years.

.2 The Control Contractor shall have a local office in Metro Vancouver for the past 5 years. The local Controls Contractor Office shall be staffed by trained personal capable of maintaining the system and training client staff. The local office shall have local availability of replacement parts

.3 The Controls Contractor shall provide information for a minimum of five successful same size or larger projects installed during the past three years by the contractor in the Metro Vancouver area.

.4 The Controls Contractor shall have successfully completed Control System Manufacturer's classes on the control system. The Installer shall present for review the certification of completed training, including the hours of instruction and course outlines upon request.

.5 Controls Contractor shall demonstrate capacity to respond to emergency calls by a local contractor (or his representative) within a two hours period of the call.

.6 The Controls Contractor shall provide 24-hour response in the event of a customer call.

1.6 CODES, STANDARDS AND PERMITS

.1 Meet requirements of all applicable standards and codes, except when more detailed or stringent requirements are indicated by the Contract Documents, including requirements of this Section. All equipment shall be installed in accordance with the latest requirements of the following:

- .1 The local Building Code
- .2 The B.C. Building Code
- .3 The National Building Code of Canada (2015)
- .4 The Workers' Compensation Act
- .5 The Canadian Electrical Code
- .6 The Canadian Standards Association
- .7 National Fire Protection Association
- .8 National Energy Code for Buildings (2015)

.2 Electric equipment shall bear CSA labels and, where applicable, ULC label certifying compliance with test standards of these agencies.

.3 Obtain all required permits and pay all fees therefore and comply with all provincial, municipal and other legal regulations, codes and by-laws applicable to the work.

.4 General contractor and all sub-contractors shall obtain security clearance as per Justice Institute requirements before perform any work inside the building.

1.7 LIABILITY

.1 Assume responsibility for laying out work and for damage caused by improper execution of work.

.2 Protect finished and unfinished work from damage.

.3 Take responsibility for condition of materials and equipment supplied and protect until work is completed and accepted.

.4 The owner shall have recourse in tort for any negligent action by the contractor or his representatives.

1.8 INSURANCE

.1 The Contractor shall provide and show proof of, at his expense, insurance in accordance with Environment Climate Change Canada (ECCC) requirements.

.2 The Contractor shall carry full employee's liability insurance for the whole of the work in accordance with the Workers' Compensation Act.

1.9 SIGNS AND PUBLICITY

.1 Neither the Contractor nor anyone directly or indirectly employed by them, shall post any site signs, nor release any publicity reports, photographs, sketches, plans or other information, orally or in writing, concerning the work performed or to be performed, without the prior written acceptance of the Owner's Representative.

1.10 PROJECT MANAGER

.1 The Contractor shall identify a Project Manager who will be responsible for all aspects of the project (including co-ordination of subcontractors and suppliers, permits, installation, commissioning and contract administration).

.2 The Owner's Representative reserves the right to interview the prospective project manager to evaluate their understanding and ability to complete the project.

1.11 WORKMANSHIP

.1 Workmanship shall be in accordance with well-established practice and standards accepted and recognized by design authorities and the trade.

.2 Employ only tradesmen holding valid provincial trade qualification certificates. Tradesmen shall perform only work that their certificate permits.

1.12 EXAMINATION OF SITE

.1 A site visit is recommended for all the contractors before tendering the project. Examine all local and existing conditions on which the work is dependent.

.2 No consideration will be granted for any misunderstanding of work to be done resulting from failure to visit the site.

.3 When the contract documents do not contain sufficient information for the proper selection of equipment for bidding, notify the design authority during the tendering period. If clarification is not obtainable, allow for the most expensive arrangement. Failure to do this shall not relieve the contractor of responsibility to supply the intended equipment.

.4 Check drawings of all trades and survey the site to verify space availability for the installation. Coordinate work with all trades and make changes to facilitate a satisfactory installation. Make no deviations to the design intent without written approval.

.5 Wall locations, ceiling layout, heights, and equipment locations shall be verified on site. Failure to do this shall not relieve the contractor of the responsibility for correct location of mechanical systems and equipment.

1.13 WORK IN EXISTING BUILDING

.1 All work on site shall be co-ordinated with the Owner's Representative so as to minimize disruptions. Execute work with least possible interference or disturbance to building operations, occupants, and normal use of premises.

.2 Air (dry bulb) temperatures during working hours (07h00 – 17h00) shall be maintained within the ideal temperature range of 20oC to 26oC range. Temperatures between 17oC and 20oC and above 26oC can be uncomfortable, and occupancy in each of those extremes shall not exceed 3 hours daily or 60 hours annually. Temperatures above 26oC are deemed uncomfortable when the humidex reading at a given temperature equals 40 oC (Office Accommodation Table) or less, with a reading of more than 40 oC considered dangerous.

.3 Temperatures shall be measured at the desktop level in those spaces within workstations that employees occupy while carrying out the majority of their normal duties.

.4 An unsatisfactory condition is deemed to exist when the humidex reading exceeds 40 oC (Office Accommodation Table) or when the air temperature (dry bulb) falls below 17oC. In those cases, construction shall be stopped, and the situation rectified to meet the temperature band requirements identified above.

Office Accommodation

Humidex Table for Temperature and Relative Humidity Readings

	Relative Humidity (%)															
Temp (0°C)	100	95	90	85	80	75	70	65	60	55	50	45	40	35	30	25	20
35		58	57	56	54	52	51	49	48	47	45	43	42	41	38	37	
34	58	57	55	53	52	51	49	48	47	45	43	42	41	39	37	36	
33	55	54	52	51	50	48	47	46	44	43	42	40	38	37	36	34	
32	52	51	50	49	47	46	45	43	42	41	39	38	37	36	34	33	
31	50	49	48	46	45	44	43	41	40	39	38	36	35	34	33	31	
30	48	47	46	44	43	42	41	40	38	37	36	35	34	34	31	31	
29*	46	45	44	43	42	41	39	38	37	36	34	33	32	31	30		
28	43	42	41	41	39	38	37	36	35	34	33	32	31	29	28		
27	41	40	39	38	37	36	35	34	33	32	31	30	29	28	28		
26	39	38	37	36	35	34	33	32	31	31	29	28	28	27			
25	37	36	35	34	33	33	32	31	30	29	28	27	27	26			
24	35	34	33	33	32	31	30	29	28	28	27	26	26	25			
23	33	32	32	31	30	29	28	27	27	26	25	24	23				
22	31	29	29	28	28	27	26	26	24	24	23	23					
21	29	29	28	27	27	26	26	24	24	23	23	22					
20	27	27	26	25	25	24	24	23	22	22	21						
19	25	25	24	24	23	23	22	22	21	21	20						
18	23	23	22	22	21	21	20	20									
17	21	21	21	20	20	19	19										

Acceptable Temperature Range

Ideal Temperature Range

*29°C If instrumentation capable of accurately measuring humidex is not practically available within one hour of a complaint being made, a temperature of 29°C or above shall be considered unsatisfactory.

Humidex
Relocate or Release Staff
Corrective Measures
Ideal Operational Range

.5 Work taking place outside of the occupied areas that does not involve power or comfort systems interruptions may occur during the day with prior approval from the Owner's Representative. Work in mechanical rooms can be performed during occupied periods between 8:00AM and 4:00PM and anytime if required to complete the work. Coordinate with the Maintenance Team Leader, in advance the areas and intended working hours.

.6 Installation of equipment in occupied areas must take place outside of regular business hours. Desks, equipment and furniture must be covered when the work is taking place. Work taking place outside of the occupied areas that does not involve power interruptions may occur during the day with prior approval from the Owner's Representative.

.7 Include in Price any overtime that may be required to tie-in services at night or on weekends.

.8 Obtain approval from the Owner's Representative prior to penetrating any structural surfaces including floor slabs. Obtain from the Owner's Representative approval of locations of all penetrations prior to commencing work. Contractor shall replace/repair any building services that are damaged due to this construction (example: drilling through concrete floors) at no extra cost.

.9 Carefully route new conduits and other new services so that they do not interfere with existing installation. Arrange and pay for any necessary relocation of existing conduit, cable tray, bus duct or any other services required for the proper installation of new Work.

.10 Removed equipment and material shall become the property of the Contractor and shall be removed from site unless otherwise requested by the Owner's Representative.

.11 After completion of work in ceiling space, arrange and pay for the repair of any damaged or dislodged fireproofing material.

.12 In area with solid ceilings, electrical and systems junction boxes along with associated wire and conduit shall be relocated to areas where ceiling access is possible, or access panels may be provided with the approval of the Owner's Representative.

.13 All Contractors shall exercise due care and diligence in working in the occupied areas. Keep the job reasonably clear of waste material and rubbish at all times during progress of the work. Clean up and restoration of the work area shall occur after each day's installation to ensure that no disruption to the work area takes place.

.14 All work on site shall be co-ordinated with the Owner's Representative so as to minimize disruptions. Installation of equipment must take place outside of regular business hours. Work taking place outside of the occupied areas that does not involve power interruptions may occur during the day with prior approval from the Owner's Representative.

1.14 CONTINUITY OF EXISTING SERVICES

.1 Keep existing building in operation at all times with minimum length of shutdown periods.

.2 Obtain permission of the Owner before shutting down or disconnecting electrical and fire protection services. Shutdowns of systems are to be co-ordinated with the PWRC Facilities Manager.

.3 Co-operate with the Owner and other contractors on the job and provide necessary services so that existing building can be kept in operation at all time.

.4 Allow for afterhours work for services to be done inside occupied areas during office hours.

.5 Where Work involves breaking into or connecting to existing services, give Owner's Representative 48 hours notice for necessary interruption of mechanical or electrical service throughout course of work. Minimize duration of interruptions. Carry out work at times as directed by governing authorities with minimum disturbance to tenant operations.

.6 Submit schedule to and obtain approval from Owner's Representative for any shut-down or closure of active service or facility including power and communications services. Adhere to approved schedule and provide notice to affected parties.

.7 Where unknown services are encountered, immediately advise Engineer and confirm findings in writing.

1.15 CLEANING

.1 The Contractor shall be responsible to keep the building, site, and premises clean and tidy with respect to his work at all times.

.2 On completion, all dirt and rubbish for which the Contractor is responsible shall be removed from the site and premises and the whole left clean and tidy. All soiling of finished walls, floors, ceilings, carpets, or other surfaces, caused by the Contractor shall be cleaned up or made good by the Contractor.

.3 All control panels, etc., shall be thoroughly vacuum cleaned of dust, dirt, and debris before start-up and hand-over.

1.16 NEW PRODUCTS ONLY

.1 All products used in this installation shall be new, currently under manufacture, and shall be applied in similar installations for a minimum of 1 year. This installation shall not be used as a test site for any new products unless explicitly approved by the Engineer in writing prior to bid date. Spare parts shall be available for at least 5 years after completion of this contract.

1.17 SHOP DRAWINGS

.1 Shop Drawings shall be submitted as per Section 01 33 00 – Submittal Procedures

1.18 AS-BUILT DRAWINGS

.1 As-Built drawings shall be submitted as per Section 01 78 00 – Closeout Submittal

1.19 OPERATING AND MAINTENANCE MANUALS

.1 Existing Operating and Maintenance Manuals shall updated as per the changes in this specification.

1.20 COMMISSIONING

.1 The control system must be commissioned and tested at the end of the work to be completely operational including the following:

.1 every new point shall be end to end checked to ensure accuracy and integrity of systems. Provide check-out data sheet signed off by the DDC Contractor.

.2 DDC Program Code shall successfully control the systems.

.3 time schedules shall be built and in control of time-controlled equipment.

.4 graphic displays must be installed and each graphic screen shall be fully operational.

.5 all specified trends covering a Seventy-Two (72) hour continuous period to confirm system operation must be created and operational.

.6 Runtime totalizer shall be set on all digital outputs.

.7 all features of system shall have been exercised.

.8 operator shall have been briefed on operation of system.

.9 all alarms shall be operational.

.10 all sensors shall have been calibrated.

.2 Results of all tests shall be documented by the Contractor and a hard copy of the commissioning sheets and trends covering a continuous period shall be submitted to Prism for review.

1.21 DEMONSTRATION

.1 The contractor shall dedicate a minimum of 2 x 4 hours on-site with the Owner and his representatives for a complete functional demonstration of all the system requirements.

.2 The demonstration constitutes a joint acceptance inspection, and acceptance of the delivered system for on-line operation.

1.22 TRAINING

.1 A training of the control system capabilities for the building operators and manager shall be performed. The contractor shall dedicate a minimum of 4 x 4 hours on-site sessions with the Owner and his representatives for operator training.

.2 Training shall include but not limited to the explanation of system operation and capabilities, system navigation, setpoint adjustments, alarm acknowledge, weekly schedules, password settings, graphic screens creation and changes, trend log settings and visualization, database management, etc.

1.23 WARRANTY

.1 At the end of the final start-up/testing and commissioning, if equipment and systems are operating satisfactorily to the Owner and Owner’s Representative, the Owner shall sign certificates certifying that the control system's operation has been tested and accepted in accordance with the terms of this specification. The date of Owner's acceptance shall be the start of warranty.

.2 Labour & materials for control system specified shall be warranted free from defects for a period of twelve (12) months after final completion acceptance by the Owner. Control System failures during the warranty period shall be adjusted, repaired, or replaced at no charge or reduction in service to the Owner.

.3 The warranty shall provide all material, parts and labour, including labour provided on an emergency response basis outside of normal working hours. Labour shall include any related travel time and other related costs associated with providing the warranty service.

1.24 ACCEPTANCE

.1 The control systems will not be accepted as meeting the requirements of Completion until all tests described in this specification have been performed to the satisfaction of both the Engineer and Owner.

.2 Any tests that cannot be performed due to circumstances beyond the control of the Controls Contractor may be exempt from the Completion requirements if stated as such in writing by the Engineer's representative. A deficiency amount will be held at Substantial Completion for such tests. Deficiency amounts will be released after tests are performed and documented to the satisfaction of the Engineer.

.3 Warranty shall start from the date of all deficiencies are corrected and tests are performed and documented to the satisfaction of the Engineer.

.4 The warranty shall cover all aspects of the control system upgrade provided under this contract, including control devices, transducers, and software.

.5 A detailed service report must be filed with the Engineer after each warranty visit, detailing the work performed, time spent, devices replaced or repaired, and the personnel involved.

.6 Emergency calls during the warranty period shall be addressed by the Contractor within four (4) hours of notification. Service shall be available 24 hours per day, seven days a week. The Engineer shall be provided an emergency phone number for contacting service personnel. The service call shall only be chargeable if inspection reveals any defect not directly covered under the terms of the specification.

1.25 SUBSTANTIAL PERFORMANCE

.1 Once the above basic requirements are met and all other features of the system are complete and acceptable, Substantial Performance shall be granted. A deficiency list shall be prepared and holdbacks applied. All deficiencies shall be corrected prior to Total Performance. Warranty shall start from the date of Substantial Performance of the work.

Part 2 Products - NOT USED

Part 3 Execution - NOT USED

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures

.2 Section 01 78 00 - Closeout Submittals

.3 Section 25 05 01 – EMCS General Requirements

1.2 GENERAL

.1 The objective of the project is to upgrade the existing DDC control systems installed at the Pacific Wildlife Research Centre (PWRC) located at 5421 Robertson Road, Delta, BC.

.2 The facility is composed by three interconnected buildings: the Science Wing, the Lodge, and the Annex. Currently there are two separate DDC system installed in the facilities.

.3 The **Science Wing** was originally provided with a Honeywell DDC system installed in 1993 and later upgraded to a Reliable Controls system. This system is obsolete and shall be replaced.

All existing DDC end devices in the Science Wing such as temperature sensors, current sensors, relays, damper actuators, and control valves including the (26) radiant heating valves shall be replaced. Control wiring to devices can be re-used provided it is compatible and fully tested.

The manual isolation valve for the Room 213 radiant heater is leaking and shall be replaced.

.4 The **Annex** is provided with a Schneider Controls system installed in 2012 by Modern Systems Management (MSM). The system is JAVA based and is having communication issues with the workstation and remote access using web browsers, such as Explorer and Chrome, no longer support JAVA due to security concerns. The system shall be replaced.

Additional DDC sensors shall be installed. All existing end control devices such as temperature sensors, current sensors, relays, valves, and damper actuators can be re-used provided they are compatible with the new DDC system and fully tested.

.5 There is no DDC system installed in the **Lodge**. This building is provided with a Honeywell electronic controller for the hot water heating system and self-controlled Danfoss thermostatic valves installed in the cast iron radiators. Hot water ceiling radiant panels are provided in the hallways to the Science Building and rooms 120, 121, 116, and 117.

All control valves serving ceiling radiant heating panels in the Lodge shall be replaced and integrated with the Science Wing DDC.

The DDC system from the Science building shall be extended to control the 3-way heating mixing valve and circulating pump in the Lodge. The existing 3-way mixing valve shall be replaced and new temperature sensors provided in the supply and return heating water piping.

DDC temperature sensors shall be installed in the rooms served by cast iron radiators. The temperature sensors shall be integrated with the DDC for unoccupied control.

The self-controlled Danfoss thermostatic valves installed in the cast iron radiators shall not be modified in the project.

.6 A Reliable Controls DDC system is being installed at the new Multi-purpose and Picnic Shelter building. This system was intended to be a standalone control system however this DDC system can communicate via BACnet MS-TP and shall be wired to the new DDC system.

.7 The DDC contractor shall upgrade the existing DDC systems in such a way that only controllers from a single DDC vendor will serve all three buildings (Science Wing, Lodge, and Annex). All existing controllers in all three buildings shall be replaced.

The retrofit single DDC system shall be BACnet IP. Controllers and other BACnet IP devices shall be networked in a home-run configuration. New cables and conduit shall be installed where necessary. Daisy-chaining the controllers or devices is not acceptable.

.8 New graphic screens shall be created for the HVAC systems in the Science Wing, Lodge, Annex, and Multi-Purpose buildings.

.9 DDC contractor shall coordinate with an internet service provider and PWRC for installing new modem/router for a separate internet access to the DDC system.

1.3 WORK COVERED BY CONTRACT DOCUMENTS

.1 Provide and install all hardware components necessary for a complete system installation, including network and communications devices; DDC controllers; field devices of all types, transformers, conduits, raceways, and wiring including power and network cabling;

.2 Program codes, graphic screens, and trend logs for boiler plant, air handling units, and all applicable equipment shall be modified as per sequences of operation in this specification;

.3 Provide trend logs as required to reflect the changes in the system operation as per this specification and to allow the building operator analysis and troubleshooting;

.4 Provide all required labour and supervision for the installation, calibration, adjustments, checkouts, commissioning of all components and devices provided.

.5 All re-used control devices in the Annex such as temperature sensors, current sensors and control relays shall be verified, tested, and calibrated as required;

.6 The new points and changes in the DDC system including new BACnet interface shall be fully tested and commissioned to prove point functionality and communication after installation.

.7 Remove all wiring, cabling, conduit, panels, and devices that are no longer used after completing the work.

.8 DDC contractor shall provide all documentation including as built drawings, O&M manuals, commissioning reports, including floor plans with correct location of each device, and etc. with complete information of the installed system;

.9 Provide a complete training and demonstration of the control system capabilities as per this specification;

.10 Provide one year Warranty as per this specification.

1.4 WORK BY OTHERS

.1 Co-operate and co-ordinate with other Contractors in carrying out their respective works and carry-out instructions from Engineer.

.2 If any part of work under this Contract depends on proper execution by or relies upon work of another Contractor, report immediately to the Engineer, in writing, any situations which may interfere with proper execution of Work.

Part 2 Products - NOT USED

Part 3 Execution - NOT USED

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 01 11 00 Summary of Work

.2 Section 01 33 00 - Submittal Procedures.

.3 Section 01 78 00 - Closeout Submittals.

.4 Section 25 05 01 – ECMS General Requirements

Part 2 Products

2.1 NOT USED

Part 3 Installation

3.1 INSTALLATION STANDARDS

.1 The intention of this clause is to guide the Contractor as to the required quality of installation.

.2 All installations shall be performed by skilled certified technicians and trades people and meet the existing building standards in all aspects.

.3 Contractor shall continually monitor the installation for code compliance and quality of workmanship.

.4 Contractor shall arrange for field inspections by local and/or Provincial authorities having jurisdiction over the Work.

.5 Equipment shall be installed to allow for easy maintenance access. Equipment shall be installed such that it does not interfere in any way with access to adjacent equipment and personnel traffic in the surrounding space.

.6 All points associated with a single zone or an individual system shall be connected to the same stand alone panel, and associated terminal unit controller.

.7 Remove all wiring, cabling, conduit, panels, and devices that are no longer used after completing the work.

.8 Patch and touch up paint to match existing or a provide cover plate where sensors were removed or replaced by new DDC sensors.

3.2 ELECTRICAL WORK BY THE CONTROLS CONTRACTOR

.1 All wiring required for devices supplied under this Specification, regardless of the voltage, shall be the responsibility of the Controls Contractor.

.2 Provision of control panels, pilot lights, selectors, relays, etc., required for the proper operation of the control systems.

.3 Conduit and wiring from the starter control circuits to the mechanical system control panels including 110 V wiring.

.4 Conduit and wiring required for the interlocking of mechanical system motor starters as required for the proper operation of the control system.

.5 Wiring from pilot devices, relays, contactors, or other control interface devices required for the proper operation of the control system.

.6 Wiring from spare 15 amp circuit breakers in power panels for line voltage power sources where required by control system. Circuit breakers shall be locking type.

.7 Power wiring and control wiring to stand alone panels and terminal unit controllers.

.8 Controls Contractor shall confirm all new wiring connections between controllers and field devices and provide a copy of the End-to-End Checkout Sheet for every control panel.

.9 Controls Contractor shall terminate all control and/or interlock wiring and shall maintain updated (as-built) wiring diagrams with termination identified at the job site.

.10 Wiring of mechanical component controls, i.e., boilers, chillers, etc.

3.3 CONTROL AND INTERLOCK WIRING

.1 All control and interlock wiring shall comply with the national and local electrical codes as well as the following clauses.

.2 All wiring shall be installed as continuous lengths, where possible. Any required splices shall be made only within an approved junction box or other approved protective device.

.3 Install plenum wiring in sleeves where it passes through walls and floors. Maintain fire rating at all penetrations in accordance with local codes.

.4 Maximum allowable voltage for control wiring shall be 120V. If only higher voltages are available, the Control System Contractor shall provide step down transformers.

.5 Adhere to Division 26 requirements for installation in raceways.

.6 Flexible metal conduits and liquid-tight, flexible metal conduits shall not exceed 3' in length and shall be supported at each end. Flexible metal conduit less than 1/2" electrical trade size shall not be used. In areas exposed to moisture, including chiller and boiler rooms, liquid-tight, flexible metal conduits shall be used.

.7 Use coded conductors throughout with different coloured conductors for each phase and white wire for neutral.

.8 All wiring in mechanical rooms and service rooms shall be in conduit or raceway. Provide 600 mm, B-X flexible connection to input and output devices where required for servicing or to accommodate vibration.

.9 Identify each wire and cable at every termination point. Identify all conduits with “neat” colour bands at no more than 7.5 m intervals and on both sides of walls and floors.

.10 Junction and Pull boxes shall be adequate tagged to indicate its use for DDC system. Self sticker labels with controls company logo could be used for that purpose.

3.4 COMMUNICATION WIRING

.1 Follow manufacturer's installation recommendations for all communication and network cabling. Network or communication cabling shall be run inside conduit and separately from other wiring.

.2 All communication wiring between main Building Controller and the Operator Interface shall be installed in conduit.

.3 All ethernet cables shall be CAT 5e or CAT 6.

.4 Controllers and other BACnet IP devices shall be networked in a home-run configuration. Daisy-chaining the controllers or devices is not acceptable.

.5 All BACnet MS/TP networks shall communicate error free at a baud rate of 76,800 bps.

.6 Low capacitance cable with less than 15 Pico farads per foot shall be provided for MS/TP networks to for stable and less network communication errors.

.7 All exposed connection for external communication device as modem, laptop, etc. shall terminate with a utility box with a faceplate with CAT5E connector.

3.5 CLASS 1 WIRING

.1 120 V circuits shall be, at a minimum, of #12 AWG RW-90 copper. For runs over 50 m in length, use #10 AWG RW-90 copper.

.2 All 120 V interlock wiring and power supplies for panels to be installed in conduit.

.3 Provide 120 V power supplies to all main DDC panels, separately circuited from all other loads.

.4 Several Application Specific Controllers may be supplied from one 120 V power supply through a 120/24V transformer in accordance with the manufacturer’s design. Only Application Specific Controllers connected to the same Building Controller may be connected to a common power supply.

3.6 CLASS 2 WIRING

.1 24 VAC power to controllers shall be separated from field devices transformer.

.2 Size and type of low voltage control signal wiring shall be suitable for the service for which it will be put to use and be the responsibility of this Contractor; minimum of #18 AWG RW-90 stranded copper conductors.

.3 Where Class 2 wires are in concealed and accessible locations including ceiling return air plenums, approved cables not in raceway may be used provided that:

.1 Circuits meet NEC Class 2 (current-limited) requirements. (Low-voltage power circuits shall be sub-fused when required to meet Class 2 current-limit.)

.2 All cables shall be UL listed for application, i.e. cables used in ceiling plenums shall be UL listed specifically for that purpose.

.4 Any existing wiring considered for re-use (i.e. thermostat wiring re-use for temperature sensor) must be fully tested and verified prior to connection to new system. Any wiring deemed to not meet the project requirements must be replaced at the cost of the contractor.

.5 Do not install Class 2 wiring in conduit containing Class 1 wiring. Boxes and panels containing high voltage may not be used for low voltage wiring except for the purpose of interfacing the two (e.g. relays and transformers).

.6 Where class 2 wiring is run exposed, wiring shall be run parallel along a surface or perpendicular to it, and bundled, using approved wire ties at no greater than 3 m [10 ft] intervals. Such bundled cable shall be fastened to the structure, using specified fasteners, at 1.5 m [5 ft] intervals or more often to achieve a neat and workmanlike result.

.7 All wire-to-device connections shall be made at a terminal blocks or terminal strip. All wire-to-wire connections shall be at a terminal block.

.8 All wiring within enclosures shall be neatly bundled and anchored to permit access and prevent restriction to devices and terminals.

3.7 INSTALLATION OF SENSORS

.1 Install sensors in accordance with the manufacturer's recommendations.

.2 Mount sensors rigidly and adequate for the environment within which the sensor operates.

.3 Sensors used in mixing plenums shall be of the averaging type. Averaging sensors shall be installed in a serpentine manner horizontally across duct with each bend supported with a capillary clip.

.4 Immersion temperature sensors shall be installed in such a manner to allow the sensing element to be truly indicative of the medium temperature. Sensors shall be installed in wells with heat conducting compound and fastened into the well with fittings designed for the purpose.

.5 Supply and install (when required) approved thermal wells of the appropriate size and type for sensing water temperatures, as required in the Points List.

.6 Strap-on type sensors shall be installed with thermal conducting compound and stainless steel band clamp.

.7 Room temperature sensors shall be installed on concealed junction boxes properly supported by the wall framing. Wiring for space sensors shall be concealed in building walls. EMT conduit is acceptable within mechanical and service rooms.

.8 Install outdoor air temperature sensors on north wall complete with sun shield at designated location.

.9 Duct static pressure sensing tip shall be located so as to properly sense the static pressure in the duct without being adversely affected by changes in flow from duct fittings. Locate sensing tip a minimum straight duct length of 6 duct diameters upstream and 4 duct diameters downstream from any duct takeoff or elbow fittings.

.10 All wires attached to sensors shall be air sealed in their conduits or in the wall to stop air transmitted from other areas affecting sensor readings.

.11 Install labels on the inside covers of all room sensors identifying the point name using peel and stick labels such as the Brother labelling system.

3.8 INSTALLATION OF PRESSURE TRANSDUCERS

.1 Install transducers in accordance with the manufacturer's recommendations.

.2 Mount transducers rigidly on a wall or on a vertical surface with the pressure ports and cable entrance on the bottom. Avoid locations with severe vibrations or excessive moisture. Ensure there is enough space around the unit to make the pressure and electrical connections.

.3 Water pressure transducers shall be provided complete with 3-way manifold valves provided by the manufacturer.

.4 Pressure probes shall be installed perpendicular to the piping. Probes installed in horizontal pipes shall not be installed at the top or the bottom of the pipe to avoid air or dirt contamination going to the sensor. Allow minimum 6 pipe diameter upstream and downstream of the probe for the location.

.5 Line/tubing connection to the transducer shall be in copper tubing and not plastic.

.6 Purge to eliminate any trapped air when connecting the tubing to the transducer connections.

.7 Install labels on the inside covers of all sensors identifying the point name using peel and stick labels such as the Brother labelling system.

3.9 INSTALLATION OF RELAYS

.1 Control and status relays are to be located in designated enclosures only. These relays may also be located within packaged equipment control panel enclosures. These relays shall not be located within Class 1 starter enclosures.

.2 All relays to be tagged indicating DDC controller, point and function. All plug-in relays shall be labeled such that removal of the component does not remove the label.

3.10 INSTALLATION OF CONTROLLERS

.1 Integral VAV box controllers shall be mounted directly on the VAV damper shaft. If existing damper actuator is re-used, mount new controller on the VAV box at same location as existing.

.2 Other equipment controllers shall be mounted inside enameled steel, fully enclosed NEMA 1 construction control cabinets with hinged door, key-lock latch, and removable sub-panels. A single key shall be common to all field panels and sub-panels.

.3 Controllers and devices shall be conveniently spaced and neatly wired. Cables shall be accommodated inside slotted plastic wiring duct (Panduit or equivalent).

.4 Input and output point wiring shall have an extra length of 50cm (1.5ft) for future panel retrofit.

.5 Panels shall have an additional 20% free face area space to accommodate additional control devices.

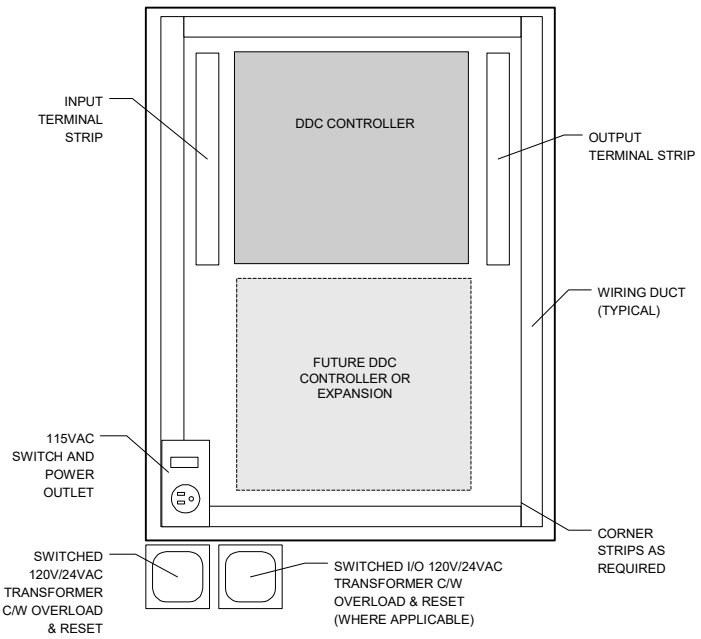
.6 Provide a separate Controller for each major piece of HVAC equipment. Points used for control loop reset such as outside air or space temperature are exempt from this requirement.

.7 All points associated with a single zone or an individual system shall be connected to the same controller. Points used for control loop reset such as outside air or space temperature are exempt from this requirement.

.8 The control system shall be designed such that each mechanical system will be able to operate under stand-alone control. As such, in the event of a network communication failure, or the loss of any other controller, the control system shall continue to independently operate under control.

.9 Building Controllers and Custom Application Controllers shall be selected to provide a minimum of 15% spare I/O point capacity for each point type found at each location. If input points are not universal, 15% of each type is required. If outputs are not universal, 15% of each type is required. A minimum of one spare is required for each type of point used.

DDC CONTROL PANEL TYPICAL LAYOUT



.10 Future use of spare capacity shall require providing the field device, field wiring, point database definition, and custom software. No additional Controller boards or point modules shall be required to implement use of these spare points.

.11 Building Controllers shall have the I/O points powered from a separate transformer to maintain the sub-network communications over an I/O device short circuit.

3.11 CONTROL PANELS

.1 Control panels shall be installed in accessible locations for ease of service.

.2 Panels mounted inside mechanical rooms and other wall mount locations shall be mounted at 1.5m from floor.

.3 Control panels mounted above dropped ceilings shall be located in corridors provided the resulting average wire length is less than 10m.

.4 Control panels shall not obstruct service access to equipment.

.5 A copy of the related as-built systems schematics, points list, and sequences of operation shall be placed inside each control panel. Points list shall be laminated and affixed inside the control panel door.

3.12 IDENTIFICATION OF HARDWARE AND WIRING

.1 All wiring and cabling, including that within factory-fabricated panels, shall be labeled at each end within 2" of termination with a cable identifier and other descriptive information. Cable identifier shall be shown on and match record documents.

.2 Permanently label or code each point of field terminal strips to show the instrument or item served.

.3 Identify control panels with minimum 1 cm letters on laminated plastic nameplates.

.4 Identify all other control components including control relays with permanent labels. Identifiers shall match record documents. All plug-in components shall be labeled such that removal of the component does not remove the label.

.5 Where new points are added or where controllers are replaced, all cabling, wiring, and device tags shall be updated, as required and as built drawings shall be issued.

3.13 CONCEALED DEVICES IDENTIFICATION

.1 Identification shall be used to indicate the location of concealed devices such as radiant valves.

.2 Identification shall be accordingly to existing code

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 01 11 00 – Summary of Work.

.2 Section 01 33 00 - Submittal Procedures.

.3 Section 01 78 00 - Closeout Submittals.

.4 Section 25 05 01 – ECMS General Requirements

1.2 COMMUNICATIONS

.1 The data communication protocol for the project shall comprise a BACnet IP inter-network. The PC Workstation and Building Controller components shall meet ASHRAE / ANSI Standard 135-2008, BACnet - A Data Communication Protocol for Building Automation and Control Networks

.2 Each BACnet device shall operate on the BACnet physical/data link protocols specified for that device as defined earlier in Section 25 30 01.

.3 The communication between the Building Controllers (B-BC), and Advanced Application Controllers (B-AAC) / Application Specific Controllers (B-ASC) shall be via BACnet networks. Arcnet, Lon or other protocols are not acceptable.

.4 All BACnet MS/TP networks shall communicate error free at a baud rate of 76,800 bps.

.5 Low capacitance cable with less than 15 Pico farads per foot shall be provided for MS/TP networks to for stable and less network communication errors.

.6 The Controls Contractor shall provide all communication media, connectors, repeaters, hubs, and routers necessary for the inter-network.

.7 Communications services over the inter-network shall result in operator interface and value passing that is transparent to the inter-network architecture as follows:

.1 Connection of an operator interface device to any one controller on the inter-network will allow the operator to interface with all other controllers as if that interface were directly connected to the other controllers. Data, status information, reports, system software, custom programs, etc., for all controllers shall be available for viewing and editing from any one controller on the inter-network.

.2 All database values (i.e., points, software variable, custom program variables) of any one controller shall be readable by any other controller on the inter-network. This value passing shall be automatically performed by a controller when a reference to a point name not located in that controller is entered into the controller's database. An operator/installer shall not be required to set up any communications services to perform inter-network value passing.

.3 The time clocks in all controllers shall be automatically synchronized daily.

.4 The Ethernet network shall be extended to all supervisory controllers, operator workstation and data server.

.5 Networks connecting zone level controllers such as VAV boxes, re-heat systems, etc. shall be directly connected to the DDC controller controlling the associated air handling unit.

1.3 INFORMATION ACCESS PROTOCOL

.1 The Operator Workstation shall use the Read (Initiate) and Write (Execute) Services as defined in Clauses 15.5 and 15.9, respectively, of ASHRAE Standard 135-2008, to communicate with BACnet objects in the internetwork.

1.4 INPUT/OUTPUT INTERFACE

.1 Hardwired inputs and outputs may tie into the system through Building, Custom, Application Specific Controllers or Lighting Controllers.

.2 All input points and output points shall be protected such that shorting of the point to itself, another point, or ground will cause no damage to the controller. All input and output points shall be protected from voltage up to 24V of any duration, such that contact with this voltage will cause no damage to the controller.

.3 Binary inputs shall allow the monitoring of on/off signals from remote devices. The binary inputs shall provide a wetting current of at least 12 mA to be compatible with commonly available control devices.

.4 Analog inputs shall allow the monitoring of low voltage (0-10 VDC), current (4-20 mA), or resistance signals (thermistor, RTD). Analog inputs shall be compatible with, and field configurable to commonly available sensing devices.

.5 Binary outputs shall provide for on/off operation, or a pulsed low voltage signal for pulse width modulation control. Binary outputs on Custom and Building Controllers shall have 3-position (on/off/auto) override switches and status lights. Outputs shall be selectable for either normally open or normally closed operation.

.6 Analog outputs shall provide a modulating signal for the control of end devices. Outputs shall provide either a 0-10 Vdc or a 4-20 ma signal as required to provide proper control of the output device. Analog outputs on building or custom programmable controllers shall have status lights and a 2-position (auto/manual) switch and manually adjustable potentiometer for manual override.

1.5 SYSTEM GRAPHICS

.1 The Operator Workstation software shall be graphically oriented. The system shall allow display of multiple graphic screens at once for comparison and monitoring of system status. Provide a method for the operator to easily move between graphic displays and change the size and location of graphic displays on the screen.

.2 An operator with the proper password level shall be able to add, delete, or change dynamic points on a graphic. Dynamic points shall include analog and binary values, dynamic text, static text, and animation files. Graphics shall have the ability to show animation of equipment.

.3 Graphic screens:

.1 A complete new set of graphic screens shall be provided.

.2 Main Menu shall display general information of the building and the DDC system. From the main menu navigation buttons should direct to each floor, to main HVAC systems such as chilled and hot water plants, and to the scheduling and network schematic screens.

.3 Scheduling graphic screen shall be created to allow the building operator to access and adjust all weekly schedules set for the building (by floor, zone, tenant, etc), Annual (Holiday) Calendar, and Exception Schedule.

.4 Floor plan graphics screens shall be created and reflect correct zoning such as areas served by radiant heating panels, VAV boxes and air handling units. The zone numbers shall be the same as the equipment tag numbers. Floor graphic screen shall include zone temperatures, setpoints and links to equipment serving the floor. Where a modulating valve serves a zone the valve commanded position shall also be shown

.5 A graphic screen shall be provided for each air handling system with a table showing all associated radiant or radiator heating valve. Graphic screen shall display air handling unit supply air temperature and a table with columns indicating room temperature, room temperature setpoint, and re-heat valve position as applicable.

.6 Graphic screens shall be created for each piece of equipment such as air handling units, fan coils, boilers, etc displaying all associated inputs/outputs/setpoints.

.7 Building Network Diagram graphic screen shall be provided showing each controller and network panel complete with tag, address, controller make and model and installed location.

.4 Screen Navigation:

.1 A menu bar shall be located at the bottom of each graphics screen. The menu bar and menu buttons shall be placed at exactly the same location on each graphic screen to allow browsing through the system by clicking on the buttons without moving the mouse.

MAIN MENU: Clicking the Main Menu button, in the left most position on the menu bar on all graphic screens, shall open the main menu graphic screen;

PREVIOUS: Clicking the Previous button, the second from the left position on the menu bar on all graphic screens, shall open the graphic screen most recently displayed prior to the currently graphic;

CUSTOM: One or more buttons for commands specific to the currently displayed graphic screen;

HELP: Clicking the Help button, located on the right most position of the menu bar on all graphic screens, shall open the help graphic screen;

.2 A key plan shall be provided in the lower right hand corner with each graphic screen showing the related floor area plus the number of floors or levels. The shaded area will depict the area served by the graphic. Clicking on the level or floor number will present the corresponding location on that floor graphic. Clicking on the non-shaded areas will present the graphic representing that area on the same floor.

.5 Minimum Requirements:

.1 Placement of any information or active icons close to the edge of the graphic display area shall be avoided to minimize issues when sizing windows or screen setup with monitors with various resolutions.

.2 The graphic title shall be located at the top of each screen. The outdoor air temperature shall be displayed at the top left corner of each graphics screen;

.3 Text in graphic screens should have adequate font size for visualization and pleasing color contrast between lettering and background. Where text size precludes uncluttered placement of all information on the graphic screen, an additional zoom graphic screen shall be provided;

.4 Point values or status shall be located as close as possible to the graphical representation of the actual physical location. If the point has an associated setpoint this point will be located directly below the actual point and be in a different colour;

.5 Status of equipment shall be displayed as ON or OFF and located on top of commanded points; Command points shall be defined as Start/Stop or Enable/Disable, etc, but not as ON/OFF;

.6 Operator overrides of input points or values or outputs normally under program control shall result in display an override (hand or red block) indication adjacent to the display;

.7 Weekly schedules shall symbolized by a clock icon and be accessed from each system schematic graphic screen;

.8 All specified multiple trends shall be accessible from the associated graphic screen, labelled and have the same placement on similar graphic screens;

.9 Runtime hour icons shall be placed as close as possible to the actual point or value being totalized. The icon shall provide access to the totalizer configuration data.

.6 Colour Selection:

.1 The visual impact of color shall align with the importance of the information.

.1 Bright red or yellow block with black letters shall be used for alarm and warning information;

.2 White block with black letters shall be used for dynamic information such as temperature and status;

.3 Light blue block shall be used for adjustable setpoints;

.4 Colour consistency shall be maintained throughout - all air systems similar, all hot water lines the same colour, all chilled water lines the same colour; return lines colour should be shown in a lower grade than the supply line.

.5 Colour selections shall provide legible gray scale outputs on printers.

.7 Output Scaling:

.1 Information on position of 3-state (incremental) actuators shall be displayed as open percentage and not as a position of each binary output.

.2 All analog output values for control of pneumatically actuated valves and dampers shall be scaled and limited to 0 to 100% open for display on graphic screens.

.8 Variables

.1 All variables specified as adjustable or configurable shall be configured as BACnet Analog Value objects. Adjustable shall signify that the object present value is displayed and can be modified on graphic screens whereas configurable signifies that the object present value can only be modified from within the object properties definition.

.2 All variables specified as fixed shall be imbedded in control programs and shall not be configured as BACnet objects.

.3 Variable names shall be defined as an acronym representing the use of the variable in the program. The variable description field shall be used to provide additional information about the variable.

.9 Trending:

.1 System schematic graphic screens shall have as many trend /multi-trend icons as required in the specification linked to the specific trend graphic screen. Trend icons should have explanatory title and be placed on left upper corner of the screen.

.10 Graphic screens shall be submitted to Prism for review prior to installation on the workstation. Final graphic screens shall be reviewed and accepted by the Building Operator and the Facility Manager.

1.6 PROGRAMMING

.1 Provide programming for the system as per specifications and adhere to the control sequences provided. All other system programming necessary for the operation of the system but not specified in this document shall also be provided by the Control System Contractor.

.2 Imbed into the control program sufficient comment statements to clearly describe each section of the program. The comment statements shall reflect the language used in the sequence of operations.

.3 Imbed into the control program sufficient comment statements to clearly describe each section of the program. The comment statements shall reflect the language used in the sequence of operations.

.4 The term “proven” (i.e. “proven on”/ “proven off”) shall mean that the equipment’s digital input (DI / BI) status point matches the state set by the equipment’s digital output (DO / BO) command point.

.5 Where fan status is determined based on current measurement, the threshold shall be established to indicate belt failure.

.6 All software applications shall reside and run in the system controllers. Editing of applications shall occur at the operator workstation.

.7 Create and name all points indicated in the points lists. Software points (variable) shall have the same characteristics on the graphic screens as the real or hardware points. A few additional points may be required to comply with the intent of the generic logic, depending on the vendors system.

.8 Points Naming Convention:

.1 Create and name all points indicated in the points lists. Software points (variable) shall have the same characteristics on the graphic screens as the real or hardware points. A few additional points may be required to comply with the intent of the generic logic, depending on the vendors system.

.2 System point names as point, variable, trend, schedule, calendar and other names shall be modular in design, allowing easy operator interface without the use of a written point index.

.3 Point naming shall be composed as follows:

SITE_BLDG_SYS_POINT_FUNC

Where:

SITE is the site identifier
BLDG is an optional building identifier (applied where applicable)
SYS is the system identifier
POINT is the point identifier(s)
FUNC is the point function

.9 Variables:

.1 All variables specified as adjustable or configurable shall be configured as BACnet Analog Value objects. Adjustable shall signify that the object present value is displayed and can be modified on graphic screens whereas configurable signifies that the object present value can only be modified from within the object properties definition.

.2 All variables specified as fixed shall be imbedded in control programs and shall not be configured as BACnet objects

.3 Provide a description for each analog and binary variable created. The description property shall include application and scope of the variable.

.4 Variable names shall be as defined as an acronym that represents the application of the variable. All variable description fields shall provide information as to the variable application. (ie. Upper range limit for static pressure reset, outside air temperature below which maximum supply water temperature setpoint is applied, boiler is disabled above this temperature)

1.7 ALARMS AND ALARM REPORTING

.1 Any object in the system shall be configurable to alarm in and out of normal state. The operator shall be able to configure the alarm limits, warning limits, states, and reactions for each object in the system.

.2 The operator shall be able to determine the action to be taken in the event of an alarm. Alarms shall be routed to the appropriate workstations based on time and other conditions. An alarm shall be able to start programs, be logged in the event log, printed, generate custom messages graphics.

.3 Each binary object shall be set to alarm based on the operator specified state. Provide the capability to disable alarming when the associated equipment is turned off or is being serviced.

.4 Each analog object shall have both high and low alarm limits and warning limits. Alarming must be able to be automatically and manually disabled.

.5 Adequate range, time delay and interlocks shall be provided to avoid nuisance alarms caused by changes of state or normal temperature recovery period.

.6 The alarm message shall be clear and provide enough information for the operator to determine the action to be taken in the event of an alarm. It shall include the name of the calling location, the device that generated the alarm, and the alarm message itself.

1.8 TREND LOGS

.1 The operator shall be able to define a custom trend log for any data in the system. This definition shall include interval, type of collection (polling or COV), start-time, and stop-time. Trend data shall be sampled and stored on the Building Controller panel and be archived on the hard disk.

.2 Trend data shall be able to be viewed and printed from the operator interface software. They shall also be storable in a tab delimited ASCII format and able to be exported for use by other industry standard word processing and spreadsheet packages.

.3 Trend axis shall be labeled with applicable units. Variable shall be assigned to an axis based on expected range and/or units.

.4 Trends logs shall be configured as per section 25 90 01 – EMCS Systems Sequences of Operation for each I/O point for 300 samples at 15-minute intervals.

1.9 OVERRIDDEN POINTS REPORT

.1 Overridden Points Report shall be created and available for the operator use

Part 2 Products

2.1 NOT USED

Part 3 Execution

3.1 NOT USED

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 01 11 00 - Summary of Work.

.2 Section 01 33 00 - Submittal Procedures.

.3 Section 01 78 00 - Closeout Submittals.

.4 Section 25 05 01 - ECMS General Requirements

Part 2 Products

2.1 OPERATOR INTERFACE (B-OWS)

.1 Existing PC based operator workstation should be used to access all information in the DDC system. The operator workstation is installed in the building operator office and shall be networked to the same Ethernet network as the building controllers.

.2 DDC contractor shall configure and connect the workstation to the DDC system.

2.2 WEB SERVER (B-OWS)

.1 The Controls Contractor shall provide a Web server able to access all information in the system. The web server shall be located in the existing Building Operator's Office.

.2 The Web Server shall provide password protected Internet access from any computer and tablet such as IPad using web browsers such as Internet Explorer, Chrome, IPad/IPhone Safari, and Firefox. All graphic screens shall reside in the Web Server.

.3 DDC remote access, providing user has adequate password, shall provide all appropriate data and control functionality, including the ability to make changes to controller program code in all network panels and controllers.

.4 The Web Server shall reside on the same high-speed network as the building controllers.

.5 Provide and install router / switches / modem and associated cables as required for remote communication to the building control system via Internet. Coordinate with PWRC personnel and an Internet Provider for installing a new Modem/Router for remote access to the DDC system via Internet;

2.3 CONTROLLERS

.1 The following requirements shall apply to Building Controllers (B-BC), Advanced Application Controllers (B-AAC) and Application Specific Controllers (B-ASC):

.2 Controllers shall be native BACnet. No translation software shall be used internal to the controller to convert from a proprietary protocol to BACnet Standard Object

Types, Standard Application Services and Devices. Gateways are not native BACnet.

.3 All controllers shall be BACnet Testing Laboratories (BTL) certified.

.4 Effective Panel Processing Speed - Maximum permissible execution time is half a second. Execution time is defined as the time it takes the controller to execute all application software from some point in the software back to the same point while simultaneously responding to operator or terminal display requests and carrying out normal inter-panel communications. Set up an analog variable counter in each panel, incremented and reset by program code, to allow for verification of the processing speed.

.5 Controllers shall have sufficient memory to support its operating system, database, programming and trending requirements. There shall be a minimum of 50% available memory free for future use.

.6 Controllers shall maintain all BIOS and programming information in the event of a power loss for at least 72 hours.

.7 Controllers shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shutdown below 80% nominal voltage.

.8 Controller operation shall be protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W at 1 m.

.9 Provide diagnostic LEDs for power, communications, and processor. All wiring connections shall be made to field removable, modular terminal strips or to a termination card connected by a ribbon cable.

.10 Controller hardware shall be suitable for the anticipated ambient conditions.

.11 Controllers used in conditioned ambient shall be mounted in NEMA 1 Type rated enclosures, and shall be rated for operation at 0°C to 50°C.

.12 Controllers used outdoors and/or in wet ambient shall be mounted within NEMA 4 Type waterproof enclosures, and shall be rated for operation at –40°C to 65°C.

.13 Controllers that perform scheduling shall have a real time clock.

2.4 BUILDING CONTROLLERS

.1 The Building Automation System shall be composed of one or more independent, stand-alone, microprocessor based Building Controllers to manage the global control strategies specified in the Sequences of Operation section of the Specifications

.2 Each Building Controller shall reside on a BACnet inter-network using the ISO 8802-3 (Ethernet) Physical/Data Link layer protocol. Each Building Controller shall also perform routing to a network of Advanced Application and Application Specific Controllers.

.3 The Building Controller shall use the Read (Initiate) and Write (Execute) Services as defined in Clauses 15.5 and 15.8, respectively, of ASHRAE Standard 135-2004, to communicate with BACnet objects in the inter-network.

.4 The controller shall provide a communications port for connection of the Portable Operators Terminal using Point-to-Point BACnet physical/data link layer protocol or a connection to the inter-network.

.5 The operating system of the Controller shall manage the input and output communications signals to allow distributed controllers to share real and virtual point information and allow central monitoring and alarms.

.6 Data shall be shared between networked Building Controllers on a peer-to-peer basis.

.7 The Building Controller shall continually check the status of its processor and memory circuits. If an abnormal operation is detected, the controller shall:

.1 assume a predetermined failure mode;

.2 generate an alarm notification.

.8 The building controllers shall be able to communicate with and download programs to Application Specific Controllers.

2.5 ADVANCED APPLICATION CONTROLLERS

.1 Advanced Application Controllers shall perform the control strategies specified in the Sequences of Operation section of the Specifications. Each of these panels shall meet the requirements as outlined in this section.

.2 The Building Automation System shall be composed of one or more independent, stand-alone, microprocessor based Advanced Application Controllers to manage the local strategies described in System software section.

.3 Controllers that perform scheduling shall have a real time clock.

.4 The operating system of the Controller shall manage the input and output communications signals to allow distributed controllers to share real and virtual point information and allow central monitoring and alarms.

.5 Data shall be shared between networked Controllers.

.6 The Controller shall continually check the status of its processor and memory circuits. If an abnormal operation is detected, the controller shall:

.1 assume a predetermined failure mode;

.2 generate an alarm notification.

.7 The Advanced Application Controller shall communicate with other BACnet devices on the inter-network using the Read (Initiate) and Write (Execute) Services as defined in Clauses 15.5 and 15.8, respectively, of ASHRAE Standard 135-95.

.8 Each controller shall reside on a BACnet network.

.9 The controller shall provide a service communication port using BACnet Data Link/Physical layer protocol to a portable operator's terminal.

2.6 APPLICATION SPECIFIC CONTROLLERS (B-ASC)

.1 Application Specific Controllers (ASC) are microprocessor-based DDC controllers, which through hardware or firmware design are dedicated to control a

specific equipment. They are not fully user programmable, but are customized for operation within the confines of the equipment they are designed to serve.

.2 Application Specific Controllers (ASC) are not acceptable in this project

Part 3 Execution

3.1 Not used

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 01 78 00 - Closeout Submittals.

.3 Section 25 05 02 – ECMS Summary of Work.

.4 Section 25 05 01 – ECMS General Requirements

Part 2 Products

2.1 CONTROL VALVES

.1 Control valves for plant equipment shall be two-way or three-way type for two-position or modulating service as scheduled or shown. Control valves for zone control may have modulating or floating point control.

.2 Body and trim style and materials shall be per manufacturer's recommendations for design conditions and service shown, with equal percentage ports for modulating service.

.3 Where CV is specified in the points list or on a valve schedule, ensure the control valve has a similar CV to that specified.

.4 Close-off (differential) Pressure Rating: Valve actuator and trim shall be furnished to provide the following minimum close-off pressure ratings:

.5 Water Valves:

.1 two-way: 150% of total system (pump) head;

.2 three-way: 300% of pressure differential between ports A and B at design flow or 100% of total system (pump) head.

.6 Sizing Criteria:

.1 two-position service / diverting application: Line size;

.2 2-way Modulating Service: Pressure drop equal to twice the pressure drop through the coil exchanger (load), 5 psi maximum;

.3 valves 1/2" through 2" shall be bronze body or cast brass ANSI Class 250, spring loaded, Teflon packing, quick opening for two-position service. Two-way valves to have replaceable composition disc, or stainless steel ball;

.4 2-1/2" valves and larger shall be cast iron ANSI Class 125.

.7 Valve Actuators:

.1 The actuator shall have electronic overload or digital rotation sensing circuitry to prevent damage to the actuator throughout the rotation of the actuator.

.2 Where shown, for power-failure/safety applications, an internal mechanical, spring return mechanism shall be built into the actuator housing.

.3 Proportional actuators shall accept a 0-10 VDC control signal.

.4 All non-spring return actuators shall have an external manual gear release to allow manual positioning when the actuator is not powered. Spring return actuators with more than 60 in-lb. torque capacity shall have a manual crank for this purpose.

.5 Actuators shall be provided with a conduit fitting and a minimum 1m electrical cable and shall be pre-wired to eliminate the necessity of opening the actuator housing to make electrical connections.

.6 Actuators shall be Underwriters Laboratories Standard 873 listed.

.7 Actuators shall allow smooth operation throughout entire operating range and assure tight shut-off against system pressure.

.8 Actuators shall remain stationary until the applied signal changes.

2.2 TEMPERATURE SENSORS

.1 Provide one of the following temperature sensor types throughout:

.1 10,000 Ohm at 25°C thermister

.2 1000 Ohm at 0°C (±0.2 ohm) thin film platinum with coefficient of resistivity of 0.000385 ohms/ohm/°C

.3 100 Ohm at 0°C (±0.2 ohm) platinum with coefficient of resistivity of 0.00385 ohms/ohm/°C

.2 Sensors shall have an accuracy of ±0.3 C or better.

.3 All temperature sensors provided shall be constructed in a strain minimizing construction with integral anchored lead wires

2.3 IMMERSION TEMPERATURE SENSORS (TSP1)

.1 Provide spring-loaded, thermowell mount sensors as follows:

.1 stainless steel sheath;

.2 spring loaded construction complete with compression fitting for 20 mm or 12 mm NPT well mounting as applicable;

.3 length as suitable for the application;

.4 standard conduit box termination, complete with screw terminal connector block.

.2 Immersion sensors shall be provided with a separable stainless steel well. Pressure rating of well to be consistent with the system pressure in which it is to be installed.

2.4 STRAP-ON TEMPERATURE SENSORS (TSP2)

.1 Provide "strap-on" type sensors having the following minimum specifications:

.1 non-corroding (brass) sheath construction;

.2 standard conduit box termination complete with screw-terminal connector block;

.3 complete with stainless steel pipe clamps;

.4 installed with heat transfer paste so as to provide a good thermal and mechanical bond with the associate pipe work;

.5 replace and restore all pipe-wrap and insulation, as disturbed by the installation, to its original condition.

2.5 DUCT MOUNTED TEMPERATURE SENSORS - (TSD2)

.1 Provide general purpose duct mount temperature sensors as follows:

.1 Copper sheathed construction

.2 Standard conduit box termination, complete with screw terminal connector block

.3 Length to extend, at minimum, one-third of the distance across the duct

2.6 DUCT AVERAGING TEMPERATURE SENSORS (TSD1)

.1 Provide duct averaging type temperature sensors as follows:

.1 Copper sheathed construction.

.2 Internal parallel/series network of multiple sensing elements encapsulated at equal distances along the length.

.3 Unless otherwise specified, a minimum of four internal sensing elements shall be used for sheath lengths less than 7 m. For lengths greater than 7 m - nine sensing elements shall be used.

.4 Location of each internal temperature sensing element shall be clearly indicated.

.5 Standard conduit box termination complete with screw terminal connector box.

.6 Probe to be capable of being formed, at field installation time, to a minimum radius of 10 cm at any point along the probe length other than within 20 cm of the connector box with no degradation to the specified performance.

2.7 ROOM TEMPERATURE SENSORS (TSR/TSR1/TSR2/TSR3)

.1 Provide room temperature sensors as follows:

.1 For non-security applications (TSR/TSR2/TSR3) the sensing element shall be installed in a vented wall mounted protective enclosure.

.2 For security applications (TSR1) the sensing element shall be attached directly to a rigid, metal cover plate designed for mounting into a recessed junction box.

.3 Equipped with set-point adjustment, override switch, display, and/or communication port as shown on points list.

2.8 DIFFERENTIAL PRESSURE TRANSMITTERS – Air Service (DPT/x)

.1 Provide differential pressure transmitters as follows:

.1 Solid-state design, operating on capacitance principle

.2 Range selected to suit application

.3 Internal materials of the transducer suitable for the application

.4 Integral filters at each air connection port

.5 Integral, accessible non-interactive zero and span adjustment

.6 Minimum operating range of 0°C to 50°C with 20% to 90% RH (non-condensing)

.7 Accuracy of ±1% range including non-linearity and hysteresis

.8 Over pressure input protection as necessary for the application

.9 Shock and vibration protection as necessary

2.9 WATER DETECTOR (WTRD)

.1 Provide water detector as follows:

.1 Form C relay output rated 5 Amps

.2 Gold plated sensing probes to detect presence of water or conductive liquid

.3 Fail safe circuitry

.4 Ambient operating range of -40°C to 85°C

.5 water and dust protection suitable for the application

.6 24 VDC nominal supply voltage

.7 Stand alone or with remote probe as required

2.10 CONTROL RELAYS (CR1, 2, 3, crs)

.1 Provide control relays as follows:

.1 Control relays shall be UL listed plug-in type with dust cover. Contact rating, configuration, and coil voltage suitable for application.

.2 Electro mechanical relays shall have integral override switch to allow local override in event of DDC Control failure.

.3 Motor rated relays shall be provided in DDC Enable application for small motors (pumps, fans, etc.) with manual starters.

.4 Provide NEMA 1 Type enclosure when not installed in local control panel.

2.11 CURRENT TRANSDUCERS (CS1)

.1 Provide current transducers as follows:

.1 range selected to match the current of the application;

.2 output to match the requirements of the DDC System;

.3 accuracy of ± 2% full scale or better;

.4 repeatability of ±2% full scale or better;

.5 over-current and over-voltage protection as applicable;

.6 shock and vibration protection as necessary.

2.12 TRANSFORMERS AND POWER SUPPLIES

.1 Provide control relays as follows:

.1 Control transformers shall be UL listed, Class 2 current-limiting type, or shall be furnished with over-current protection in both primary and secondary circuits for Class 2 service.

.2 Unit shall operate between 0°C and 50°C.

.3 Unit output shall match the required output current and voltage requirements. Current output shall allow for a 50% safety factor. Unit shall have built-in over-voltage protection.

.4 A single transformer limited to a Class 2 (100VA) transformer could be used to power several VAV box controllers. Transformers shall be located inside the air handling unit mechanical room.

2.13 FIELD DEVICE TYPES

.1 Field devices, specifications shall be based on the following device types as noted in the points lists and/or drawings.

Table 1: Control Device Types

Device Type	Description	Technical Performance	Standard of Acceptance
CR1	Control relay (Dry contact electro-mechanical relay)	240V, 10 amps rated capacity. SPST function. Normally open (or normally closed) as required by points list or application	IDEC - RH Series Carlo Gavazzi - RCP8 Functional Devices RIB Series
CS1	Current Transducer		Greystone CS-450.
CV1	Control Valve (2 or 3 way, 2 position, spring return actuator)	Brass or bronze globe valve construction with threaded connections. Material suitable for chilled water or hot water up to 125°C. Body pressure rating of 875 kPa (300 psi), 24 VAC spring return actuator. Close off pressure rating to meet system pressure but no less than 12 psi minimum.	Belimo G2/G3 LF / NF / AF Series actuator
CV3	Control Valve (2 – 3 way modulating, non-spring-	Globe valve body, with equal percentage flow characteristics,	Johnson VG4000/5000 Series Johnson VG7000 Series

Device Type	Description	Technical Performance	Standard of Acceptance
	return)	threaded connections. Material suitable for chilled water or hot water up to 125°C, Body pressure rating of 875 kPa (300 psi). Close off pressure rating to meet system pressure but no less than 12 psi minimum. Modulating actuator with 0-10 VDC signal range, power to open and power to close.	Belimo G2 / G3 MFT series Submittal Data - Submittal data shall include the proposed CV rating for each control valve.
CV4	Control Valve (2 - 3 way, modulating, spring return)	Globe valve body, with equal percentage flow characteristics, threaded connections. Material suitable for chilled water or hot water up to 125°C, Body pressure rating of 875 kPa (300 psi). Close off pressure rating to meet system pressure but no less than 12 psi minimum. 24VAC spring return to open modulating actuator with 0-10 VDC signal range.	Johnson VG4000/5000 Series Johnson VG7000 Series Belimo G2 / G3 MFT series Submittal Data - Submittal data shall include the proposed CV rating for each control valve.
DPTL	Differential Pressure Transmitter - liquids	+/- 1% FS Accuracy Pressure Range to suit application. Proof pressure min 2X of maximum full scale Burst pressure 5X of maximum full scale 3-valve manifold.	Setra Model 231 c/w 3-valve manifold Greystone WP-D-xxx-LCD-VB
TSD	Duct temperature sensor	Length to extend, at minimum, one-third of the distance across the duct	Greystone TE-200-B Delta DTS-400
TSD1	Duct temperature sensor, averaging		Greystone TE200-DC
TSR	Room temperature sensor		Greystone TE200-AE
TSR1	Room temperature sensor with momentary override switch.		Greystone TE200-AE-x-BS
TSR2	Room temperature sensor, security type.		Greystone TE200-AS
TSR3	Room temperature sensor complete with momentary override switch, setpoint adjustment, and display		Greystone TE200-AE-x-AP-BS-AC Delta BACstat II DNS-24L Reliable: Smart-Sensor LCD
TSO	Outside air temperature sensor		Greystone TE200-F / FE
TSP1	Temperature Sensor, immersion type.		Greystone TE-200-C.

Device Type	Description	Technical Performance	Standard of Acceptance
TSP2	Temperature Sensor, strap-on-type.	Apply heat transfer paste between sensor plate and pipe	Greystone TE200-ES Alt : TE200-E
WTRD	Water Detector	Weatherproof enclosure	Greystone WD100, 102

Part 3 Execution

3.1 NOT USED

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 01 78 00 - Closeout Submittals.

1.2 CLOSEOUT SUBMITTALS

.1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

Part 2 PRODUCTS

1.3 GENERAL

.1 Controllers shall be selected to provide a minimum of 15% spare I/O point capacity for each point type found at each location. If input points are not universal, 15% of each type is required. If outputs are not universal, 15% of each type is required. A minimum of one spare is required for each type of point used.

.2 All points associated with a single zone or an individual system shall be connected to the same control panel, and associated terminal unit controller.

.3 DDC points list for the Annex is based on control drawings prepared by Modern Controls. Some HVAC systems have more than one controller (B#x) due to controller I/O point limitations. The point identification in the list does not reflect the existing I/O point identification; points are grouped as per application/equipment and panel location.

.4 Remove and discard (recycle) old controllers and wiring.

.5 See Point List on the following pages.

Annex HRV-1 & 2 –Mechanical Room 206 (Existing Schneider Controllers B#1, 5, 6, 10, and 11)

Point	Label	Point Description	Device	Comments
xx-IP1	ANN_ANN_HRV1_SAT	HRV-1 Supply Air Temperature	TSD2	New
xx-IP2	ANN_HRV12_OAD_S	HRV-1, 2 Outdoor Air Damper Status		Existing
xx-IP3	ANN_HRV12_EAD_S	HRV-1,2 Exhaust Air Damper Status		Existing
xx-IP4	ANN_HRV1_SFS	HRV-1 Supply Fan Status		Existing
xx-IP5	ANN_HRV1_EFS	HRV-1 Exhaust Fan Status		Existing
xx-IP6	ANN_HRV1_DF_S	HRV-1 Defrost Status		Existing
xx-IP7	ANN_HRV1_ALM	HRV-1 Alarm Status		Existing
xx-IP8	ANN_HRV1_RH1_SAT	HRV-1 RH-1 Supply Air Temperature		10k Existing
xx-IP9	ANN_HRV1_RH1_HWRT	HRV-1 RH-1 Return Water Temperature		10k Existing
xx-IP10	ANN_HRV1_RH1_FRZ	HRV-1 RH-1 Freezestat	From B#5	Relocate
xx-IP11	ANN_HRV1_RH2_SAT	HRV-1 RH-2 Supply Air Temperature		Existing
xx-IP12	ANN_HRV1_RH2_HWRT	HRV-1 RH-2 Return Water Temperature		Existing
xx-IP13	ANN_HRV1_RH2_FRZ	HRV-1 RH-2 Freezestat		Existing
xx-IP14	ANN_HRV2_SFS	HRV-2 Supply Fan Status		Existing
xx-IP15	ANN_HRV2_EFS	HRV-2 Exhaust Fan Status		Existing
xx-IP16	ANN_HRV2_DF_S	HRV-2 Defrost Status		Existing
xx-IP17	ANN_HRV2_ALM	HRV-2 Alarm Status		Existing
xx-IP18	ANN_HRV2_RH3_SAT	HRV-2 RH-3 Supply Air Temperature		Existing
xx-IP19	ANN_HRV3_RH3_HWRT	HRV-2 RH-3 Return Water Temperature		Existing
xx-IP20	ANN_HRV2_RH3_FRZ	HRV-3 RH-3 Freezestat		Existing
xx-IP21	ANN_CRWLS_EF1_S	Crawlspace EF-1 Status		Existing
xx-IP22	ANN_EF101_S	Meeting Room 1 EF-101 Status		Existing
xx-IP23	ANN_EF101_OVR	Meeting Room 1 EF-101 Override Switch		Existing
xx-IP24	ANN_EF102_S	Meeting Room 2 EF-102 Status		Existing
xx-IP25	ANN_EF102_OVR	Meeting Room 2 EF-102 Override Switch		Existing
xx-IP26	ANN_AC03_S	AC Split System AC-03 Status	CS1	New
xx-IP27	ANN_AC04_S	AC Split System AC-04 Status	CS1	New
xx-OP1	ANN_HRV12_OAD	HRV-1, 2 Outdoor Air Damper Command		Existing
xx-OP2	ANN_HRV12_EAD	HRV-1,2 Exhaust Air Damper Command		Existing
xx-OP3	ANN_HRV1_SFC	HRV-1 Supply Fan Command		Existing
xx-OP4	ANN_HRV1_EFC	HRV-1 Exhaust Fan Command		Existing
xx-OP5	ANN_HRV1_RH1_C	HRV-1 RH-1 Re-heat Valve Command		Existing
xx-OP6	ANN_HRV1_RH2_C	HRV-1 RH-2 Re-heat Valve Command		Existing
xx-OP7	ANN_HRV2_SFC	HRV-2 Supply Fan Command		New
xx-OP8	ANN_HRV2_EFC	HRV-2 Exhaust Fan Command		New
xx-OP9	ANN_HRV2_RH3_C	HRV-2 RH-3 Re-heat Valve Command		Existing
xx-OP10	ANN_CRWLS_EF1_C	Crawlspace EF-1 Command		Existing
xx-OP11	ANN_EF101_C	Meeting Rm 1 EF-101 Command		Existing
xx-OP12	ANN_EF102_C	Meeting Rm 2 EF-102 Command		Existing

Annex Heating Plant –Mechanical Room 107 (Existing Schneider Controllers B#3, and 4)

Point	Label	Point Description	Device	Comments
xx-IP1	ANN_HW_B1_HWST	Boiler B-1 Supply Water Temperature		Existing
xx-IP2	ANN_HW_HWST	Secondary Supply Water Temperature		Existing
xx-IP3	ANN_HW_B1_HWRT	Boiler B-1 Return Water Temperature		Existing
xx-IP4	ANN_HW_HWRT	Secondary Return Water Temperature		Existing
xx-IP5	ANN_HW_B1_S	Boiler B-1 Status	(*)	(split existing)
xx-IP6	ANN_HW_B1_ALM	Boiler B-1 Alarm	(*)	(split existing)
xx-IP7	ANN_HW_P1_S	Secondary Pump P-1 Status		Existing
xx-IP8	ANN_HW_P2_S	Boiler Pump P-2 Status		Existing
xx-IP9	OAT	Outdoor Air Temperature		Existing
xx-IP10	ANN_HW_HE1_HWST	HE-1 HW Supply Water Temperature		Existing
xx-IP11	ANN_HW_HE1_HWRT	HE-1 HW Return Water Temperature		Existing
xx-IP12	ANN_HW_HE1_P3_S	Secondary Pump P-3 Status		Existing
xx-IP13	ANN_DHW_HW_HE1_P4_S	DHW HE-1 Pump P-4 Status		Existing
xx-IP14	ANN_DHW_HW_HE1_HWST	HE-1 DHW Supply Water Temperature		Existing
xx-IP15	ANN_DHW_HW_HE1_HWRT	HE-1 DHW Return Water Temperature		Existing
xx-IP16	ANN_DHW_HW_HWT	DHW Tank Temperature		Existing
xx-IP17	ANN_DHW_HW_HWT_ALM	DHW High Temperature Alarm		Existing
xx-IP18	ANN_ER201_RT	Electrical Room 201 Temperature		Existing
xx-IP19	ANN_EF103_S	Electrical Room 201 EF-103 Status	From B#12	Relocate
xx-IP20	ANN_AC01_S	AC Split System AC-01 Status	CS1	New
xx-IP21	ANN_AC02_S	AC Split System AC-02 Status	CS1	New
xx-OP1	ANN_HW_B1_C	Boiler B-1 Enable		Existing
xx-OP2	ANN_HW_B1_RST	Boiler B-1 Setpoint Reset		Existing
xx-OP3	ANN_HW_P1_C	Secondary Pump P-1 Command		Existing
xx-OP4	ANN_HW_P2_C	Boiler Pump P-2 Command		Existing
xx-OP5	ANN_HW_HE1_P3_C	Secondary Pump P-3 Command		Existing
xx-OP6	ANN_DHW_HW_HE1_P4_C	DHW HE-1 Pump P-4 Command		Existing
xx-OP7	ANN_EF103_C	Electrical Room 201 EF-103 Command		Existing

(*) Existing combined point shall be split in two separate inputs

Annex - Infloor Heating - Mechanical Room 107 (Existing Schneider Controllers)

Controller B#2

Point	Label	Point Description	Device	Comments
xx-IP1	ANN_IHM1_RWT	I H Manifold #1 Return Water Temperature		Existing
xx-IP2	ANN_IHM1_RPx_S	I H Manifold #1 Pump RP-1 Status		Existing
Network	ANN_IHM1_RTxxx	I H Room xxx Temperature		Existing
xx-OP1	ANN_IHM1_HCV_C	I H Manifold #1 Heating Valve Command		Existing
xx-OP2	ANN_IHM1_RP1_C	I H Manifold #1 Pump RP-1 Command		Existing

Controller B#7

Point	Label	Point Description	Device	Comments
xx-IP1	ANN_IHM2_RWT	I H Manifold #2 Return Water Temperature		Existing
xx-IP2	ANN_IHM2_RP3_S	I H Manifold #2 Pump RP-2 Status		Existing
Network	ANN_IHM2_RTxxx	I H Room xxx Temperature		Existing
xx-OP1	ANN_IHM2_HCV_C	I H Manifold #2 Heating Valve Command		Existing
xx-OP2	ANN_IHM2_RP3_C	I H Manifold #2 Pump RP-2 Command		Existing

Controller B#8

Point	Label	Point Description	Device	Comments
xx-IP1	ANN_IHM3_RWT	I H Manifold #3 Return Water Temperature		Existing
xx-IP2	ANN_IHM3_RP3_S	I H Manifold #3 Pump RP-3 Status		Existing
Network	ANN_IHM3_RTxxx	I H Room xxx Temperature		Existing
xx-OP1	ANN_IHM3_HCV_C	I H Manifold #3 Heating Valve Command		Existing
xx-OP2	ANN_IHM3_RP3_C	I H Manifold #3 Pump RP-3 Command		Existing

Controller B#9

Point	Label	Point Description	Device	Comments
xx-IP1	ANN_IHM4_RWT	I H Manifold #4 Return Water Temperature		Existing
xx-IP2	ANN_IHM4_RP4_S	I H Manifold #4 Pump RP-4 Status		Existing
Network	ANN_IHM4_RTxxx	I H Room xxx Temperature		Existing
xx-OP1	ANN_IHM4_HCV_C	I H Manifold #4 Heating Valve Command		Existing
xx-OP2	ANN_IHM4_RP3_C	I H Manifold #4 Pump RP-4 Command		Existing

Annex - Infloor Heating – Mechanical Room 209 – (Existing Schneider Controllers)

Controller B#10

Point	Label	Point Description	Device	Comments
xx-IP1	ANN_IHM5_RWT	I H Manifold #5 Return Water Temperature		Existing
xx-IP2	ANN_IHM5_RP5_S	I H Manifold #5 Pump RP-5 Status		Existing
xx-IP3	*RH3-FRZ*	*HRV-1 Freezestat*		Relocate
Network	ANN_IHM5_RTxxx	I H Room xxx Temperature		Existing
xx-OP1	ANN_IHM5_HCV_C	I H Manifold #5 Heating Valve Command		Existing
xx-OP2	ANN_IHM5_RP5_C	I H Manifold #5 Pump RP-5 Command		Existing

Controller B#11

Point	Label	Point Description	Device	Comments
xx-IP1	ANN_IHM6_RWT	I H Manifold #6 Return Water Temperature		Existing
xx-IP2	ANN_IHM6_RP6_S	I H Manifold #6 Pump RP-6 Status		Existing
xx-IP3	*EF103_ST*	*EF-103 Status*		Relocate
Network	ANN_IHM6_RTxxx	I H Room xxx Temperature		Existing
xx-OP1	ANN_IHM6_HCV_C	I H Manifold #6 Heating Valve Command		Existing
xx-OP2	ANN_IHM6_RP6_C	I H Manifold #6 Pump RP-6 Command		Existing

Controller B#12

Point	Label	Point Description	Device	Comments
xx-IP1	ANN_IHM7_RWT	I H Manifold #7 Return Water Temperature		Existing
xx-IP2	ANN_IHM7_RP7_S	I H Manifold #7 Pump RP-7 Status		Existing
xx-IP3	*H1_AL / H2-AL*	*HRV-1 / HRV-2 Alarm*		Relocate
Network	ANN_IHM7_RTxxx	I H Room xxx Temperature		Existing
xx-OP1	ANN_IHM7_HCV_C	I H Manifold #7 Heating Valve Command		Existing
xx-OP2	ANN_IHM7_RP7_C	I H Manifold #7 Pump RP-7 Command		Existing

Controller B#13

Point	Label	Point Description	Device	Comments
xx-IP1	ANN_IHM87_RWT	I H Manifold #8 Return Water Temperature		Existing
xx-IP2	ANN_IHM8_RP8_S	I H Manifold #8 Pump RP-8 Status		Existing
Network	ANN_IHM8_RTxxx	I H Room xxx Temperature		Existing
xx-OP1	ANN_IHM8_HCV_C	I H Manifold #8 Heating Valve Command		Existing
xx-OP2	ANN_IHM8_RP8_C	I H Manifold #8 Pump RP-8 Command		Existing

Science Wing Heating Plant –Mechanical Room (Existing Reliable Controllers)

Point	Label	Point Description	Device	Comments
xx-IP1	SCI_HW_B1_HWST	Boiler B-1 Supply Water Temperature	TSP1	Replace
xx-IP2	SCI_HW_B1_HWRT	Boiler B-1 Return Water Temperature	TSP1	Replace
xx-IP3	SCI_HW_P1_S	Boiler Pump P-1 Status	CS1	Replace
xx-IP4	SCI_HW_B1_S	Boiler B-1 Status	-	Existing
xx-IP5	SCI_HW_P2_S	Secondary Pump P-2 Status	CS1	Replace
xx-IP6	SCI_RAD_HWST	Radiant Heating Supply Water Temperature	TSP1	Replace
xx-IP7	SCI_RAD_HWRT	Radiant Heating Return Water Temperature	TSP1	Replace
xx-IP8	SCI_EF2_S	Women's Washroom EF-2 Status	CS1	Replace
xx-IP9	SCI_EF5_S	Men's Washroom EF-5 Status	CS1	Replace
xx-IP10	SCI_OAT	Outdoor Air Temperature	TSO	Replace
xx-IP11	LOD_HW_P4A_S	Lodge Secondary Pump P-4 Status	CS1	New
xx-IP12	LOD_HWST	Lodge Heating Supply Water Temperature	TSP1	Replace
xx-IP13	LOD_HWRT	Lodge Heating Return Water Temperature	TSP1	New
xx-IP14	LOD_ACC_RT	Lodge Access Corridor Temperature	TSR	New
xx-OP1	SCI_HW_B1A_C	Boiler B-1 Enable	CR1	Replace
xx-OP2	SCI_HW_P1A_C	Boiler Pump P-1 Command	CR1	Replace
xx-OP3	SCI_HW_P2A_C	Secondary Pump P-2 Command	CR1	Replace
xx-OP5	SCI_SEC_HTG_VLV_C	Secondary Heating Valve CV-1 Command	CV4	Replace
xx-OP6	LOD_HW_P4A_C	Lodge Secondary Pump P-4 Command	CR1	New
xx-OP7	LOD_SEC_HTG_VLV_C	Lodge Secondary Heating Valve Command	CV4	Replace
xx-OP8	SCI_EF2_C	Women's Washroom EF-2 Command	CR1	Replace
xx-OP9	SCI_EF5_C	Men's Washroom EF-5 Command	CR1	Replace

Existing Heating Valves

Tag	Service	GPM	Size	CV	Comments
CV-1	Science Secondary Heating Valve	20	1 ¼"	16	Replace
CV-2	Science AHU-1 Heating Valve	12	1"	10	Replace
CV-3	Lodge Secondary Heating Valve	22	1 ¼"	16	Replace

Science Wing AHU-1 (Existing Reliable Controller)

Point	Label	Point Description	Device	Comments
xx-IP1	SCI_AHU1_SFS	AHU-1 Supply Fan Status	CS1	Replace
xx-IP2	SCI_AHU1_SFF	AHU-1 Supply Fan Flow Status	-	Existing
xx-IP3	SCI_AHU1_SAT	AHU-1 Supply Air Temperature	TSD	Replace
xx-IP4	SCI_AHU1_RAT	AHU-1 Return Air Temperature	TSD	Replace
xx-IP5	SCI_AHU1_MAT	AHU-1 Mixed Air Temperature	TSD1	New
xx-IP6	SCI_AHU1_ALM	AHU-1 Freezestat Alarm	-	Existing
xx-IP7	SCI_AHU1_RT	AHU-1 Lobby Temperature	TSR	Replace
xx-IP8	SCI_AHU1_HCP_S	AHU-1 Heating Coil Pump Status	CS1	Replace
xx-IP9	SCI_FIRE_ALM	Fire Alarm Status	-	Existing
xx-IP10	SCI_EF1_S	Dry Lab Fumehood EF-1 Status	CS1	Replace
xx-IP11	SCI_EF1_SW_S	Dry Lab Fumehood Switch Status	CS1	Replace
xx-OP1	SCI_AHU1_SFC	AHU-1 Supply Fan Command	CR1	Replace
xx-OP2	SCI_AHU1_MAD	AHU-1 Mixing Dampers Command	-	Existing
xx-OP3	SCI_AHU1_HTG_VLV	AHU-1 Heating Coil Valve Command	CV4	Replace
xx-OP4	SCI_AHU1_HCP_C	AHU-1 Heating Coil Pump Command	CR1	Replace
xx-OP5	SCI_EF1_C	Dry Lab Fumehood EF-1 Command	CR1	Replace

Science Wing and Lodge Radiant Panels – Input Points

Point	Label	Point Description	Device	Comments
xx-IP1	SCI_RM102_RT	Student Room 102 Temperature	TSR3	Network Tstat
xx-IP2	SCI_RM105_RT	Student Room 105 Temperature	TSR3	Network Tstat
xx-IP3	SCI_RM108_RT	Non-Game Biologist Rm 108 Temperature	TSR3	Network Tstat
xx-IP4	SCI_RM109_RT	Student Room 109 Temperature	TSR3	Network Tstat
xx-IP5	SCI_RM118_RT	Plant Ecologist Rm 118 Temperature	TSR3	Network Tstat
xx-IP6	SCI_RM117_RT	System Ecologist Rm 117 Temperature	TSR3	Network Tstat
xx-IP7	SCI_RM116_RT	Research Technician Rm 116 Temperature	TSR3	Network Tstat
xx-IP8	SCI_RM113_RT	Wet Lab Room 113 Temperature	TSR3	Network Tstat
xx-IP9	SCI_RM112_RT	Dry Lab Room 112 Temperature	TSR3	Network Tstat
xx-IP10	SCI_RM107_RT	Men's Washroom 107 Temperature	TSR3	Network Tstat
xx-IP11	SCI_RM104_RT	Women's Washroom 104 Temperature	TSR3	Network Tstat
xx-IP12	SCI_RM202_RT	Toxic Biologist Room 202 Temperature	TSR3	Network Tstat
xx-IP13	SCI_RM204_RT	Resident Room 204 Temperature	TSR3	Network Tstat
xx-IP14	SCI_RM206_RT	Marine Biologist Room 206 Temperature	TSR3	Network Tstat
xx-IP15	SCI_RM208_RT	Visiting Scientist Room 208 Temperature	TSR3	Network Tstat
xx-IP16	SCI_RM216_RT	Wildlife Chair Room 216 Temperature	TSR3	Network Tstat
xx-IP17	SCI_RM215_RT	Wildlife Tech Room 215 Temperature	TSR3	Network Tstat
xx-IP18	SCI_RM214_RT	Wildlife Chair Room 214 Temperature	TSR3	Network Tstat
xx-IP19	SCI_RM213_RT	Assess Room 213 Temperature	TSR3	Network Tstat
xx-IP20	SCI_RM211_RT	Research Scientist Rm 211 Temperature	TSR3	Network Tstat
xx-IP21	SCI_RM212_RT	Research Scientist Rm 212 Temperature	TSR3	Network Tstat
xx-IP22	SCI_RM210_RT	Fraser Biometrician Rm 210 Temperature	TSR3	Network Tstat
xx-IP23	SCI_RM209_RT	Habitat Biologist Rm 209 Temperature	TSR3	Network Tstat
xx-IP24	SCI_RM207_RT	Fraser Basin Biolog Rm 207 Temperature	TSR3	Network Tstat
xx-IP25	SCI_RM205_RT	Research Scientist Room 205 Temperature	TSR3	Network Tstat
xx-IP26	SCI_RM203_RT	Toxic Biologist Room 203 Temperature	TSR3	Network Tstat
xx-IP27	LOD_RM209_RT	Lodge 2nd Floor Office 209 Temperature	TSR2	Network Tsensor – New
xx-IP28	LOD_RM120_RT	Lodge 1st Floor Office 120 Temperature	TSR3	Network Tstat – New
xx-IP29	LOD_RM121_RT	Lodge Office 121 Temperature	TSR3	Network Tstat – New
xx-IP30	LOD_UP_CORR_RT	Lodge – Science Wing Upper Corridor Temp.	TSR3	Network Tstat – New
xx-IP31	LOD_LOW_CORR_RT	Lodge – Science Wing Lower Corridor Temp.	TSR3	Network Tstat – New
xx-IP29	LOD_RM116_RT	Lodge Basement Room 116 Temperature	TSR3	Network Tstat – New
xx-IP30	LOD_RM117_RT	Lodge Basement Room 117 Temperature	TSR3	Network Tstat – New
xx-IP31	LOD_RM221_RT	Lodge Staff Room 221 Temperature	TSR2	Network Tsensor – New
xx-IP32	LOD_RM200_RT	Lodge Entry Hall 200 Temperature	TSR2	Network Tsensor – New
xx-IP33	LOD_RM201_RT	Lodge Office 201 Temperature	TSR2	Network Tsensor – New
xx-IP34	LOD_RM202_RT	Lodge Office 202 Temperature	TSR2	Network Tsensor – New
xx-IP35	LOD_RM211_RT	Lodge Office 211 Temperature	TSR2	Network Tsensor – New
xx-IP36	LOD_RM210_RT	Lodge General Office 210 Temperature	TSR2	Network Tsensor – New
xx-IP37	LOD_RM203_RT	Lodge Office 203 Temperature	TSR2	Network Tsensor – New
xx-IP38	LOD_RM204_RT	Lodge Office 204 Temperature	TSR2	Network Tsensor – New
xx-IP39	LOD_RM205_RT	Lodge Office 205 Temperature	TSR2	Network Tsensor – New
xx-IP40	LOD_RM207_RT	Lodge Office 207 Temperature	TSR2	Network Tsensor – New
xx-IP41	LOD_RM208_RT	Lodge Office 208 Temperature	TSR2	Network Tsensor – New
xx-IP42	LOD_RM102_RT	Lodge Office 102 Temperature	TSR2	Network Tsensor – New

xx-IP43	LOD_RM103_RT	Lodge Office 103 Temperature	TSR2	Network Tsensor – New
xx-IP44	LOD_RM104_RT	Lodge Office 104 Temperature	TSR2	Network Tsensor – New
xx-IP45	LOD_RM105_RT	Lodge Office 105 Temperature	TSR2	Network Tsensor – New
xx-IP46	LOD_RM106_RT	Lodge Office 106 Temperature	TSR2	Network Tsensor – New
xx-IP47	LOD_RM108_RT	Lodge Office 108 Temperature	TSR2	Network Tsensor – New
xx-IP48	LOD_RM109_RT	Lodge Office 109 Temperature	TSR2	Network Tsensor – New
xx-IP49	LOD_RM110_RT	Lodge Office 110 Temperature	TSR2	Network Tsensor – New
xx-IP50	LOD_RM111_RT	Lodge Office 111 Temperature	TSR2	Network Tsensor – New
xx-IP51	LOD_RM112_RT	Lodge Office 112 Temperature	TSR2	Network Tsensor – New

Notes:

1 – New network temperature sensors

2 - Room numbers in the points list are based on architectural drawings and should be revised/updated as per current room numbers.

Science Wing Radiant Panels – Outputs Points

Point	Label	Point Description	Device	Comments
xx-OP1	SCI_RM102_RAD	Student Room 102 Rad Valve	CV1	Replace
xx-OP2	SCI_RM105_RAD	Student Room 105 Rad Valve	CV1	Replace
xx-OP3	SCI_RM108_RAD	Non-Game Biologist SCI_RM 108 Rad Valve	CV1	Replace
xx-OP4	SCI_RM109_RAD	Student Room 109 Rad Valve	CV1	Replace
xx-OP5	SCI_RM118_RAD	Plant Ecologist Room 118 Rad Valve	CV1	Replace
xx-OP6	SCI_RM117_RAD	System Ecologist Room 117 Rad Valve	CV1	Replace
xx-OP7	SCI_RM116_RAD	Research Technician SCI_RM 116 Rad Valve	CV1	Replace
xx-OP8	SCI_RM113_RAD	Wet Lab Room 113 Rad Valve	CV1	Replace
N/A	N/A	Room 113 Isolation Valve	N/A	Replace
xx-OP9	SCI_RM112_RAD	Dry Lab Room 112 Rad Valve	CV1	Replace
xx-OP10	SCI_RM107_RAD	Men's Washroom 107 Rad Valve	CV1	Replace
xx-OP11	SCI_RM104_RAD	Women's Washroom 104 Rad Valve	CV1	Replace
xx-OP12	SCI_RM202_RAD	Toxic Biologist Room 202 Rad Valve	CV1	Replace
xx-OP13	SCI_RM204_RAD	Resident Room 204 Rad Valve	CV1	Replace
xx-OP14	SCI_RM206_RAD	Marine Biologist Room 206 Rad Valve	CV1	Replace
xx-OP15	SCI_RM208_RAD	Visiting Scientist Room 208 Rad Valve	CV1	Replace
xx-OP16	SCI_RM216_RAD	Wildlife Chair Room 216 Rad Valve	CV1	Replace
xx-OP17	SCI_RM215_RAD	Wildlife Tech Room 215 Rad Valve	CV1	Replace
xx-OP18	SCI_RM214_RAD	Wildlife Chair Room 214 Rad Valve	CV1	Replace
xx-OP19	SCI_RM213_RAD	Assess Room 213 Rad Valve	CV1	Replace
xx-OP20	SCI_RM211_RAD	Research Scientist Room 211 Rad Valve	CV1	Replace
xx-OP21	SCI_RM212_RAD	Research Scientist Room 212 Rad Valve	CV1	Replace
xx-OP22	SCI_RM210_RAD	Fraser Biometrician SCI_RM 210 Rad Valve	CV1	Replace
xx-OP23	SCI_RM209_RAD	Habitat Biologist SCI_RM 209 Rad Valve	CV1	Replace
xx-OP24	SCI_RM207_RAD	Fraser Basin Biolog SCI_RM 207 Rad Valve	CV1	Replace
xx-OP25	SCI_RM205_RAD	Research Scientist SCI_RM 205 Rad Valve	CV1	Replace
xx-OP26	SCI_RM203_RAD	Toxic Biologist Room 203 Rad Valve	CV1	Replace
xx-OP27	LOD_RM120_RAD	Lodge Office 120 Rad Valve	CV1	Replace
xx-OP28	LOD_RM121_RAD	Lodge Office 121 Rad Valve	CV1	Replace
xx-OP29	LOD_UP_CORR_RAD	Lodge – Science Wing Upper Corridor Rad Valve	CV1	Replace
xx-OP30	LOD_LOW_CORR_RAD	Lodge – Science Wing Lower Corridor Rad Valve	CV1	Replace
xx-OP31	LOD_RM116_RAD	Lodge Basement Room 116 Rad Valve	CV1	Replace
xx-OP32	LOD_RM117_RAD	Lodge Basement Room 117 Rad Valve	CV1	Replace

Note:

1 - Radiant valves in the Science Wing and the three in the Lodge shall be replaced with a 2-way open/close, spring return to open control valve.

2 – Replace existing wiring with new control wiring.

Part 1 General

1.1 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 01 78 00 - Closeout Submittals.

.3 Section 25 05 02 – EMCS Summary of Work.

.4 Section 25 05 01 – ECMS General Requirements

Part 2 Products

1.2 NOT USED

Part 3 Execution

1.3 GENERAL

.1 Variables

.1 Adjustable shall signify that the object present value is displayed and can be modified on graphic screens whereas configurable signifies that the object present value can only be modified from within the object properties definition. All variables specified as fixed shall be imbedded in control programs.

1.4 ANNEX CONTROL SEQUENCES

.1 Existing control sequences for the Annex shall be retained. Refer to MSM Control Drawings for reference and implementation.

.2 Any clarification required would be provided during the implementation phase.

1.5 SCIENCE WING AND LODGE BOILER CONTROL

.1 General

.1 Heating water for the building is provided via a Thermific Model N-900 propane fired boiler located in the mechanical room. The boiler provides heating water for the Lodge and Science Wing.

.2 The boiler is equipped with a low water cut-out switch and a high temperature limit switch that will both de-energize the boiler if a hazardous condition exists. The heating water is circulated through the boiler and to the heating equipment by pump P-1. The heating water is provided to AHU-1 located in the attic area fan room, unit heaters and radiant panels.

.3 The heating water is also provide to control valves CVG-1 and CV-2 which regulate the temperature of the heating water supplied to the radiation system and the air handling unit heating coil respectively. Pump P-3, a Taco Model 113, and

control valve CV-2, which serve the air handling unit heating coil are each located in the attic area fan room.

.2 Start-up:

.1 The heating water system shall operate based on an annual calendar allowing the heating plant to be off during summer months. The Summer Schedule shall be adjustable at the graphic screen and initially set from July 1st to August 30th.

.2 The heating plant shall be enabled continuously when the outdoor air temperature is less than a 5ºC (adjustable) setpoint for more than 30 minutes.

.3 Occupied Mode:

.1 Subject to the heating calendar, the heating plant shall be enabled in occupied mode when the outdoor air temperature is below 15ºC (adjustable) for more than 30 minutes and on a heating demand or warm up mode from the spaces.

.2 When the heating plant is enabled, pump P-1 shall start and operate continuously. A critical alarm shall be generated on a pump failure.

.3 The hot water supply temperature setpoint shall be reset according to outdoor air temperature as follows:

OAT	Supply Water Temp
-10°C	90°C
18°C	60°C

.4 The maximum and minimum supply water and outdoor air temperatures shall be adjustable at the system graphic screen.

.5 The boilers shall be controlled by the integral boiler thermostats and safeties. The boiler shall start and operate upon proof of water circulation by the boiler water flow switch.

.6 A boiler failure alarm shall be issued if a boiler is enabled for more than 10 minutes and the boiler supply water temperature is less than 5ºC above the return water temperature.

.7 The DDC system shall monitor the boiler primary circuit return water temperature and enable the boiler if the return water temperature drops below the minimum boiler entering water temperature setpoint initially set to 50ºC (122ºF) or as recommended by the boiler manufacturer.

.4 Morning Warm-up Mode:

.1 The boiler shall be enabled when the system is in warm-up mode.

.5 Unoccupied Mode

.1 The heating plant shall operate in unoccupied mode when all systems are outside the assigned weekly schedule operating periods subject to the holiday calendar.

.2 The heating plant (boiler and pumps) shall be disabled at the beginning of the unoccupied period when the outdoor air temperature is above the continuous operation setpoint initially set at 5ºC (adjustable).

.3 The heating plant shall be enabled based on the number of systems calling for unoccupied heating (temperature in the spaces below the unoccupied temperature setpoint) initially set at 5 requests. The heating plant shall also be enabled if the return or supply water temperature decreases below 60ºC (adjustable) to avoid condensation. Once enabled, the lead heating plant shall operate until the next occupied period.

.6 Alarms

.1 Provide the following alarms:

Alarm	Alarm Source	High Limit	Low Limit
High Boiler SWT (6)	Boiler SWT Sensor	> 105ºC	-
Boiler Failure	SWT / RWT Sensor		(*)
Primary Pump Failure	Motor status	-	-

(*) Boiler alarm shall be generated if the boiler has been enabled for more than 10 min continuously and the temperature differential is less than 5ºC.

.2 Applicable interlocks as well as adequate time delay shall be provided to avoid nuisance alarms caused by changes of state as well normal temperature recovery period.

.7 System Graphics

.1 System graphic screen shall indicate the complete equipment layout with all inputs, outputs, setpoints, and alarms as shown in Appendix A. Provide navigation buttons to main menu, associated trends and associated screens. All setpoints shall be adjustable at graphic screen.

.8 Trends

.1 Provide 300 sample trends, at 15-minute intervals as applicable, for the following points/variables:

Multitrend 1

Point	Trend Type
Outdoor air temperature	Polling
Supply Water Temperature	Polling
Supply Water Temperature Setpoint	Polling
Return Water Temperature	Polling

.9 Run Time Logs:

.1 Run time totalizers shall be provided as follows:

Heating Pump P-1 Status

1.6 SCIENCE WING RADIANT HEATING PUMP P-2 CONTROL

.1 General

.1 Secondary heating pump P-2 circulates temperate hot water to the Airtex radiant ceiling panels installed along the perimeter windows and cabinet heater installed at the main entrance. A 3-way valve modulates to maintain the supply water temperature.

.2 Start-up:

.1 The secondary heating water system shall operate based on a weekly schedule for the spaces allowing the heating water pump to shutdown during unoccupied periods. Pump P-2 shall run continuously if the outdoor air temperature is below 5ºC (adjustable).

.3 Optimum Start Mode:

.1 A heating optimum start algorithm shall be implemented to start the pumps at the latest possible time to bring the building temperature to the occupied setpoint at the beginning of occupancy.

.4 Occupied Mode:

.1 The hot water circulating pumps shall start during occupied periods if the outdoor temperature is lower than 18ºC (adjustable) for more than 15 minutes and disabled at +2ºC differential or on a heating request from more than (3) (adjustable) spaces.

.2 The radiant hot water supply temperature setpoint shall be initially reset according to outdoor air temperature as follows:

OAT	Supply Water Temp
-10°C	85°C
18°C	60°C

.3 Maximum and minimum supply water and outdoor air temperatures shall be adjustable at graphic screen.

.4 A trim and respond algorithm shall be applied to adjust the secondary heating water setpoints, as determined by outdoor reset. The DDC shall pool the heating request at 5 minutes interval. If the heating requests are above the heating request setpoint initially set at 5 (adjustable), the reset temperature shall be increased by 1°C, else reduce the supply reset by 1°C.

.5 Unoccupied Mode:

.5 The secondary heating pumps shall be commanded off at the end of the occupied period.

.6 The pumps shall start if three (adjustable) or more spaces temperature falls below the unoccupied temperature setpoint initially set at 15ºC (adjustable) and stop when the all space temperatures are above the unoccupied temperature setpoint plus 2ºC.

.6 System Graphics

.1 System graphic screen shall indicate the complete equipment layout with all inputs, outputs, setpoints, and alarms as well as minimum and maximum setpoints temperatures and unoccupied temperature setpoint. Provide navigation buttons to main menu, associated trends and screens as well as to heating season calendar. All setpoints shall be adjustable at graphic screen.

.7 Alarms

.1 Alarms shall be provided as follows:

Alarm	Alarm Source	High Limit	Low Limit
Supply Water Temp. Extreme	SWT Sensor	SP + 3°C	SP - 3°C
Pump Failure	Motor status	-	-

.8 Trends

.1 Provide 300 sample trends, for each system, at 15-minute intervals as applicable, for the following points/variables:

Point	Trend Type
Outdoor Air Temperature	Polling
Minimum Room Temperature	Polling
Maximum Room Temperature	Polling
Unoccupied Temperature Setpoint	Polling
Sec Pump P-2 Status	Polling
Hot Water Supply Temperature	Polling
Hot Water Return Temperature	Polling
Heating Valve Command	Polling

.9 Run Time Logs

.1 Run time totalizers shall be provided as follows:

Pump P-2 Status

1.7 SCIENCE WING AND LODGE RADIANT PANELS CONTROL

.1 General

.1 There are (26) Airtex radiant panels in the Science Wing and (6) in the Lodge installed along the perimeter windows walls and a cabinet heater installed at the main entrance. The radiant panels shall be provided with a 2-way open/close hot water valves and shall be controlled based on room temperature sensor located in the area served by the radiant panel.

.2 DDC contractor shall replace all radiant panel control valves with same size control valves with open/close actuators. Control wiring shall also be replaced.

.2 Start-up:

.1 Radiant panels shall operate during occupied hours based on the occupancy schedule for the area.

.3 Morning Warm-up Mode:

.1 The radiant panel shall be in occupied mode when the associated circulating pump is in warm-up mode.

.5 Occupied Mode:

.1 DDC system shall open/close the radiant panel heating valve as required to maintain the occupied setpoint temperature initially set at 22.5ºC. This setpoint shall be adjustable at the local temperature sensor and on the operator workstation graphic screen.

.6 Unoccupied Mode:

.1 DDC system shall cycle the associated radiant panel heating valve as required to maintain the unoccupied setpoint temperature initially set at 15ºC (adjustable).

.7 Alarms

.1 Provide the following alarms:

Alarm	Alarm Source	High Limit	Low Limit
Space Temperature Extreme	RMT Sensor	SP + 2°C	SP - 3°C

A time delay of 20 minutes shall be provided to avoid nuisance alarms caused by changes of state or normal temperature recovery period.

.8 System Graphics

.1 Radiant panels shall be indicated in a floor plan graphic screen complete with room temperature, setpoint and valve position. All setpoints shall be adjustable at graphic screen.

.2 Provide a table showing all radiant panels with room temperatures, setpoints, valve position along with supply and return water temperature, mixing valve position and pump status.

.9 Trends

.1 Provide 300 sample trends for each radiant panel, at 15-minute intervals as applicable, for the following points/variables:

Point	Trend Type
Room Temperature	Polling
Room Temperature Setpoint	Polling
Heating Valve Command	Polling

1.8 SCIENCE WING AIR HANDLING UNIT CONTROL

.1 General

.1 AHU-1 is a constant flow air handling unit with mixing air dampers, hot water heating coil, circulation pump, and supply air fan. The unit is installed in the attic area fan room and provide tempered make-up air to the central stairway area of the building.

.2 Start-up:

.1 The air handling unit(s) shall operate in occupied hours based on a system specific weekly schedule subject to the global holiday calendar or whenever fume hood fan EF-1 is energized.

.2 If proper operation is not established after a time delay an alarm shall be annunciated at the operator's workstation. On a supply fan failure alarm, the mixing dampers shall be set to full recirculation.

.3 Morning Warm-up / Optimal Start:

.1 The system shall incorporate a heating optimal start routine that shall start the unit at the latest possible time to have the space at the setpoint at the weekly schedule start times.

.2 The outdoor air damper shall be allowed to fully close during the warm-up period.

.3 The optimal start period shall be limited to a maximum two hours operation.

.4 Occupied Mode:

.1 AHU-1 shall run continuously during occupied periods.

.2 Once supply fan operation is confirmed, the mixing air dampers shall modulate in sequence (split range control) with the heating coil valves to maintain the supply air temperature setpoint. Supply air temperature setpoint shall be reset from 13°C to 32°C as required to maintain a space temperature of 22.5°C (adjustable).

.3 The economizer shall be enabled on a call for cooling and when the outdoor air temperature is 2°C below the return temperature and disabled when the outdoor air temperature is equal to the return air temperature.

.4 Mixing dampers shall be controlled based on system start-up ramp, mixed air low limit (freeze protection), supply air temperature control (split range), and minimum damper position.

.5 When the economizer is disabled the mixing dampers shall move to the minimum outside air damper position set at 30% (adjustable). The mixing damper position shall be overridden to maintain a minimum mixed air temperature of 10°C.

.6 When fume hood exhaust fan EF-1 is energized the dampers are positioned to provide 100% (adjustable) outdoor air.

.7 The heating coil valve shall modulate open only when the mixing dampers have moved to the commanded minimum outside air damper position.

.8 The heating coil pump shall start and run continuously on a heating coil valve command above 15%. The heating coil pump shall stop when the heating coil valve is closed for 10 minutes continuously. The pump shall run continuously when the outdoor air temperature is below 3°C.

.9 Low limit temperature thermostat with manual reset (freezestat) installed after the heating coil is hardwired to shutdown the supply air fan. The freezestat auxiliary contact shall indicate an alarm to the DDC system. On freezestat alarm the DDC system shall close the outdoor air damper, start the heating coil circulating pump, and fully open the heating coil valve.

.5 Unoccupied Mode:

.1 During unoccupied mode the supply air fan shall be off and the outdoor air damper closed.

.2 When the outdoor air temperature is below 4°C, the heating coil valve shall modulate to maintain a minimum mixed air temperature of 10°C. Above 4°C the heating coil valve shall be closed.

.6 Fire Mode

.1 The DDC system is interfaced with the fire alarm panel. A signal from the fire alarm panel shall shut down the air handling unit.

.7 Alarms

.1 Provide the following alarms:

Alarm	Alarm Source	High Limit	Low Limit
Supply Temperature Extreme	Supply Temp Sensor	SP + 5°C	SP - 5°C
Low Mixed Air Temperature	MAT Sensor	-	< 6°C
Supply Fan failure	Fan Motor status	-	-
Freezestat Alarm	Freezestat Contact	-	-
Heating Coil Pump Failure	Motor status	-	-

.2 Adequate time delay shall be provided to avoid nuisance alarms caused by changes of state or normal temperature recovery period.

.8 System Graphics

.1 System graphic screen shall indicate the complete equipment layout with all inputs, outputs, setpoints, and alarms.

.2 Provide navigation buttons to main menu, associated trends and screens. All setpoints shall be adjustable at graphic screen.

.9 Trends

.1 Provide 300 sample trends, at 15-minute intervals as applicable, for the following points/variables:

Trend 1:

Point	Trend Type
Supply Air Temperature	Polling
Supply Air Temperature Setpoint	Polling
Outdoor Air Temperature	Polling
Return Air Temperature	Polling
Lobby Temperature	Polling
Mixed Air Temperature	Polling
Mixing Damper Command	Polling
Heating Valve Command	Polling

Trend 2:

Point	Trend Type
Supply Air Temperature	Polling
Supply Air Temperature Setpoint	Polling
Space Temperature	Polling
Space Temperature Setpoint	Polling
Mixed Air Temperature	Polling
Supply Fan Status	Polling
Heating Valve Command	Polling
Heating Coil Pump Status	Polling

.10 Run Time Logs

.1 Run time totalizers shall be provided as follows:

Supply Fan Status
Heating Coil Pump Status

1.9 SCIENCE WING DRY LAB FUMEHOOD EXHAUST FAN EF-1 CONTROL

.1 General

.1 Exhaust fan EF-1 is located in the attic area and connected to the dry laboratory's fume hood.

.2 Start-up and Operation

.1 EF-1 is energized via a manual switch, located besides the fume hood that provides an input to the DDC control system.

.2 When the switch is set to the "ON" position the DDC system shall start the AHU-1 supply fan to provide 100% outdoor air. When air flow is proven by the air pressure switch the DDC system energizes EF-1.

.3 Alarms

.1 If proper operation is not established after a time delay an alarm shall be annunciated at the operator's workstation.

.4 System Graphics

.1 EF-1 shall be indicated on the AHU-1 graphic screen. System graphic screen shall indicate the complete equipment layout with all inputs, outputs, setpoints, and alarms.

.5 Trends

.1 Provide 300 sample trends, at 15-minute intervals as applicable, for the following points/variables:

Point	Trend Type
Exhaust Fan EF-1 Command	COV
Exhaust Fan EF-1 Status	COV
Fumehood Switch Status	COV
AHU-1 Supply Fan Status	COV
AHU-1 Damper Position	Polling
AHU-1 Supply Air Temperature	Polling
Lobby Temperature	Polling

.6 Run Time Logs

.1 Run time totalizers shall be provided as follows:

Exhaust Fan EF-1 Fan Status

1.10 SCIENCE WING WASHROOM EXHAUST FAN EF-2 AND EF-5 CONTROL

.1 General

.1 Exhaust fan EF-2 serves Women's Washroom and EF-5 serves Men's Washroom. The exhaust fans are located in the ceiling space.

.2 Start-up and Operation

.1 EF-2 and EF-5 shall operate continuously during the scheduled occupied periods of the building.

.3 Alarms

.1 If proper operation is not established after a time delay an alarm shall be annunciated at the operator's workstation.

.4 System Graphics

.1 EF-2 and EF-5 shall be indicated on the AHU-1 graphic screen. System graphic screen shall indicate the complete equipment layout with all inputs, outputs, setpoints, and alarms.

.5 Trends

.1 Provide 300 sample trends, at 15-minute intervals as applicable, for the following points/variables:

Point	Trend Type
Exhaust Fan EF-2 Command	COV
Exhaust Fan EF-2 Status	COV
Exhaust Fan EF-5 Command	COV
Exhaust Fan EF-5 Status	COV

.6 Run Time Logs

.2 Run time totalizers shall be provided as follows:

Exhaust Fan EF-2 Fan Status
Exhaust Fan EF-5 Fan Status

1.11 LODGE HEATING PUMP P-4 CONTROL

.1 General

.1 Secondary heating pump P-4 circulates temperate hot water to the Lodge heating system. A 3-way valve modulates to maintain the supply water temperature.

.2 Most lodge zones are heated by cast iron hydronic radiators with thermostatic valves. Temperature sensors shall be installed throughout the lodge for remote monitoring and P-4 control.

.2 Start-up:

.1 The secondary heating water system shall operate based on a weekly schedule for the spaces allowing the heating water pump to shutdown during unoccupied periods. Pump P-4 shall run continuously if the outdoor air temperature is below 5ºC (adjustable).

.3 Optimum Start Mode:

.1 A heating optimum start algorithm shall be implemented to start the pumps at the latest possible time to bring the building temperature to the occupied setpoint at the beginning of occupancy.

.2 Optimum start shall be based on the average of all new lodge room temperature sensors.

.4 Occupied Mode:

.1 The hot water circulating pumps shall start during occupied periods if the outdoor temperature is lower than 18ºC (adjustable) for more than 15 minutes and disabled at +2ºC differential or on a heating request from more than (3) (adjustable) spaces.

.2 The radiant hot water supply temperature setpoint shall be reset according to outdoor air temperature as follows:

OAT	Supply Water Temp
-10°C	85°C
18°C	40°C

.3 Maximum and minimum supply water and outdoor air temperatures shall be adjustable at graphic screen.

.5 Unoccupied Mode:

.1 The secondary heating pumps shall be commanded off at the end of the occupied period.

.2 The pumps shall start if the temperature in one of the monitored spaces temperature falls below the unoccupied temperature setpoint initially set at 15ºC (adjustable) and stop when the all space temperatures are above the unoccupied temperature setpoint plus 2ºC.

.6 System Graphics

.1 System graphic screen shall indicate the complete equipment layout with all inputs, outputs, setpoints, and alarms as well as minimum and maximum setpoints temperatures and unoccupied temperature setpoint. Provide navigation buttons to main menu, associated trends and screens as well as to heating season calendar. All setpoints shall be adjustable at graphic screen.

.7 Alarms

.1 Alarms shall be provided as follows:

Alarm	Alarm Source	High Limit	Low Limit
Supply Water Temp. Extreme	SWT Sensor	SP + 3°C	SP - 3°C
Pump Failure	Motor status	-	-

.8 Trends

.1 Provide 300 sample trends, for each system, at 15-minute intervals as applicable, for the following points/variables:

Point	Trend Type
Outdoor Air Temperature	Polling
Minimum Room Temperature	Polling
Maximum Room Temperature	Polling
Sec Pump P-4 Status	Polling
Hot Water Supply Temperature	Polling
Hot Water Return Temperature	Polling
Heating Valve Command	Polling

.9 Run Time Logs

.1 Run time totalizers shall be provided as follows:

Pump P-4 Status

1.12 LODGE HEATING RADIATORS CONTROL

.1 General

.1 There are 28 radiators and 6 ceiling radiant panel valves in the Lodge. Radiators are controlled by an integral thermostatic valve and the ceiling radiant panels are controlled by electric thermostats.

.2 The radiant panel valves shall be replaced with new 2-way open/close valves and controlled by the DDC system. Existing electric thermostat shall be replaced by a new DDC temperature sensor. The radiant panel valves shall be controlled as described for the Science Wing radiation panels.

.3 Temperature sensors shall be installed in the zones served by the radiators for remote monitoring and pump P-4 control (see above) only. The radiators shall continue to be controlled by their thermostatic valves.

.2 Start-up and operation:

.1 The radiant ceiling panel valves shall be controlled in the same manner as the radiant ceiling panels for the Science Wing.

.2 Radiators shall operate as controlled by the integral thermostatic valve as adjusted by the occupants.

END OF SECTION