.1 General

.1 The Mechanical Consultant shall submit to UVic, Facilities Management a design philosophy for the proposed building mechanical and plumbing systems. Major components of the philosophy must be accepted in principle by Facilities Management prior to the Construction document stage. Any deviations from the prescribed guidelines must be approved in writing by UVic Facilities Management.

.2 Consultants are expected to produce designs that meet User needs and allow Facilities Management to continue to meet those needs in the future in a safe efficient manner.

.3 Drawings shall show all mechanical and plumbing equipment in elevation or isometric in details when required. Ensure mounting heights for the equipment are specified. Consider maintenance access and function as part of the design. No mechanical room layout will be accepted with poor or difficult access for maintenance.

.4 For new buildings, connection to the campus heating mains for primary heating or back-up only shall be discussed and agreed to with Facilities Management. As of 2010 the source of heat to the campus heating mains is four natural gas fired boiler plants (with backup diesel fuel for the largest plant).

.5 The buildings within Ring Road and many of the larger buildings outside Ring Road are primarily heated by the campus mains heating system. Each building has a heat exchanger (or heat exchangers) to separate the campus heating water from the building heating water. The design was based on campus heating water entering the heat exchangers at 115^{o}C (240^{o}F) and leaving at 93^{o}C (200^{o}F) and the building water leaving at 93^{o}C (200^{o}F) (or 88^{o}C (190^{o}F) for the oldest buildings) and returning at between 71^{o}C (160^{o}F) and 82^{o}C (180^{o}F) (or 66^{o}C (150^{o}F) and 77^{o}C (170^{o}F) for the oldest buildings). However the campus mains typically run at about 111^{o}C (232^{o}F).

.6 The campus mains may in future run at a lower temperature. Design of new heaters in existing buildings to provide the required heating with a heating water inlet temperature of 82^{o}C (180^{o}F) or lower and design all new buildings served by the campus heating mains with a maximum building heating water supply temperature of 82^{o}C (180^{o}F) or lower. All design temperatures to be discussed with FMGT.

.7 The installation of rooftop equipment shall avoid placement within “Control Zones” (the area between an unguarded edge of a building or structure and a line which is set back a safe distance of at least two meters).

.8 FMGT Operations shall be consulted in the design and layout of all Mechanical Room and service spaces as the end user of the facility.

.9 Obtain parts supplier lists from FMGT Operations. Only products available through these suppliers shall be specified for:

- .1 Plumbing
- .2 HVAC
- .3 Fire Protection

.2 Mechanical Cooling

.1 UVic buildings are generally not air conditioned for occupant comfort. Where conditions require mechanical cooling, submissions for variance from this guideline shall be made as part of the initial submission of project design philosophy.

.3 Sustainable Design

.1 The University is committed to working towards reducing its negative impact on the environment. That includes consuming less energy and reducing CO_2 and other environmentally harmful emissions. It also includes all initiatives that have been identified in such programs as LEED.

.2 The Consultant shall determine from Facilities Management the extent to which a new building or a renovation should incorporate environmentally friendly measures in the mechanical systems. Even if there is no plan to participate in a LEED or other program, the consultant shall give due consideration to incorporating all practical measures to achieve sustainable mechanical systems. This is acknowledged as a complex balance between capital and life-cycle costs, functionality, dependability, consistence with existing systems, material and equipment, proven performance, flexibility in operation, flexibility to accommodate future changes, simplicity, operability, maintainability, visual and audible impact, use of natural resources, impact on the environment and perhaps other important issues for a given system.

.3 The Consultant shall provide a list during schematic design of the intended sustainable measures that will be taken for a project. The consultant shall also list other sustainable measures that are recommended or suggested even though they may initially exceed the scope of the project for consideration by Facilities Management.

.4 Systems shall be designed to minimize the use of municipal water and to preserving ground water conditions.

.5 Systems shall be designed to minimize consumption of electrical power and fossil fuels. Electrical resistive heat shall be avoided.

.6 Systems shall be designed to minimize emissions to air, water and ground.

.4 Existing Systems

.1 An acceptable schedule for interrupting existing systems and services must be arranged in advance with Facilities Management. A minimum of 48hrs notice shall be the expected timeframe for service shut-downs.

.2 Existing services may be shut down or placed back in service only by Facilities Management shop personnel.

.3 Arrange work to minimize the duration of the shut down of any existing services.

.4 Protect systems from contamination and protect areas outside of combustion zone.

.5 Mechanical Rooms

.1 Coordinate with Architect to locate Mechanical Rooms in areas accessible from outdoors. Confirm that sufficient space is provided to remove largest piece of equipment from the Mechanical Room.

.2 Where rooftop mechanical rooms are designed, stairway or elevator access to the roof is mandatory, to suit service and maintenance requirements.

.3 Provide full perimeter containment wells encompassing DHW or other water tanks / storage equipment with adequate drainage.

.6 Acceptable Products

.1 Obtain a list of mechanical parts suppliers from Facilities Management. Specify matching products. This includes but is not limited to the following areas:

.1 Plumbing.
.2 Fire Protection.
.3 HVAC.

.7 Site Services

.1 Avoid running site utilities through or under buildings. Exceptions must be accepted in advance by Facilities Management.

.8 Operation and Maintenance Manuals

.1 Coordinate requirements with Section 1.4.

.2 Plumbing and Mechanical Sections shall be separated.

.9 Record Drawings

.1 Record drawings shall be electronic AutoCAD drawings and electronic pdf format drawings and must comply with Industry Standard.

.10 Electric Motors

.1 Open drip-proof except where service requires different.
.2 Specify high or premium efficiency.
.3 Specify inverter duty where driven by variable frequency drive.
.4 Motors less than 1/2 hp shall be 120/1/60. Motors 1/2 hp and larger shall be three phase.

.11 Belt Drives

.1 Specify multiple belt drives with matching belts on 3/4 hp motors and larger.
.2 Adjustable bases with adjusting screws for alignment and belt tension.
.3 Specify variable pitch motor sheave only up to 7.5 hp.
.4 Motor sheaves shall be steel or cast iron.
.5 Drives shall be selected for minimum 150% of motor hp.
.6 Do not specify synchronous belt drives.

.12 Drive Guards

.1 Specify means to permit lubrication and use of test instruments with guards in place.

.13 Unprotected Fan Inlets or Outlets

.1 Guards or screens, removable for servicing.

.14 Spare Parts

.1 Specify provision of the following spare parts:
  .1 One set of belts for each drive.
  .2 One set of filter media for each filter or filter bank in addition to final operating set.

.15 Automatic Drains

.1 Automatic air vents, relief vents and any automatic drain from a closed piping system shall be located in an accessible location where the drainage can be readily and easily observed. Where the source of the drainage (e.g. automatic air vent) cannot be easily observed, that drain shall be clearly labelled to indicate the type and location of the source.

.1 General

.1 All plumbing shall comply with the BC Plumbing Code.

.2 Avoid th**e** use of storm pumps and sanitary sewer system pumps if possible. Design within reasonable limits to ensure that all areas possible are drained by gravity systems.

.3 All necessary storm and sanitary pumps shall be tied into emergency power, and sump levels shall be monitored electronically through the B.A.S.

.4 All sanitary sumps within buildings must have gas tight covers and be vented to outdoors.

.5 Floor drains connected to sump pumps must have backflow valves.

.6 Do not use floor drains in private washrooms, specify only in public washrooms and where automatic flushing devices are used.

.7 Review acid waste requirements with Facilities Management.

.8 Confirm that all plumbing equipment requiring annual or more frequent maintenance is readily accessible. Provide minimum 900mm clear around equipment.

.9 Specify curbs and house keeping pads under equipment and around pipe penetrations in Mechanical rooms.

.10 Where solar collectors are planned or contemplated, consult with Facilities Management for approval of concept. Panel locations shall be readily accessible for maintenance.

.11 Backflow prevention is required on all primary water supplies into buildings.

.2 Non-Potable Water

.1 Wastewater from the Outdoor Aquatic Facility (an aquaculture facility south of the Cunningham Building) is cleaned and chlorinated and piped around a portion of the campus. It is available for non-potable use which primarily to 2010 has been used for flushing water closets and urinals. There is sufficient capacity for this use for many more buildings. Facilities Management has a set of guidelines for its use and the design of the system (requires pumping, a small open storage tank and municipal water make-up with air gap to the tank). Even if the Treated Water is not being extended to a new building, consideration should be given to piping the water supply piping to the water closets and urinals separately from the rest of the building domestic water piping so retrofitting Treated Water in the future does not require re-piping the building domestic cold water. Note that the best use is for central heavily used washrooms; it may not be practical to extend piping to a single, distant, low-usage fixture.

Determine with Facilities Management whether the Treated Water or piping for future use should be included in the project.

.3 Acid Waste

.1 The Elliott, Petch and Cunningham buildings each have an acid waste piping system. There is a UVic laboratory policy of not putting any unacceptable waste down drains. As of 2010 the issue of whether laboratory plumbing renovations should connect to that system with acid resistant piping or non-acid resistant piping is under review. In the meantime all connections to these systems shall be with materials designed for acid waste. For each project, confirm in advance of design the status of that decision.

.2 Do not specify plastic piping for use in building except for acid waste systems.

.3 All buried acid wastes system piping shall be glass type.

.4 Salvage

.1 UVic does not have extensive storage facilities for salvaged material. Typically the Plumbing Shop will wish to have salvaged plumbing sinks and trim in good condition and laboratory gas outlets and turrets from benches or fume hoods. Glass acid waste piping and fittings has also typically been salvaged.

.2 On renovation projects the Consultant shall submit a list of items to be considered for salvage to Facilities Management at the start of the design stage. The Consultant shall coordinate with Facilities Management to determine all materials to be salvaged and the roles of the Plumbing Shop and contractor in the work of salvage which shall then be clearly specified.

.3 Sometimes Plumbing Shop prefers to use its own forces to remove the material to be salvaged in advance of the construction contract. Other times they prefer the Contractor to remove the materials and store them on site for the Shops to remove.

.4 All materials to be salvaged shall carefully removed and stored to prevent damage and the contractor shall obtain a signed receipt from the Plumbing Shop for all salvaged materials.

.5 Sleeves

.1 Specify Schedule 40 steel pipe sleeves at points where pipes pass through masonry, concrete or fire rated assemblies and at Mechanical Room floor penetrations to stories below.

.2 Sleeves shall have an annular fin continuously welded at midpoint where passing through foundation walls.

.3 Specify fill for voids around pipes.

.4 Caulk between sleeve and pipe in foundation walls and below grade floors with waterproof, fire retardant, non-hardening mastic.

.5 Where sleeves pass through walls or floors, provide space for fire stopping. Where pipes/ducts pass through fire rated walls, floors and partitions, maintain fire rating integrity. Ensure there is no contact between copper tube or pipe and ferrous sleeve.

.3 Escutcheons

.1 Specify escutcheons on pipes passing through walls, partitions, floors and ceilings in finished areas.

.2 Chrome or nickel plated brass or Type 302 stainless steel, one piece type with set screws.

.1 General System Design

.1 Use air systems in combination with perimeter radiation. Perimeter radiation shall be capable of being operated independent of the air system.

.2 Avoid all air systems.

.4 Zone mechanical systems by intended occupancy, separate interior and exterior zones.

.5 Provided reheat coils in each interior zone.

.6 All air handling units shall have heating or preheat coils even if building load indicate that one is not required.

.7 Proposed fan volume control schemes based on building static pressure must have prior approval from FMGT.

.8 Do not specify variable pitch in motion fans.

.9 Design all air handling units with minimum 15% spare volumetric and static pressure capacity.

.10 Buildings with no mechanical cooling (typical) shall have cooling circulation air increased by minimum of 25% or have sufficient volume to meet WCB requirements with respect to maximum space temperature, whichever is greater. Consider additional costs of construction and compare to cost of adding and operating mechanical cooling.

.11 Radiant heating panels shall not face windows.

.12 Provide separate exhaust to all photocopier rooms or areas. Exhaust to outdoors.

.13 Ensure sufficient air mixing within the occupied space on VAV systems under all operating conditions.

.14 VAV systems shall have reheat coils.

.15 Window mounted air conditioners and exhaust fans are not acceptable.

.16 All exhaust ductwork within the building shall be under negative pressure.

.17 Specify separate ventilation and heat recovery systems for Mechanical and Electrical rooms.

.18 Do not specify sidewall supply registers for classroom applications.

.19 Laboratory design shall meet best practices of applicable AHRAE design standards, and /or the equivalent CSA standard recognized by the BC Building Code.

.20 Return and supply fans requiring volumetric tracking shall have same type devices for volume control, i.e. inlet dampers must be only used with inlet dampers, VFD’s with VFD’s etc.

.21 If fume hood exhaust systems are located in mechanical penthouses they shall be located in separate self contained area within the Mechanical Penthouse.

.22 Where fume hood fans are contained within mechanical penthouses, pressurize the penthouse with supply air from the building from a safe outside source to avoid the possibility of recirculation exhaust air into the service space and to provide flushing of contaminants if a minor duct leak occurs. Fumes from industrial lab process shall be removed from spaces by the use of dedicated exhaust systems (not recirculation permitted).

.23 Ventilations systems shall be designed to limit bio-contamination. Spaces containing 'like-risks' can share ventilation systems, while bio and chemical ventilation systems shall be separated to avoid cross contamination.

.24 Humidification shall be applied to each specific zone which requires local control. Avoid upstream humidification and downstream dehumidification.

.2 Air Outlets and Inlets

.1 Do not specify balancing dampers at the face of air outlets and inlets. Locate balancing dampers sufficient distance into the ductwork to maintain acceptable sound level within the conditioned space. (NC 30 35 or less)

.2 Co-ordinate with architectural discipline.

.3 Outside Air Intake Louvers

.1 Locate outside air intake louvers as far away as practical from all sources of contamination; avoid locating intakes at loading docks, fume hood exhausts, generator exhausts. Outside air intake louvers are not to be located on roof tops where fume hood exhausts are located.

.2 Locate outside air intake louvers as high as possible above grade and shall not be at grade level.

.3 Where below grade intakes are unavoidable install bird/debris screen on outside of the louvers.

.4 Where roof top parapets or screening hinder effective cross ventilation exhaust discharges, plumbing stacks and other contaminated discharges shall be elevated above air intakes at a minimum distance proscribed by code/regulation and/or good engineering practices.

.4 Painting

.1 Specify corrosion resistant primer paint to ferrous supports and site fabricated work (pewter gray).

.5 Salvage

.1 UVic does not have extensive storage facilities for salvaged material. Air conditioners, motors, variable frequency drives in good condition have previously been considered for salvage. Occasionally a small fan or a fume hood in good condition has been salvaged.

.2 On renovation projects the Consultant shall submit a list of items to be considered for salvage to Facilities Management at the start of the design stage. The Consultant shall coordinate with Facilities Management to determine all materials to be salvaged which shall then be clearly specified.

.3 The Mechanical Shop prefers the Contractor to remove the materials and move them to a designated storage place on campus.

.4 All materials to be salvaged shall carefully removed and handled to prevent damage and the contractor shall obtain a signed receipt from the Mechanical Shop for all salvaged materials.

.6 Photocopier exhaust.

.1 Provide exhaust air from photocopier rooms, areas with large photocopiers (larger than a typical office copier) and areas for regular large copy production.

.1 Identification

.1 When identifying systems and components in existing buildings, the new items shall be numbered sequentially with existing systems.

.2 The Consultant shall inventory all existing equipment during the design phase and provide FMGT a comprehensive equipment listing with the proposed new labelling scheme for review and approval. Upon approval, equipment labelling requirements shall be clearly specified within the construction documents.

.2 Labels

.1 Provide laminated plastic labels with black face and white centre, 100 mm x 35 mm x 2.5 mm thickness for the following applications:
- .1 Gauges and Panels engrave with 6 mm high lettering.
- .2 Equipment and Fume Hoods engrave with 10 mm high lettering.

.3 Ceiling Access

.1 Color Coded Dots:
- .1 Provide self-adhesive color coded dots 6 mm in diameter to delineate ceiling access..

.4 Valve Tags

.1 Tags shall be 40 mm diameter brass or laminated plastic with 10 mm engraved with sequential numbering.
.2 Hang with chains from valves.
.3 Provide a valve tag list.

.5 Stenciled Letters

.1 Black stencilled letters and numbers 25 mm high, to sign painting standards.
.2 Black stencilled direction arrows shall be 175 mm long by 56 mm wide.

.6 Duct Work and Access Panels

.1 Use the system designators stated on the drawing and specification.
.2 Duct identification and direction arrows shall be located on all duct runs in Mechanical Rooms and Penthouses. Maximum distance between markings shall be 8 meters.
.3 Where ducts pass through walls or partitions identify ducts on both sides of the wall beside each access panel.
.4 Access Panels shall be identified according to function.

.7 Piping

.1 Provide painted or manufactured labels, arrows, bands as required in mechanical and service rooms for easy identification.
.2 Where pipes pass through walls or partitions identify pipes on both sides of the wall.
.3 Maximum distance between markings shall be 8 meters where exposed or above ceilings.
.4 Identify at all access panels.
.5 Identify at all valves except where otherwise clearly and easily identified.

.8 Manufacturer's Nameplates

.1 Do not paint, insulate or cover manufacturers' name plates or regulatory registration plates on equipment.

.1 General Requirements

.1 Insulation shall be installed by qualified insulation fitters.

.2 Insulation shall be installed in accordance with the requirements and recommendation of B.C. Insulation Contractors Association Manual.

.2 Campus Heating Mains

.1 This system may operate with up to 116°C [241°F] water.

.2 Provide minimum 50mm [2”] thick, mineral fibre insulation on piping (not drains) with vapour barrier jacket and where in trenches or manholes provide a generous coating of water water-proofing sealer.

.3 Mains valves 65 mm (NPS 2-1/2) and larger shall have bonnets insulated with removable insulation jackets.

.3 Refrigeration Piping (including chilled water)

.1 Where installed outdoors, provide a continuous aluminum jacket finish (to prevent birds removing the insulation).

.2 Provide closed-cell insulation and best industry practice to seal surface at all locations including hangers and exposed fittings.

.4 Insulation Finish

.1 Provide aluminum jacket over all outdoor insulation.

.2 Provide an all service jacket and pre-fitted PVC jacketed elbows and fittings for all indoor insulated pipe with the exception of:

.1 Provide a “Thermocanvas” type finish and pre-fitted PVC jacketed fittings on all piping in mechanical rooms and where exposed to occupant view.

.1 General Requirements

.1 All new ventilations systems, or those affected by the project shall be cleaned by a professional cleaning Trade Contractor with appropriate equipment and trained personnel.

.2 The following air systems shall be cleaned as specified by the Mechanical Consultant:

.1 Supply, Return, Relief, Exhaust
.2 Air Conditioning

.3 All components within each new or affected system shall be thoroughly cleaned to the Consultants satisfaction.

.4 On new construction, renovation or retrofit projects, the ductwork shall be cleaned before the air systems are balanced or calibrated.

.5 All damper positions shall be marked before cleaning and returned to their original position unless the system is to be balanced.

.6 Cleaning shall generally include high capacity power vacuum, compressed air or wire brushing. Solvent cleaning to be avoided.

.2 Filters

.1 The cleaning Contractor shall replace any temporary or existing filters and supply and install new filters as specified by the Consultant after the air system is cleaned.

.1 Campus Heating Mains

.1 All piping shall be Schedule 40 steel to ASTM A53 Grade B.

.2 All piping shall be welded except manual air vent and drain valves may be screwed and piping downstream of them may be screwed.

.3 Manual air vent and drain valves shall be ball valves with wing-type (not lever-type) handles.

.4 There shall be no high or low point in the piping between heating mains manholes. If this cannot be avoided then air vents/drains must be provided at the high/low point.

.5 Valves (other than air vent and drain valves) shall be class 150 ball valves. 150pisq/400°F. >=1 ½" must must be equipped with gear driven operator to slow speed to open valve. >= 4" to have ¾" gate bypass for warmup.

.6 For the most part these mains run underground. Where underground they shall run in a concrete trench typical in design and construction to the existing which are designed for water-tightness and to have removable lids.

.7 Mains valves, drain valves and vents shall be in accessible manholes or in building mechanical rooms.

.8 Where possible arrange take-offs for a building to be valved such that future shutdown of a section of the mains will not interrupt service to the building.

.2 Builidng Heating, Heat Recovery, and Chilled Water Piping and Valves

.1 Piping may be steel to ASTM A53 Grade B or type L copper, to ASTM B88M-86.

.2 Connections for steel pipe shall be welded and flanged on pipe NPS 2-1/2 [65 mm] diameter and larger and shall be screwed on pipe NPS 2 [50 mm] diameter and smaller.

.3 Connections for copper pipe shall be brazed with silver base brazing alloy, 538ºC [1000ºF] melting point but with soldered to screwed cast bronze fittings (to ANSI B16.18) or wrought copper fittings (to ANSI B16.22).

.4 Grooved mechanical couplings are not acceptable.

.5 Press-fit type couplings are not acceptable.

.6 Valves NPS 2-1/2 [65 mm] and larger shall be flanged. Valves NPS 2-1/2 (65 mm) and smaller shall be soldered or screwed.

.7 Butterfly valves may only be used on Heat Recovery or Chilled Water System systems or Heating Water systems where the maximum design temperature does not exceed 180°F (82°C).

.8 Balance valves shall be multiple-turn, memory stop, positive shut-off with inlet and outlet pressure connections, calibrated for flow measuring.
Acceptable Products: Armstrong CBV, Tour & Anderssen STA.

.3 Pressure Gauges

.1 Minimum 85 mm (3-1/2" diameter), with isolating cock, Imperial and S.I. units. Selected for normal working pressure is about mid-range.

.2 Dwyer magnehelic gauge across each filter bank

.4 Piped systems Cleaning

.1 For the campus heating mains, process water lines or chilled water lines, retain the services of a professional Cleaning Agency to supervise the chemical cleaning and flushing of the new piping. Facilities Management Mechanical Shop will provide the subsequent chemical treatment.

.1 Coordination Requirements

.1 Coordinate with the University of Victoria [UVic] Facilities Management – Plumbing Shop.

.2 Contact UVic Facilities Management for water supply information from the UVic water model.

.3 Coordinate verification of the sprinkler system with UVic Plumbing Shop. Contact UVic Facilities Management in advance of verification to provide opportunity for Plumbing Shop personnel to be present during verification. If a code consultant has been retained, coordinate design with their recommendations.

.2 General

.1 Submit to UVic, Facilities Management a design philosophy for the proposed building fire protection systems. Major components of the philosophy must be accepted in principle by Facilities Management before the project can proceed to Construction. Consultants are expected to produce designs that meet user needs and allow Facilities Management to continue to meet those needs in the future in a safe efficient manner.

.2 New buildings shall be fully sprinklered regardless of code requirements. Renovated facilities in fire sprinklered buildings shall be designed to maintain the fire sprinkler protection. Generally, renovated facilities in non-fire sprinklered buildings will not require fire sprinklers but may require roughed-in fire sprinkler piping to accommodate future building fire sprinklers

.3 UVic is largely self-insured and has a policy to manage risk and enhance the safety of its facilities to the benefit of faculty, staff, students, and visitors. Fire sprinkler protection at the University shall be consistent with standard industry practice with reasonable deviations to increase system longevity and provide flexibility for subsequent renovation.

.4 Clearly determine with Facilities Management in advance whether the systems will be designed under Scenario 1 or Scenario 2 of the B.C. Building Code and whether or not the services of a Code Consultant are required.

.5 NFPA Codes (latest edition) and BC Building Code shall be used to determine level of protection required.

.6 UVic campus straddles two jurisdictions – Saanich and Oak Bay. The specific jurisdiction that a particular building is in will be the Authority Having Jurisdiction.

.7 UVic's fire protection systems shall meet latest applicable NFPA codes and the Authority Having Jurisdiction policies in effect.

.8 All fire protection systems shall be designed by Consultant firms and Professional Engineers specializing in fire protection design. Mechanical Engineers wishing to undertake the designs must demonstrate that they posses fire protection design experience. The intent of this requirement is to ensure that designs not only meet the minimum code requirements but meet specific building requirements which can only be evaluated by an expert in the field.

.9 All contract documents and 'as built' drawings must meet criteria outlined in NFPA 13. All calculations must be sealed by a Professional Engineer registered in British Columbia.

.10 Provide fire hydrants to meet UVic and Saanich/Oak Bay requirements.

.11 Information on water supply available for fire fighting must be obtained through UVic Facilities Management which has a model for the UVic water system (Focus Engineering).

.12 Do not specify Halon Systems. Pre-action and clean agent systems shall only be provided where the need is coordinated in advance with Facilities Management.

.13 Coordinate with Electrical Consultant for the fire alarm panel monitoring requirements for flow switches and valves and for heat tracing and alarming of wet pipes exposed to freezing conditions.

.14 Typically conceal all piping (but not necessarily standpipe risers in stairwells). Coordinate with the Architect for chases and enclosures to conceal the piping where necessary.

.3 Final Functional Testing

.1 Certify fire systems have been tested to meet requirements of Authorities Having Jurisdiction.

.2 Insulate or conceal work only after testing and approval by the Authorities Having Jurisdictions and the Fire Protection Design Engineer and after the Plumbing Shop has been given notice and the opportunity to review.

.3 Conduct tests in presence of the Fire Protection Design Engineer and Authorities Having Jurisdiction who wish to be present.

.4 Coordinate verification of the sprinkler system with the Plumbing Shop. Contact UVic Facilities Management in advance of verification to provide opportunity for Plumbing Shop personnel to be present during verification.

.5 Test fire systems in accordance with Authorities Having Jurisdiction and as required by applicable codes.

.6 Operate all control valves to verify proper operation of the valve and associated tamper switch.

.7 Operate all test connections to verify water flow switch operation.

.8 Provide project record drawings and maintenance manuals to Facilities Management prior to building turnover.

.4 Fire Pump

.1 Design system to avoid the need for a fire pump. Specify a fire pump only where the system cannot reasonably be designed without one and only after consulting with Facilities Management.

.2 Where a fire pump is provided include a metered bypass for testing the fire pump.

.5 Painting

.1 All exposed fire protection piping and equipment shall be painted red.

.2 Specify at least one coat of corrosion resistant primer paint to ferrous supports and site fabricated work (pewter grey).

.6 System Drains

.1 System drains shall be piped to drains sufficient to handle the full anticipated flow.

.7 Building Fire Protection Water Service

.1 Provide a single combined domestic/fire protection water service to a building unless there is a compelling reason to provide two separate services.

.2 Sprinkler system drains should discharge to a sanitary sewer drain, not a storm drain.

.8 Spare Parts and Cabinet

.1 Specify spare parts to suit the critical requirements of the project.

.2 Specify the following spare parts at minimum:

.1 Sufficient numbers (minimum of 6) of spare sprinkler heads of each type used on the project.
.2 Sprinkler wrench, recessed head socket type with ratchet, to fit all sprinkler heads
.3 One set of packing and one casing joint gasket for each pump.
.4 Provide a red cabinet with name plate “SPARE SPRINKLERS” suitable for storing the spare sprinklers and wrenches.

.9 Signs

.1 Provide all control, drain and test valves with signs hung by a chain identifying the type of valve, the area (floor or portion of the building) affected by the valve and whether Normally Open or Normally Closed. Submit the wording to UVic Facilities Management for approval.

.10 Pressure Gauges

.1 Gauges shall be minimum 85 mm (3 ½”) diameter, bourdon type pressure gauge, 0-200 psi or 0 – 250 psi.

.11 Fire Sprinkler Systems/Standpipes

.1 Zone control valves may be concealed if a sufficiently sized access panel is provided to allow for maintenance and testing. Coordinate location with Facilities Management.

.2 Provide a shut off valve (to be easily accessible and visible) at the base of each standpipe riser. Do not locate in crawl space.

.3 A building with a standpipe system shall have a flow switch monitored for trouble alarm in the main to detect flow from the standpipe.

.4 Pipe shall be ferrous to NFPA 13 except drain pipe may be copper to NFPA 13. Do not use plastic piping.

.5 Flexible head drops shall not be used.

.6 Ring type hangers are not acceptable.

.7 Snap–let type fittings are not acceptable.

.8 Provide chrome plated fire hose valves in finished areas.

.12 Sprinklers Subject to Freezing

.1 Where sprinkler main piping is wet and subject to freezing, provide heat tracing connected to the fire alarm panel with high/low temperature monitoring. Coordinate with the Electrical Consultant.

.13 Dry Pipe Alarm Valve

.1 Dry pipe alarm valves, trim packages, accelerators and air maintenance devices, shall all be of the same manufacturer.

.14 Inspector’s Test and Drains

.1 For each zone provide an inspector’s test and drain in a lockable panel, cage or room not subject to vandalism. The discharge shall be into a drain riser on multi-storey buildings.

.1 Cross Connection Control

.1 Cross connection control shall be carried out in accordance with the Capital Regional District Bylaw No. 3516 which references CSA Standard B64.10 – 2007.

.2 Following installation, a test report completed by a certified tester shall be submitted to the Owner, indicating satisfactory operation of each device.

.3 Tests are to be conducted well in advance of date of Substantial Completion.

.4 Provide one repair kit for every cross connection control device installed.

.5 Dual premise backflow preventers are required on primary water supplies into the building. Design must include means of testing equipment on an annual basis without shutting down the building water supply. Equipment shall be installed in accessible location or appropriate access facilties provided (ie. platforms).

.6 Specify backflow preventers as required by BC Plumbing Code and the Capital Regional District Bylaw No. 3516 which references CSA Standard B64.10 - 2007.

.7 Specify strainers for all domestic water systems upstream of the premise backflow preventers.

.2 Trap Primers

.1 Past experience with many types of manufactured trap primers has resulted in the conclusion that they are not all reliable.

.2 Provide trap priming for all floor drains and for hub drains where it is likely that low or intermittent usage will allow the trap to lose its liquid seal.

.3 Proceeding from most preferred to least preferred, consider a DDC controlled control valve system of trap priming with backflow prevention a manufactured electronic trap priming system (e.g. Zurn Z-1020) with backflow prevention for a single trap where a regularly used plumbing fixture is close by, a Zurn Z-1022 trap primer with a fixed air-gap accessory for a single trap where a regularly used plumbing fixture is not close by, a Precision Plumbing Products Model P-1 trap primer adjusted for a continuous slow drip.

.4 Locate trap primers where they are easily serviced (janitor rooms, mechanical rooms, under counters and use unions and isolating valves to facilitate replacement.

.3 Cold Water Pressure Booster Systems

.1 If any project requires a booster system consult Facilities Management for water supply details.

.4 Isolation Valves

.1 Provide isolation valves as close as practical to each fixture for each group of plumbing fixtures:
- .1 At each main branch supply point.
- .2 At each piece of equipment.
- .3 As required by the applicable codes and bylaws.

.5 Drain Valves

.1 Specify at low points and at section isolating valves unless otherwise specified.

.2 Ball valves, NPS 3/4 with male hose end and cap for small quantity drainage. NPS 1-1/2 for large (zone) quantity drainage with removable reducer to male hose end and cap.

.1 Plumbing Piping Type

.1 Domestic water piping shall be type L hard drawn copper tubing to ASTM B88 or type L copper pipe to ASTM B42.

.2 Fittings shall be copper to ASTM B16.18, brass to ASTM B16.22, press type, or mechanical formed tee type (T-Drill).

.3 Do not specify flexible drainage piping.

.4 Do not specify ABS or PVC pipe under traffic areas with less than 30” cover.

.2 Piping Tests

.1 Provide a hydrostatic test on all new piping at 1380 kPa (200 psig) for 8 hours.

.1 Plumbing Fixtures - Public

.1 All plumbing fixtures at UVic are considered “Public” except for those that are in individual residential suites (e.g. cluster housing, family housing, don suite in a student residence) which are referred to as “Private”.

.2 Water Closets
- .1 Wall Hung
- .2 Acceptable Manufactuers: American Standard, Crane, Toto
- .3 Seats: Bemis or equivalent
- .4 Trims: Hands Free, Stainless Steel, by Delta Commercial, Sloan or Toto
- .5 Capacity: 6 lpf maximum, processing a minimum of 500g of solids in accordance with MaP standards as issued by Veritec Consulting Inc. And Koeller and Company

.3 Urinals:
- .1 Acceptable Manufactuers: American Standard, Crane, Toto
- .2 Capacity: 6 lpf maximum
- .3 Waterless urinals are not acceptable.
- .4 Trims: Hands free, stainless steel, by Delta Commerical, Sloan or Toto

.4 Lavatories
- .1 Vitreous China
- .2 Acceptable Manufactuers: American Standard, Crane, Toto
- .3 Trims: Hands free, by Delta Commerical or Sloan

.5 Power for the hands free controls shall be building power (on standby power where provided for that building). Battery-powered units are not acceptable even where automatic recharging is included in the fixture.

.6 Showers:
- .1 Field constructed (tile)
- .2 Solid surface (acrylic)
- .3 All accessible showers and all showers in lockable rooms shall be grouted under the base to prevent deflection. Grout by general contractor.
- .4 Accessible shower trim shall be compliant with CSA B651.

.7 All fixtures shall be white and colour-matched (there is a variety of whites) where within a single room.

.8 All washroom fixtures within the building shall be, where possible, of the same manufacturer.

.9 Specify water conserving type of fixtures and trim.

.10 Provide a chrome plated, hot and cold hose outlet under the lav counter (preferably in the Male washroom) for each group of Public washrooms. Standard of acceptance: Delta 28T8183.

.2 Plumbing Fixtures – Private

.1 “Private” plumbing fixtures are those that are located in washrooms that serve only a single residential suite, e.g. cluster housing, family housing, don suite in a residence building. Common washrooms for a group of student residence rooms are considered “Public”.

.2 Water closets

.1 Tank Type; Floor mounted
.2 Capacity: 6 lpf maximum, processing minimum 500g of solids
.3 Color: White
.4 Seat: Closed front; white
.5 Trims: Stainless Steel
.6 Acceptable Manufacturers: American Standard, Crane, Toto

.3 Lavatories
.1 Vitreous China; manufacturers: American Standard, Crane, Toto
.2 Trims: Single lever, brass body. Acceptable manufacturers are Delta, Moen, Crane.

.4 Showers
.1 Field constructed (tile)
.2 Solid surface (acrylic)
.3 All accessible showers and all showers in lockable rooms shall be grouted under the base to prevent deflection. Grout by general contractor.
.4 Accessible shower trim shall be compliant with CSA B651.

.3 Accesible Water Closet

.1 Accessible water closets shall provide suitable back support for the user
.1 Water closet with tank – provide bolted connection for lid to tank and ensure tank design is suitable to act as a support.
.2 Water closet without tank – provide a toilet seat with adequately positioned wall support to provide support to the user.
.3 Acceptable Product: Crane – Hymont 3701 / Hymont Jr. 3816 / A.S. Madera.

.4 Janitorial Plumbing Fixtures

.1 Sinks: Moulded stone, floor mounted type, 600 mm x 900 mm.

.2 UVic will provide an automatic cleaning solution dispenser. Provide a separate ½" RPBA water connection with backflow prevention for chemical soap connection.

.3 The faucet shall be reinforced and be complete with a pail hook. The mixing of hot and cold water shall be manual.

.4 Standard of acceptance for the sink is Fiat MSB 3624. Acceptable manufacturer: Williams

.5 Standard of acceptance for the faucet is Delta 28T-2383.

.5 Food Services

.1 Standard of acceptance for trims: T&S Brass

.6 Laboratory Plumbing Fixtures

.1 Most existing laboratories constructed or renovated before 2009 have Tech/Cambridge Brass trim with corrosion resistant finish. More recently (when that finish was no longer available) Tech/Cambridge Brass trim with chrome finish has been used or WaterSaver. This trim includes water faucets, compressed air and gases outlets both inside fume hoods and wall or counter mounted except that chrome finish has not been used in fume hoods.

.2 Where a renovation requires only a very few fixtures and there are others remaining, check with the Plumbing Shop to determine if they have in stock matching trim available to be used for the renovation. If not, evaluate the relative corrosion potential for the installation

and select trim to match the existing with chrome finish unless the corrosion potential is high and in that case select WaterSaver with suitable finish.

.3 Trim for sinks are typically hot and cold gooseneck type with type handles except for ADA trim which shall have blade handles, vacuum breaker and tapered, barbed nozzles except sometimes aerator type outlets for wash-up sinks. Many outlets had aspirators in the past but consideration shall be given to compressed air aspiration (check with Facilities Management). Some sinks require distilled/deionised water outlets. They are typically gooseneck type.

.4 Laboratory sinks are typically 316 stainless steel with counter-top flange (although with suitable counter and where coordinated with the Architect, under-counter mount is acceptable), no ledge-back, cross strainer outlet. Standard of acceptance Aristaline Acceptable manufacturers are Architectural Metal Industries, Franke, Steel Queen

.7 Emergency Fixtures

.1 Emergency water at all emergency showers and eyewashes supply shall be tempered and not exceed to Max 20° C.

.2 Emergency showers/eye wash stations shall have ‘stay open’, hand controlled valves.

.3 Emergency showers/eye wash stations shall each have a floor drain plumbed in, complete with trap primers.

.4 Eye wash shall be specified as eye wash only not face and eye wash combination.

.5 Emergency shower/eye wash isolating valves shall not be readily accessible to the user.

.6 All eyewash and emergency showers shall be provided as per WCB requirements.

.7 All plumbing fixtures and trim used in handicapped accessible locations shall comply with the British Columbia Building Code

.8 Drinking Fountains

.1 All buildings over 600 gross square metres shall have at least one accessible drinking water fountain, located in a public area. The drinking fountain should include an appropriate fixture for filling water bottles.

.2 Drinking water fountains shall not be cooled.

.3 Drinking water fountains shall not have filters (no backflow preventers will be required).

.4 Drinking water fountains shall only be located inside buildings at level 1 entrance lobbies and should be visible from the exterior.

.1 Roof Drains

.1 Consider possible roof deflections when positioning roof drains. Do not locate drains near beams and columns which tend to become high spots on flat roofs with minimum slopes.

.2 Provide minimum of two (2) roof drains to all major roof areas as insurance against clogging and flooding (e.g., two at 75 m diameter preferred even if 1 at 100 mm diameter will do).

.3 Where roof areas are enclosed by parapet walls, coordinate with Architect for provision of scuppers for relief in emergency flooding situations as per the B.C. Plumbing Code.

.1 Pumping of Sewage

.1 Sewage pumping systems are undesirable and every reasonable effort must be made to design a building project that incorporates gravity sewerage systems. If, however, gravity systems are not possible then do the following:

.2 All portions of the building that can be gravity drained shall be gravity drained.

.3 Provide a high water alarm through the BMS.

.4 Where a source of emergency power is available pumps and controls shall be connected to emergency power.

.5 All floor drains at or below the flood level of sewer pump sump shall have backwater valves.

.2 Pumps Seals

.1 Specify mechanical seals compatible with intended service on all pumps

.1 General

.1 Water heaters with storage capacity of 180 L or less and heating capacities of 4.5 kW or less may be electric and shall have a drain pan piped to drain.

.2 For larger tanks and heating capacity, the heat source shall be the campus heating mains. The maximum required domestic hot water temperate shall be 60°C [140°F]. Where hotter domestic water is required it shall be boosted from 60°C [140°F] using a heating source other than the campus heating mains. Natural gas or other service over electric is preferred. Temporary hot water source [140°F] for low occupancy periods (ie summer break) should be installed to accommodate central heating plan shutdowns for maintenance service.

.3 For tanks heated by campus heating mains and where interruption of domestic hot water service is particularly problematic (e.g. food services, laboratories), provide two brazed-plate, double-wall heat exchangers in parallel with isolating valves so one can be removed for cleaning while the other remains in service. Otherwise provide a single brazed-plate, double-wall heat exchanger. Consider multiple 450L glass-lined, insulated storage tanks or single stainless steel tank.

.2 DHW Recirc Automatic Flow Valves

.1 Domestic hot water recirculation valves shall be pressure independent constant flow, factory set, stainless steel. Standard of acceptance: Griswold standard flow cartridge.

.2 Select valves flow settings for minimum flow required to maintain warm water throughout the system and size the recirculation piping and pump accordingly.

.3 DHW Recirc

.1 Provide sufficient balancing valves to ensure adequate flow through each domestic hot water recirculation branch to maintain hot water.

.2 DHW recirculation pump controls on the DDC with return water temperature sensor point.

.1 Distilled and deionized Water Systems

.1 In each of the Elliott and the Cunningham buildings there is a distilled water system. PVC piping shall be used to extend or modify the system.

.2 In the Petch building there is a deionised water (reverse osmosis) system. It is a loop with constantly circulating water. Extension or modification shall maintain the single loop flow. Single pipe branches to outlets shall be kept as short as practical. Modify or extend with PVC.

.3 FMGT will coordinate any temporary shutdowns of the existing systems as required.

.3 Where users provide purifiers, pipe the distilled water to them.

.4 Use distilled water compatible outlets/faucets.

.2 Compressed Air

.1 Use copper for compressed air piping.

.1 General

.1 Main Campus Loop – Industrial type, minimum boiler efficiency of 85%; gas fired.

.2 Off Campus Loop – Condensing boiler (if supply water temperature demands permit); minimum life span – 20 years.

3. Minimum life span to exceed 25 years (industrial grade) for greater than 250,000 btu/hr burner rating (input).

.1 Mechanical Cooling

.1 Some spaces require mechanical cooling because of equipment heat gain or process driven requirements.

.2 Air cooled split systems or evaporating type condensers (closed or open) using treated water for make-up may be used. Systems using municipal water or other portable water (pass through cooling) are not acceptable.

.3 Packaged roof-top equipment is generally not acceptable.

.4 Units with modulating cooling capacity are preferred (e.g Mitsubishi variable refrigerant flow, inverter compressors).

.5 Consider heat pump units instead of cooling only. Multi-zone heat pump systems must have master controls that communicate with the BAS.

.6 For a new building consider a centralized cooling system with chilled water if numerous spaces (present or future) are anticipated to require cooling.

.7 Refrigerants shall not be CFC or HCFC type. R134a, R407c and R410a refrigerants are acceptable. For low temperature refrigeration R507 is acceptable.

.1 Ductwork

.1 All ductwork shall be metal, typically galvanized steel. Flexible ductwork is not acceptable.

.2 Fume hood duct shall normally be 18 gauge, 316 stainless steel, continuously welded. Exceptionally corrosive situations may require more corrosion resistant materials.

.3 Flexible duct of 300 mm maximum length is acceptable only on a horizontal branch duct to an individual diffuser to allow alignment with the ceiling grid. It may provide a maximum of 15 degrees change in direction. No flexible duct shall be used for diffuser necks.

.4 Ductwork shall be to SMACNA standards excluding beaded, crimp joints and snaplock seams. Adjustable elbows must be the same gauge as the adjoining duct and only used if all sectional joints are sealed and secured in the installed position.

.5 Ducts shall be sealed to SMACNA Seal Classification A or B as appropriate for the rated working pressure.

.6 Specify access panel each side of heating coils.

.7 Specify filter protection of heat recovery coils.

.8 Motorized control dampers are strongly preferred over backdraft dampers.

.9 Balance dampers of same material as the ductwork and shall have bushing-type bearings and a quadrant operator capable of locking the damper in a fixed position.

.10 Avoid ductwork acoustical liners. Employ other methods acceptable to FMGT.

.1 Heat Exchangers

.1 Heat exchangers using Campus Heating Water or any service over 82ºC [180ºF] shall be brazed plate type (not gasketted, plate-and-frame type).

.2 Heat exchangers for domestic hot water heating shall be double-wall brazed plate type.

.3 Heat exchangers for hydronic systems with water temperature 80ºC [180ºF] or below may be plate and frame or brazed plate type.

.4 Heat exchangers anticipated to be in year-round service shall be installed as a pair each having 60% of design capacity and each with valves and unions so as to be removable without interfering with the operation of the other. This allows removal for replacement or cleaning. Duplex heat exchangers for domestic hot water heating shall only be considered where interruption of domestic hot water would be very disruptive (e.g. laboratory use, food services use).

.5 Provide a two-way control valve on the campus mains return from the heat exchanger. Provide a 20 mm (NPS 3/4) heat exchanger by-pass between the campus mains supply and return with a modulating control valve (c_v between 1.5 and 2.0), a throttling valve and isolation valves.

.6 The building heating water pumps shall be designed either with duplex pumps or with valves and piping that can provide back-up in the event of failure of any one pump.

.7 The heating coils should be on a separate heating water circuit from radiation to allow for different scheduled temperature control.

.8 Provide flexible piping connectors on all piping conections. Standard of acceptance: Flextech Style FB26-TF.

.9 Provide isolating valve, pressure gauge, thermometer, temperature sensor on each pipe connection.

.10 Standard of acceptance: Alpha Laval Brazed Plate – Model CB200

.1 Outdoor Air Handling Units

.1 Select for long-life, weather tightness, good quality.

.2 Standard of Acceptance: Haakon, Scott Springfield or equal.

.3 On large units include a service corridor or mechanical (non-plenum) room for controls.

.4 Include over-head lifting point for motors 7.5 hp and larger.

.5 Variable frequency drives are required where variable volume control is required.

.6 Pilot lights on plenum light switches.

.7 Quality plenum door hardware.

.8 Exterior doors lockable and keyed to suit appropriate UVic mechanical access key.

.9 Weather louvres preferred to exterior hoods.

.10 Electrical power and controls wiring in EMT conduit.

.11 Typically locate air handlers in Mechanical Rooms. When necessary locate outdoors. Coordinate access to equipment with Architect. Typically full stairway access is required to Mechanical Rooms and to roof top equipment with paver walkways across roof and around equipment to protect roofing. Coordinate railings/fall protection with Architect.

.1 Centrifugal Fans

.1 Bearings: Heavy duty pillow-block, grease lubricated ball or roller self aligning type, minimum life of AFBMA L-10 80k or AFBMA L-50 400k.

.2 Extend grease nipples to exterior of guards.

.3 Sound power levels to AMCA 311.

.4 Statically and dynamically balanced, constructed in conformity with AMCA 99.

.5 Ratings: based on tests performed in accordance with AMCA 211, and ASHRAE 51.

.6 Units shall bear AMCA certified rating seals.

.1 Filters

.1 Filters for service rooms, protection of heat recovery coils or for small air handling units (less than 500 l/s) shall be minimum MERV 8. Standard of acceptance is 50 mm thick AAF AM-AIR 300. Acceptable product is Farr 30/30.

.2 Filters for air handling systems over 500 l/s shall be a combination of a MERV 8 pre-filter and a MERV 13 final filter unless user requirements stipulate a higher value. Pre-filter standard of acceptance: 100 mm thick AAF AM-AIR 300, acceptable product: Farr 30/30. Final filter standard of acceptance, 100 mm thick AAF AM-AIR Varicell II, acceptable product: Farr Econocell.

.3 Preference for pre-filter bank to be slide-in type. Final filter bank shall be built up from gasketted, individual filter frames with spring clips.

.4 Separate filter gauge for each filter bank. Standard of acceptance: Dwyer Series 2000.

.5 Design for suitable access for changing filters.

.1 Fume Hoods

.1 Design and install fume hoods to comply with recognized authorities (CSA, ASHRAE) as prescribed in Part 6 of the BCBC. Perform risk assessment to determine if fume hood and/or cabinets (including bio safety) should be connected to emergency power.

.2 Ductwork shall be stainless steel type 316, 18 ga minimum, 2B finish except No. 4 finish where in exposed occupied spaces and shall be suitable for the gas and/or vapours carried from source to exhaust fan. Strong corrosive fumes may attack stainless steel and other materials may need to be specified.

.3 Ducts from fume hoods shall be routed to the roof of the building as directly as possible for discharge above the re-circulation cavity boundary of the structure.

.4 Horizontal ducts shall be kept to a minimum and shall be graded up in direction of air flow.

.5 Exhaust fans shall have interior surfaces in contact with the air stream coated with a chemical resistant coating.

.6 Canvas or any other flexible connections are not acceptable on the discharge side of the fan.

.7 Provide control handles on the exterior of the fume hood for all fume hood services.

.8 New fume hoods shall have flow monitors/alarms as per CSA standards.

.9 Avoid sound attenuators on fume hood exhaust fans. Select fans with lower sound level instead.

.1 General

.1 The control system shall be fully electric / electronic except for remaining existing pneumatic controls. Special applications may require pneumatic activation.

.2 All controls work shall be done by one of the following Reliable Controls Corporation representatives:
- .1 Foster Air Conditioning Ltd.
- .2 Houle Electric Ltd.
- .3 Kerr Controls Inc.

.3 All products used shall be manufactured by Reliable Controls Corporation or where they do not manufacture required products the products used shall be as recommended by Reliable Controls Corporation for incorporation into their controls system.

.4 All work shall be consistent with the latest University of Victoria standards for controls systems including all hardware, software and graphics. The specified controls contractors are expected to be fully conversant with those standards and shall allow for all measures required for the specified work to meet those standards

.5 Provide modifications to the control system complete with all necessary components and connections to achieve the specified functions.

.6 Include for any required expansion of the existing DDC system to accommodate the required additional control inputs and outputs. All new outputs shall each have an integral HOA toggle switch.

.7 New controls panels shall be the MACH Series controllers designed and built by Reliable Computer Systems. New controllers shall have a minimum 10% spare points. Controllers must be capable of communicating with RCP protocol on both main and sub network as well as BACnet.

.8 The control system and all controllers and hardware shall be BACnet Testing Laboratories (BTL) certified.

.9 All control panels and components (except valves, dampers and sensors) shall be located in the mechanical rooms or in service rooms or spaces as acceptable to Facilities Management.

.10 Program a trend log and, where appropriate, totalization for each point.

.11 The Mechanical Consultant shall coordinate with the Electrical Consultant which systems shall be hard-wired under the electrical documents to shut down in the event of detection of a fire.

.2 Existing Controls

.1 Most of the older buildings have pneumatic controls but almost all have a central DDC system that was retrofitted in the 1990's. When these buildings are renovated, replace the local pneumatic controls within the renovation area and provide all new controls within the renovation area with compatible electronic sensors, actuators and control valves controlled by the DDC system. Provide additional control panel capacity as required for the controls. Note the requirement for new controls outputs to have an HOA switch on each output. Modify the controls sequence to suit. Update the controls graphics to include all new and modified controls.

.2 Remove all reasonably accessible redundant pneumatic tubing and all redundant pneumatic controls components and tightly cap all remaining pneumatic tubing ends.

.3 Remove all reasonably accessible redundant controls conduit, wiring and equipment.

.4 The long term objective is to eliminate the pneumatic controls except where required for special applications.

.3 Alarms

.1 Software alarms shall be identified as regular or critical. Critical alarms shall be connected from the DDC system to the campus alarm system for monitoring and response by Campus Traffic and Security.

.4 Identification

.1 Label and identify all panels and points with a numbering system consistent with UVic's DDC network numbering system.

.2 Identify all controls with symbols relating directly to the control diagram. Use plasticized tags, engraved brass, aluminum, metalphoto or laminated plastic labels and secure them to, or adjacent to, the control devices with key chains.

.3 Identify all junction box covers with control company label. Paint junction box covers to UVic standard colour.

.4 Identify with colour bands, all conduits at all junction and pullboxes, at both sides of wall and floors and at not more than 7.5 m [25 ft] intervals along the length. Identification bands to be sprayed on and not less than 100 mm [4"] wide. Bands shall be colour to UVic standard.

.5 Use colour coded conductors, white for neutral.

.6 All manual switches, unless they come with standard nameplates, shall be labelled with engraved plastic laminate nameplates to clearly indicate the service. Wording on nameplates shall be subject to approval by Facility Management.

.7 Identify all DDC panels and associated devices with symbols relating directly to the control diagram. Provide plastic labels for each input and output point with the following information:
- .1 Point descriptor.
- .2 Point type and channel number.
- .3 Corresponding DDC panel number.

.8 Mount an input/output layout sheet within each DDC panel. This sheet shall include the name of the points connected to each controller.

.2 Graphics and points acceptance procedures

.1 A copy of each graphical screen page both new and modified existing shall be signed off and dated by the Controls Contractor and Facility Management's representative. Any changes shall be noted. This signed set shall be left on site as the "Record Drawings".

.2 A summary print out of each group of point types for each panel shall be printed after commissioning and calibration. Each sheet shall be signed by the Controls Contractor's commissioning person, and Facility Management's representative.

.3 If any changes are noted during spot checks they shall be manually written on the original print out with the date and signature of person noting changes.

.3 Testing and Commissioning

.1 The Controls Contractor shall comprehensively commission and test all components and functions of the controls system and provide documentation to verify.

.2 Consider whether the system warrants a comprehensive seven day test.

.4 Demonstration to Owner

.1 The Controls Contractor shall demonstrate to Facility Management's designated personnel the adjustment, operation and maintenance, including pertinent safety requirements, of the controls equipment and system provided to the satisfaction of Facility Management's representative.

.5 Electrical Components, Wiring and Conduit

.1 Carrier System:
- .1 All wiring for 24 volts or less in mechanical service spaces, in stud walls or where exposed to view shall be run in EMT conduit except wiring to all operators and to all sensors subject to vibration shall be run in flexible metallic conduit for the final 900 mm [3 feet].
- .2 Provide conduit for all wiring between the fire alarm panel and the DDC panels.
- .3 All wiring for over 24 volts shall be run in EMT conduit.
- .4 Provide steel fittings with nylon throats for all conduit connections.

.2 Wire:
- .1 Line voltage power or switched power wiring - #12 gauge copper wire minimum.
- .2 Line voltage control wiring - #14 gauge copper wire, length not to exceed 50 meters; #12 gauge copper wire, lengths exceeding 50 meters.
- .3 Low voltage - wire as directed by applicable electrical codes and requirements but minimum #20 gauge.

.3 Cable: Data transmission cable shall be minimum Cat. 5e cable.

.6 Temperature Sensors

.1 Room temperature sensors in staff areas (non-student, non-public areas) - two-wire type with up/down temperature adjust.

.2 Room temperature sensors in student or public areas – no user interface input.

.7 Control Valves and actuators

.1 Standard of acceptance: Belimo ball valve, B200 series with stainless steel ball and characterizing disc in the inlet of 2-way valves and in the control ports of 3-way valves.

.2 Consider whether spring return or fail to last controlled position is desired for each valve.

.3 Acceptable Products: Johnson Controls, Honeywell

.8 Control Dampers

.1 Low leakage type with blade and frame seals.

.2 Blades shall be horizontal in vertical mounted dampers.

.3 Acceptable Products: Ruskin CD-36, TAMCO Series 1000 (T.A.Morrison), Johnson Controls, Honeywell.

.4 Control valves on campus heating mains shall be selected to operate continuously at 121°C (250°F).

.9 Control Damper Actuators

.1 Electric/Electronic Damper Actuators:
- .1 Actuators shall be direct coupled.
- .2 Spring return.
- .3 Acceptable Products: Belimo.

.10 Standby Power

.1 Consider whether the controls system should be on standby/emergency power, or UPS when central applications are controlled or the equipment being controlled is on emergency power. Consider the impact of power transfer to the control system and whether a UPS system is appropriate.

.11 Controls Points

.1 Provide current sensors for all motor-driven equipment except small fan-coils, unit heaters, force flow heaters, washroom exhaust fans for individual washrooms, and other minor, non-critical equipment.

.2 Monitor supply air temperature downstream of every VAV box with a heating coil.

.3 Determine in advance with Facilities Management whether every office should have its own independent temperature control or if offices are to be grouped under a single temperature control.

.4 Monitor the building incoming domestic water pressure before the premise backflow prevention and after the building prv.

.5 Provide pressure differential monitoring across major air filter banks.

.6 Provide differential pressure or current sensors across pumps.

.7 Provide an independent output for each of the return air damper, the outdoor air damper and the relief damper on mixed air systems.

.8 Monitor all equipment remote alarm contacts.

.9 For variable frequency drives provide output to control ON/OFF and speed and monitor ON/OFF status, run speed, alarm contact

.10 Provide ON/OFF control for all motor-driven equipment unless manually operated.

.11 Provide control and operating schedule for DHW recirc pumps.

.12 Provide hard wired low-temperature shutdown (freeze protection) for air handling systems and monitor its status.

.13 Generally provide control of all mechanical equipment but not to override or replace integral equipment controls and safeties (e.g. boiler enable/disable but not burner ON/OFF).

.14 Monitor the temperature of any electrically freeze-protected piping or equipment.

.15 Monitor the status of regular/emergency/standby electrical power.

.16 Monitor status of automated glycol make-up systems and glycol tank level alarm.

.17 Monitor closed pipe systems pressure at or hydraulically near the expansion tank.

.18 Monitor DHW temperature. Where DHW heating is by heating water, control the heating.

.19 Monitor the pneumatic controls air pressure.

.20 Monitor campus heating mains water temperature to and from the building heat exchanger and monitor the flow to it to provide energy monitoring and totalization. Consider use of manufactured energy monitoring equipment.

.21 Provide a campus mains two-way control valve in the return from the building heat exchanger.

.22 Provide a small control valve (c_v between 1.5 and 2.0) between the campus mains supply and return pipes (prevent thermal shock if main valve closes for extended period).

.23 Provide temperature monitoring of the building heating mains and of each individually pumped heating circuit.

.24 Provide alternating control of duty and standby equipment.

.25 Monitor all mass and energy meters provided with contacts for remote monitoring.