# Division 00 Procurement and Contracting Requirements

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**Division 28 Electronic Safety and Security**

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</table>
1.0 GENERAL

1.1 SECTION INCLUDES:

.1 Words, Terms and Communications.
.2 Complementary Documents.
.3 Specification grammar.
.4 Applicable Codes
.5 Cooperation & Coordination
.6 Storage, Handling & Protection
.7 Transportation
.8 Owner Supplied Materials
.9 Weather Conditions
.10 Workers
.11 Conduct of Personnel
.12 Publicity
.13 Accessibility for the Disabled
.14 Utilities
.15 Trademarks & Labels
.16 Responsibility

1.2 RELATED MATERIALS

.1 Section 01 11 00 Summary of Work
.2 Section 10 14 00 Room Numbering
.3 This section describes requirements applicable to all sections within Divisions 01 to 33.
.4 Section 33 00 10.1 SFU MMCD Infrastructure Data Standards

1.3 WORDS, TERMS AND COMMUNICATIONS

.1 In this document the following definitions/abbreviations appear in italics:

**SFU Facilities** means the Building Operations department of Simon Fraser University

**SFU** means Simon Fraser University, and unless noted otherwise, means Building Operations.

**Consultant** means the person identified as such in the request for Tenders and Tender Form and as defined in CCDC2-2008.

**Project Manager** means the person identified as such in the request for Tenders and Tender Form.
Owner means Simon Fraser University.

For definitions of commissioning terms, refer to Section 01 91 00 Commissioning.

.2 SFU PROJECT NUMBERS
.1 SFU assigns project numbers to all project work. Without exception SFU project numbers must appear on all correspondence and documents prepared for or sent to SFU.

.3 LINES OF COMMUNICATION
.1 All information from the University regarding the contract, such as specific instructions of the Owner, requirements and changes during construction will be issued through the SFU Facilities. The SFU Facilities shall be kept advised at all times of all informal contact and discussions between the Consultant and/or the Contractor with other staff of SFU. SFU will not be responsible for any circumstances which may arise from instructions, information and approvals having been obtained from SFU through channels other than the above.

.4 CORRESPONDENCE
.1 The Contractor shall submit correspondence to the Consultant unless otherwise instructed. Should the Contractor feel that the matter requires immediate action by SFU, then a copy of the correspondence may be sent directly to SFU Facilities.

1.4 COMPLEMENTARY DOCUMENTS
.1 Generally, drawings indicate graphically, the dimensions and location of components and equipment. Specifications indicate specific components, assemblies, and identify quality.
.2 Drawings, specifications, diagrams and schedules are complementary, each to the other, and what is required by one, to be binding as if required by all.
.3 Should any conflict or discrepancy appear between documents, which leaves doubt as to the intent or meaning, refer to the General Conditions in the contract documents.
.4 Examine all discipline drawings, specifications, schedules, diagrams and related Work to ensure that Work can be satisfactorily executed.
.5 All specification sections of the Project Manual and Drawings are affected by requirements of Division 01 sections.

1.5 APPLICABLE CODES, STANDARDS, REGULATIONS
.1 In the absence of other standards being required by the Contract Documents, all work is to conform to, or exceed the minimum standards of the B.C. Building Code, SFU Infrastructure Data Standards, City of Burnaby Engineering Design Criteria, the Canadian Standards Association, the Fire Safety Act, the Workers’ Compensation Board of British Columbia, National Fire Protection Association, Canadian Electric Code, B.C. Plumbing Code, Factory Mutual Engineering, Underwriter’s Laboratory of Canada, B.C. Fire Code Regulations, and the standards of manufacturers of material supplied for this project, whichever is/are applicable.
Wherever standards are referred to in the specifications, the latest edition of the standard shall apply at time of Bid except where such editions have not been adopted by B.C. Building Code.

The following regulations and plans are to be adhered to for all projects: University Act, Fisheries Act, BC Greenhouse Gas Reduction Target Act, and the City of Burnaby-Burnaby Mountain Conservation Area Community Plan.

If required by the Consultant the manufacturer/supplier or Contractor shall furnish documentation indicating compliance with the requirements of the B.C. Building Code including where required, certification by an Engineer registered in the Province of British Columbia.

SFU Policies and Regulations must be adhered to and include but are not restricted to the following (Complete listing of SFU Policies can be found at http://www.sfu.ca/policies.html):

- GP 16 No Smoking Policy
- GP 17 University Occupational Health and Safety
- GP 22 Fire Safety
- GP 25 Response to Violence and Threatening Behavior
- GP 38 Sustainability Policy
- GP 42 Risk Management
- GP 43 University Energy Utilization Policy
- GP 18 Human Rights Policy
- AD 1.03 Parking, Mobility and Vehicle Traffic
- AD 11.21 Ethical Procurement Policy
- SFU 2021 Sustainability Vision and Goals
- SFU 2021 Strategic Energy Management Plan

Any work shown on the drawings or described in the specifications which is at variance with the applicable codes shall be brought to the attention of the Consultant.

SFU Facilities requires SFU Infrastructure Data Standards (modified from MMCD Infrastructure Data Standards) for all the Utility design work & submission. All the documents & packages can be found at:
https://vault.sfu.ca/index.php/s/GQO5n1r4dUvTwcW

Additional documentation and training videos can be found on https://apw.retrieve.com/#/ to create an account to access.

In no instance shall the standards established by the drawings and specifications be reduced by any of the applicable codes.

1.6 COOPERATION AND COORDINATION

Coordinate the work of sub-contractors with efficient and continuous supervision.

Work orders are the formal method that project and projects managers communicate with SFU Facilities.

Cooperate with SFU authorities and other Contractors engaged in simultaneous development of adjacent facilities. Coordinate access to the site, the location, removal or adjustment of temporary fences, sheds and utility services.

Coordinate the work of each trade to ensure that such work is consistent with the requirements for the work of a following trade.
Before commencing any work, each trade must report any inconsistency between the work of a preceding trade and the requirements for their work. Any costs incurred by the Contractor or trades to rectify such inconsistencies shall be at no expense to the Owner.

The Contractor shall coordinate the work of all trades requiring suspension or fixing devices to be incorporated into the structure. Where required, such suspension or fixing devices are to be built into the structure and/or by of the type specified or detailed herein, the Contractor shall submit to the Consultant details of the device he proposes to use accompanied by such information as the Consultant may require to assess the capability of the proposed device.

### 1.7 STORAGE, HANDLING AND PROTECTION

1. Handle and store products in manner to prevent damage, adulteration, deterioration and soiling and in accordance with manufacturer's instructions when applicable.

2. Store packaged or bundled products in original and undamaged condition with manufacturer's seal and labels intact. Do not remove from packaging or bundling until required in Work.

3. Store products subject to damage from weather in weatherproof enclosures.

4. Store cementitious products clear of earth or concrete floors, and away from walls.

5. Keep sand, when used for grout or mortar materials, clean and dry. Store sand on wooden platforms and cover with waterproof tarpaulins during inclement weather.

6. Store sheet materials and lumber on flat, solid supports and keep clear of ground. Slope to shed moisture.

7. Store and mix paints in heated and ventilated room. Remove oily rags and other combustible debris from site daily. Take every precaution necessary to prevent spontaneous combustion.

8. Remove and replace damaged products at own expense and to satisfaction of Consultant.

9. Touch-up damaged factory finished surfaces to Consultant’s satisfaction. Use touch-up materials to match original. Do not paint over name plates.

### 1.8 TRANSPORTATION


2. Transportation cost of products supplied by Owner will be paid for by Owner. Unload, handle and store such products.

### 1.9 OWNER SUPPLIED MATERIALS

1. The Contractor is responsible for scheduling delivery of items supplied by the Owner as required to maintain the construction schedule.

2. The Contractor is also responsible to check materials as they are delivered and to notify the Project Manager immediately through the Consultant of any materials supplied by the Owner that do not meet specified standards or are received in damaged condition.
1.10 WEATHER CONDITIONS

.1 All sections of work shall include in their tender an allowance sufficient to cover full, continuous working operation through normal weather conditions, without interruptions or shutdowns.

1.11 WORKERS

.1 All work shall be performed by skilled mechanics, experienced in their trade; according to rules and customs of best trade practices for first class work and to the various standards recommended and specified.

.2 Construction Force: The Contractor shall provide and maintain, in full operation at all times during the performance of the contract, a sufficient crew of labourers, mechanics and foremen to execute the work.

1.12 CONDUCT OF PERSONNEL

.1 Sexual Harassment

.1 There is a great deal of sensitivity on the campus regarding sexual harassment. Sextist and/or racist comments or actions may be reported to the Campus Security and lawsuits or human rights complaints could be filed.

.2 Specific examples of actions that are considered offensive with zero tolerance by the University under the Policy would be:

.1 calls or audible comments directed at or about passersby, particularly regarding physical or sexual attributes,

.2 prolonged staring by individuals or groups,

.3 whistling or catcalls, or

.4 throwing items at or in front of passersby in order to gain their attention.

.3 Refer to the latest version of SFU’s Sexual Violence and Misconduct Prevention, Education and Support Policy for further details.

.2 Smoking: SFU has a NO SMOKING policy in all work areas except in specified rest areas which are specifically designated as smoking areas.

.3 Grooming: SFU retains the right to restrict and control the clothing worn by, and the grooming of, employees, Consultants or visitors to the campus where these may conflict with health and safety considerations and regulations.

1.13 PUBLICITY

.1 All publicity relating to the Project is subject to the approval of the Owner and no mention of the project in advertising or articles in any publication will be permitted unless approved in writing through the Owner. Publicity or advertising implying endorsement of a product, Contractor or Consultant will not be permitted.

.2 Barriers shall not be put in the way of disabled people in and around campus facilities (ie. unnecessary steps, narrow aisles etc.) Disabled refers to the visually impaired as well as the physically disabled.
1.14 UTILITIES
1.1 Contractor shall be responsible for capping, plugging, disconnecting, relocating or divertive all utilities interfering with construction operation. If the Contractor discovers unidentified utilities, the Contractor shall:
   .1 Contact SFU Facilities.
   .2 Provide a drawing outlining proposed changes.
   .3 Obtain approval from SFU Facilities before commencement of work.
1.2 SFU Infrastructure Standards details and links can be found in Part 1.5.7.
1.3 All contractors and consultants shall contact SFU Facilities Services for all utility information before starting any work.

1.15 TRADEMARKS AND LABELS
1.1 Trademarks and labels, including applied labels shall not be visible in the finished work. Such trademarks or labels shall be removed by grinding if necessary, or painted out where the particular materials are being painted. The exception of this requirement shall be those essential to obtain identification of mechanical and electrical equipment and where required by Code to ensure compliance.

1.16 RESPONSIBILITY
1.1 The Contractor shall assume full responsibility for laying out the work and ensuring it does not conflict with the work of other trades, and for any damage caused to the Owner or other Sub-contractors by improper location or carrying out of the work.
1.2 If more than one interpretation can be taken from the specification or drawings regarding labour, material, or equipment, notify the Consultant immediately for clarification. If clarification cannot be obtained, consider the most costly alternative to apply. No allowance will be made for a tender based on the lesser.
1.3 The dimensions given on the drawings of the existing work are approximate and the Contractor must take actual measurements before ordering materials, equipment and the like. Failure to comply with the requirement will make the Contractor fully responsible for replacing such material or equipment at no extra cost to the contract.
1.4 Prior to the submission of shop drawings and/or the installation of work to be performed, promptly advise the Consultant of any specified equipment, material, or installation which appears inadequate or unsuitable or in violation of applicable codes.

***END OF SECTION***
SPEC NOTE: This Section is intended to include basic identification of work, type of Contract, work by others or Owner which affect this Contract, work sequence, pre-ordered Products and similar work not readily identifiable from Contract Documents. This section relies on provisions of CCDC2 2008 General Conditions. This section and highlighted parts in particular should be edited as applicable to each project.

1.0 GENERAL

1.1 SECTION INCLUDES

.1 General description of Work.
.2 Contract Method.
.3 Work by Owner or Other Contractors.
.4 Assigned Contracts
.5 Work sequence.
.6 Contractor use of premises.
.7 Owner occupancy.
.8 Partial Owner occupancy.
.9 Products ordered in advance.
.10 Owner furnished products.

1.2 RELATED SECTIONS

.1 Section 01 31 00 Project Management and Coordination
.2 Section 01 32 16 Construction Progress Schedule
.3 Section 01 35 16 Alteration Project Procedures
.4 Division 27 Communications
.5 Division 28 Electronic Safety and Security
.6 Appendix: - Additional information of work and products by others to be incorporated in Project.

1.3 WORK COVERED BY CONTRACT DOCUMENTS

.1 Work of this Contract consists of architectural, structural, plumbing, mechanical and electrical work to (brief descriptive summary of Project), and comprises in general:

.1 Construction of new (brief description)
.2 Addition to (brief description)
.3 Renovations of (brief description)
.4 Demolition of (brief description)

.2 The Work is more particularly described in the Contract Documents

1.4 CONTRACT METHOD / COMPLETION

.1 Construct the Work under a single lump sum fixed price contract.

.2 Complete the Work so as to be certifiable by the Consultant as having attained Substantial Performance on or before (Date, or state: time proposed).

.3 The Contractor shall work closely with the SFU Project Manager, Owner’s forces carrying out Owner’s work, as well as Other Contractors engaged by the Owner to carry out related work.
.4 The Contractor is required take the leading role in the organizing, scheduling and coordinating all of the work for an efficient and speedy completion. Scheduling of the Work is the responsibility of the Contractor. Coordinate scheduling of the Work with the Project Manager.

.5 The contractor shall create a site plan for all projects including laydown, traffic flows and muster areas.

.6 Provide sufficient labor and materials to complete the Work within the time required for each construction phase, as well as to meet overall completion within the Contract Time. Any required overtime and similar costs to complete the project by the agreed completion date is included in the Contract Price.

.7 All parties shall cooperate and resolve disputes so as not to affect progress of the Work. The Contractor shall take remedial action to correct and make up any default, as the work progresses.

.8 Arrange and carry out the Work so as to maintain access and exits; avoid conditions of unacceptable noise, dust, and appearance; minimize disruption to SFU operations.

.9 The Owner’s requirement to maintain SFU operations takes precedence over the Contractor’s requirements.

1.5 WORK BY OWNER OR OTHER CONTRACTORS

.1 Refer to the General Conditions of the construction contract. All trades to confirm proper interface and coordination prior to proceeding with related work.

.2 WORK BY OWNER: Work of Project which is specifically excluded from this Contract and which will be carried out by the Owner simultaneously with the Work under this Contract:

.1 SFU will

.1 supply and install required Utility Services to project site up to point of connection as designated by SFU Facilities, for connection by the Contractor and putting into service by SFU Facilities, as follows:

.1 Domestic Water
.2 Sanitary
.3 Storm
.4 Gas
.5 Electrical

.2 Campus Security Locksmiths will

.1 remove construction cylinders and supply and install final keyed lock cylinders in hardware provided by this Contract.
.3 SFU Safety and Risk Services will supply and install the following Division 28 Electronic Safety and Security systems, including electronic devices and components and Division 28 Electronic Safety and Security wiring up to point of interface connection as designated by SFU Safety and Risk Services:

.1 Burglary Alarm
.2 Access Control
.3 CCTV

.2 All related Division 26 power, pathway and rough-ins and Section 08 71 00, 2.1.3 Electrified Hardware installation are to be provided by other under this Contract.

.3 Division 28 Electronic Safety and Security wiring to be provided by others under this Contract.

.4 SFU IT Services will:

.1 supply and install the following, including system electrical devices and components and low voltage wiring and cabling:

.1 Data Systems

.2 Central RF Systems (This includes CCTV & CATV “cablevision” Systems)

.3 Central Demarcation connections, (Demarc Outlets), for centrally “other” centrally controlled and/or monitored systems up to point of interface connection as designated by the Contractor for connection and commissioning by the contractor and verification by SFU IT Services. These systems include:
- Building Automation System (BAS)
- Master Hydro Utility Meters
- Fire Alarm System transponders
- Bell System
- Master Clock System
- Elevators
- Security & Access Control System panels

.2 However, all related pathways and rough-ins are to be provided under this Contract.

.3 WORK BY OTHER CONTRACTORS: Work of Project which is specifically excluded from this Contract, for which the Owner has awarded or will be awarding separate contracts and which will be carried out by Other Contractors simultaneously with the Work under this Contract. Regardless of scope of work by other contractors, the project General Contractor shall coordinate with other contractors, as well as SFU Project Managers to minimize disruption and maximize efficiency:

.1 Items or work specifically shown or scheduled on Drawings, or specified to be supplied and/or installed by Others
.2 SEPARATE CONTRACT #1: A Signage Contractor(s) to supply and install interior and exterior signage. All required backing for mounting of signage, power supply, and final electrical connection required by the signage company shall be provided under this Contract.

.3 SEPARATE CONTRACT #2: A Furniture Contractor(s) to supply and install furniture and furniture accessories.

.4 SEPARATE CONTRACT #3: (description of work, name of firm, contacts, etc.)

.5 SEPARATE CONTRACT #XX: to be issued by Addendum if applicable.

.4 OWNER-SUPPLIED PRODUCTS: Work of this Project includes the coordination, as well as the installation unless otherwise noted, of products including Owner-supplied equipment shown, scheduled, specified or identified in Contract Documents as NIC (Not-in-Contract) or similar designation.

1.6 ASSIGNED CONTRACTS

.1 Owner has awarded the following pre-tendered Subcontractor contracts to expedite the Work or for other purposes in the Owner’s interests. General contractor will coordinate work with all subcontractors while working with SFU closely:

ASSIGNED SUBCONTRACT #1: (description of work and name of subcontract firm, contacts, etc., or delete this clause entirely)

ASSIGNED SUBCONTRACT #XX: to be issued by Addendum if applicable.

.1 The Contractor is to assume these pre-tendered contracts and incorporate all of this work and costs in the Base Bid Price, and execute a Subcontractor agreement with the designated subcontractor on execution of the Owner/Contractor Agreement.

.2 At the Contractor’s request, assigned Subcontractors to:

.1 Furnish to Contractor, bonds covering faithful performance of subcontracted work and payment of obligations thereunder.

.2 Purchase and maintain liability insurance to protect Contractor from claims for not less than limits of liability which Contractor is required to provide to Owner.

.2 Owner has awarded the following preordered product contracts to expedite the Work or for other purposes in the Owner’s interests:

ASSIGNED PRE-ORDERED PRODUCT CONTRACT #1: (description of product/equipment and name of firm supplying, contacts, etc., or delete this clause entirely)

ASSIGNED PRE-ORDERED PRODUCT CONTRACT #XX: to be issued by Addendum if applicable.
On submitting the Bid Offer, the Bidder will have ascertained all conditions and complete details of the work included and to be carried out under these assigned contracts from the assigned firms.

The Total Contract Price includes any additional overhead and profit, and other work and costs required, to make the work of these assigned contracts fully compatible with the Work of these Contract Documents.

### 1.7 WORK SEQUENCE

.1 It is intended that the construction work proceed in a phased and organized manner which minimizes disruption to SFU operations.

.2 The Contractor shall prepare a preliminary and proposed sequence of construction and construction schedule, for presentation at a First Project Meeting (refer to Section 01 33 00 Submittal Procedures) for review and acceptance in principle by the SFU Project Manager. The Contractor shall revise the proposed sequence schedule as directed for final acceptance by the SFU Project Manager, before commencement of on-site construction work.

.3 The finalized schedule shall clearly define:

   .1 the phasing of the work
   .2 the limit of construction work during each phase and sub-phase, including location of barriers, hoarding, and covered ways
   .3 the duration of each phase
   .4 the sequence of construction within each phase to co-ordinate the work of all trades, that of Owner, and that work under other contracts.
   .5 baseline start dates, finish dates, and task durations.
   .6 detail level of work shall be broken down so that no task noted on the schedule is greater than 2 weeks.

.4 The Contractor shall provide monthly project schedule updates, both in hard copy and electronic form. Electronic format shall be Microsoft Project 98 or later. The schedule update shall detail:

   .1 task actual start, duration, and completion dates.
   .2 percent complete of each task.
   .3 critical tasks, task linkages, and order/delivery dates for major equipment components.
   .4 all approved change orders, linked to the approved tasks, with notes on schedule impacts, if any.

.5 The Contractor, all subcontractors and suppliers of material required for the Work will expedite and proceed with the Work so as to conform to the agreed schedule and phases.
.6 Any float (also described as “slack” or “cushion”) that exists in the Construction Schedule (as to the overall Contract Time and as to parts of the Work) does not belong exclusively to the Owner or exclusively to the Contractor, but rather will:

.1 firstly, be used for and applied to obviate any delay or extension of time otherwise provided for in the Contract, including any delay or extension of time otherwise provided for or described in the schedule, or that would otherwise result from a Change Order or Change Directive / Site Work Order, or any other delay or extension of time that the Contractor would otherwise be entitled to, and despite any provision of the Contract allowing for delay or extension of time the Contract Time will not be delayed or extended to the extent that float is available at the time the matter, circumstance or event arose or occurred, and

.2 any remaining will, in the administration and interpretation of the Contract, be shared and applied equitably by and between the Owner and the Contractor.

.7 The phasing and sub-phasing of the work shall be as established and finalized by consultation between the Contractor and the SFU Project Manager, before commencement of the work, and as the work progresses.

SPEC NOTE: Use the following paragraphs for Project when a specific sequence of Work is required, for Owner occupancy, for partial occupancy. Edit as appropriate. Coordinate with Articles ‘Contractor Use of Premises’, ‘Owner Occupancy’, ‘Progress Schedule’ and with Drawings.

.8 All work within an area or phase must be fully completed and operational, in order to be considered ready for Owner occupancy.

.9 For each phase, Mechanical and Electrical trades to provide all temporary hook-ups and services required, provide relocation and removal as required, and work required to keep all life safety, communications, and security systems fully operational.

.10 Required stages or phasing: as designated on Drawings, and as follows:

.1 [_____]

.2 [_____]

1.8 CONTRACTOR USE OF PREMISES

.1 Coordinate use of premises with SFU Facilities to allow:

.1 Owner occupancy.
.2 Partial Owner occupancy.
.3 Work by other contractors.
.4 Public usage.

.2 On handover and acceptance, Owner will provide for occupied areas:

.1 Operation of HVAC and electrical systems.
.2 Maintenance.
.3 Security.
1.9 OWNER RISK MITIGATION

1. SFU has many special events that can cause significant operational risks. Coordinate with owner regarding any events or activities that may impact, contribute to, or be affected by the following:

1.1 Convocation
1.2 Exams
1.3 Parking
1.4 Weather
1.5 Noisy Work Restrictions
1.6 MEXX
1.7 Shutdowns
1.8 Odour
1.9 Dust
1.10 Pests
1.11 Hazardous Materials
1.12 SFU Internal Approval Processes (eg critical submissions, connections to existing and shutdowns of related systems)
1.13 Union Requirements

***END OF SECTION***
1.0 GENERAL

1.1 SECTION INCLUDES

.1 Hours of Work
.2 General Restrictions
.3 Service Connections, including:
   .1 Connecting to existing services.
   .2 Service Shut-down of existing services.
   .3 Service Connection to Utility services.
.4 Special scheduling requirements.
.5 Markings
.6 Publicity / Advertising

1.2 RELATED SECTIONS

.1 Section 01 35 29 Health, Safety, and Emergency Response Procedures
.2 Section 01 33 00 Submittal Procedures
.3 Section 01 35 43.13 Environmental Procedures for Hazardous Materials
.4 Section 01 51 00 Temporary Facilities & Controls

1.3 GENERAL RESTRICTIONS

.1 No work of any kind can begin until the proper authorization and/or work permits have been obtained.

.2 Prior to the start of work all contractors and subcontractors must complete SFU Contractor Safety Orientation.

.3 Stop work around an area where existing previously unidentified hazardous material is discovered (refer Section 01 35 43.13), including materials suspected of containing asbestos, lead and immediately contact the SFU Project Manager for direction before continuing with the Work affected. Prior to the start of any project a Pre-demolition assessment on existing or potential hazardous building materials must be completed by a qualified person. Any hazardous building materials (asbestos, lead, silica, etc) must be removed in accordance to WorkSafe BC and SFU requirements.

.4 For staging and storage, contractors are restricted to the enclosed construction premises for all work and storage of materials, tools and equipment.

.5 SFU traffic and parking regulations apply throughout SFU, which includes in general:
   .1 All parking at and within the project site must first be registered with SFU Parking & Sustainable Mobility – 778.782.5534 and a permit purchased. There is NO FREE PARKING on Campus. No vehicle parking on grassed areas, boulevards, sidewalks, etc.
   .2 No vehicle may enter the “EMERGENCY ZONES” at any time without receiving clearance and a permit from the Parking & Sustainable Mobility.
.3 There are several loading bay areas on campus. Review with SFU Facilities the allocated contractors drop off areas. The time limit of 30 minutes is strictly enforced unless previously authorized by Campus Security.

.6 Construction Vehicle Access

.1 SFU Parking Services is responsible for monitoring traffic flow and parking on campus. There is a 3.7m height restriction for access through Rotunda/Transportation Centre tunnel. Construction vehicles are not allowed to go through the Rotunda. All projects must confirm access restrictions with SFU Project Manager/Representative and University Communications.

.1 Supplementary information is available at the following links:

.1 University Communications:
http://www.sfu.ca/university-communications.html

.2 Traffic Notices:

.3 Campus Map:
http://www.sfu.ca/content/dam/sfu/fs/files/Campus%20maps/sfu_printable_campus_map__11x17.pdf

.7 Existing Building Elevators

.1 Should a particular item be of such size and configuration that it is physically impossible to use the designated route of freight elevators, alternative arrangements must be reviewed with SFU Facilities.

1.4 HOURS OF WORK

.1 Construction work time, normal hours:

.1 7:00 to 20:00 hrs. Monday to Friday and 09:00 to 20:00 hrs. Saturday, unless specifically authorized in writing by the SFU Project Manager and coordinated with the City of Burnaby on a project by project basis.

.2 Construction work time, additional restrictions:

.1 No construction, reconstruction, alteration, repair, landscaping or demolition work which generates noise or disturbs the peace within or in proximity of residential facilities or other facilities designated by SFU Project Manager may occur: Before 7:00am or after 8:00pm from Monday to Friday, before 9:00am or after 8:00pm on Saturday, any time on Sunday or any Statutory holidays.
Noise impacting adjacent University buildings and occupants must be controlled to below maximum WorkSafe BC exposure limits, City of Burnaby by-law, and relevant standards for indoor office environments. Continuous noise at any time shall not exceed 85 dBA when measured at least 15.2 meters from the source in a residential, multifamily, public or institutional district.

.2 Noisy operations such as jack hammering, cutting and coring performed Mondays to Fridays are generally to be carried out before 08:00 and after 16:30 hrs. unless specifically authorized in writing by the SFU Project Manager. The premium time shall be included in the tender amount. Similarly, work that generates fume, dust, and odors which impact nearby occupants are to be carried out before 08:00 and after 16:30 hrs unless authorized in writing by SFU Project Manager.

.3 No construction work may take place on Sundays or on days observed as a holiday, unless specifically authorized in writing by the SFU Project Manager.

.4 For work conducted near student residences, additional quiet hours should be respected where noisy construction work should avoid the hours of 11:00pm to 8:00am Sunday – Thursday, and 1:00am to 9:00 am Friday and Saturday.

.5 Exceptions to construction additional restrictions will be considered for special events (i.e. concerts, festivals, fairs).

.3 Construction work time, additional special restrictions:

.1 Limit construction activities, particularly those generating noise and other distractions, so as not to affect the following SFU operations within the following time periods:

.1 student examinations: (place, dates, times)
.2 conferences: (place, dates, times)
.3 convocation: (place, dates, times)
.4 (description: place, dates, times)
.5 other: issued by addendum if applicable.

.2 The Owner reserves the right to adjust the Contractor's activities relative to SFU's scheduled examinations.

.4 Complaints and work carried out contrary to Hours of Work restrictions will be assessed by the SFU Project Manager or designated representative, whose instructions are to be followed immediately.

1.5 EXISTING SERVICES

.1 Notify SFU Facilities of required Service Shutdown and intended interruption of services and obtain required permission.

.2 Where Work involves breaking into or connecting to existing services, give SFU Project Manager three working days’ notice for necessary interruption of mechanical or electrical service throughout course of work, and obtain approval to proceed. Minimize duration of interruptions. Carry out interruptions at times accepted by the SFU Project Manager and the written approvals issued.
1.6 SERVICE CONNECTION DEFINITIONS

.1 A Service Connection is defined as any new physical link made to an existing SFU service distribution system, including gas, water, electricity, sewer, steam, communications and fire suppression system.

.2 A Service Shut-down is defined as a total stoppage of the distributed service to a particular area, including coordination of shut off at isolation valves.

1.7 PROCEDURE - GENERAL

.1 The following procedure will apply whenever construction work is being connected to any of the Campus services or when a service shut-down is required:

.2 Service Shut-down requests should be directed to SFU Facilities. Adequate time should be provided for SFU Facilities to review the request and prepare resources for proposed shutdown. Shut-downs shall be kept to a minimum.

1.8 MARKINGS

.1 No organic markings such as felt pens or paint shall be used on any surface, whether exposed or to be concealed or covered by subsequent work, unless part of a specified identification system.

.2 No temporary markings shall remain visible in exposed areas after Project completion.

***END OF SECTION***
1.0 GENERAL

1.1 CONTRACT CHANGES - GENERAL

.1 No change to the Contract, either in the Contract Price or the Work will be recognized unless it is covered by a formal Change Order or Change Directive in accordance with the General Conditions.

1.2 CHANGE ORDERS

.1 Any change which will affect the Contract Price, Cash Allowances, or the Work, shall be documented by issuing a Change Order (CO). Clarification of work shown on the drawings or in the specifications can be handled by issuing Site Instructions if the contract value or time is not affected by the instruction.

.2 If the Contractor is made aware of the possible need for a Change Order due to discovered site conditions by the site staff, a Contemplated Change Order (CCO) shall be prepared. The Contractor shall, with the assistance of sub-contractors, estimate the cost and schedule impacts of the possible change, complete and sign-off the CCO form, attach a cost breakdown on the Contractor’s letterhead, and submit the package to the Consultant for consideration and issuance of a CCO.

.3 If the CCO is approved, the Consultant will complete a CO, which must be signed by the Project Manager. Upon receipt of the approved CO, the Contractor shall advise the site staff and sub-contractors of the change and arrange for the execution of the change in the Work.

1.3 CHANGE DIRECTIVE

.1 If the Owner requires the Contractor to proceed with a change in Work prior to the Owner and Contractor agreeing upon the corresponding adjustment in Contract Price, the owner, through the Consultant, shall issue a Change Directive.

.2 A Change Directive shall only be used to direct a change in the Work which is within the general scope of the Contract Documents.

.3 A Change Directive shall not be used to direct a change in the Contract Time only.

.4 Upon receipt of a Change Directive, the Contractor shall proceed promptly with the change in Work.

.5 The adjustment to the Contract Price for a change carried out by way of a Change Directive shall be determined on the basis of the cost of the Contractor’s actual expenditures and savings.

***END OF SECTION***
1.0 GENERAL

1.1 CONTRACTOR PAYMENTS

Spec. Note: On Projects where the Consultant is the SFU, select (Project Manager) where noted.

.1 All payments must conform to latest BC Builders Lien Act.

.2 Schedule of Values

.1 Where multiple progress draws are anticipated, the Contractor shall submit a Schedule of Values to the (Consultant) (Project Manager) (unless otherwise instructed) for approval before the submission of the first progress draw.

.2 The format and schedule of values requires the review and acceptance by the SFU Project Manager prior to submittal of the first progress claim.

.3 If directed by the Project Manager, the Contractor shall supply a construction cash flow for the Owner’s review. The cash flow shall reflect the items listed in the Schedule of Values. The time durations for the cash flow shall be monthly. The Contractor shall modify the cash flow to include approved Change Orders.

.4 Schedule of Values and cashflow calculations are to be double checked prior to submission.

.5 For projects greater than 5 million dollars construction cost, a payment certifier, typically the prime consultant, is required for coordination of all disciplines within the contract.

.3 Progress Draws

.1 The Contractor shall review the proposed draw with the (Consultant) (Project Manager) (unless otherwise instructed), prior to formally submitting the claim. Claims shall be dated and submitted for review as of the last working day of the month.

.2 All invoices are to be addressed to SFU c/o (Consultant) (Project Manager). (Original invoices must be submitted to the attention of the Project Manager and shall be in the same amount as the amount certified by the Consultant.) Photocopies or FAX's will not be accepted. Invoices must show the SFU project name and number and the GST registration number of the firm submitting the invoice. Once approved by SFU Facilities, the finance department will prepare a cheque the Contractor to pick up the cheque.

.3 Coordinate the format of the Progress Claim with the (Consultant) (Project Manager). Each change order shall be listed separately on the Progress Claim.

.4 Statutory Declarations are required with all progress claims except first claim.

.5 WorkSafeBC Clearance is required with all progress claims.
.6 Updated project schedule, both in hard copy and electronic form, is required with all progress claims.

.7 The Owner reserves the right to withhold payment if liens are filed or registered when payment is otherwise due.

.8 Title to all Materials delivered to the Site for which credit for work performed is claimed in any application for payment shall, on the making of such payment, vest in the Owner.

.9 No payment by the Owner under the Contract nor partial or entire use or occupancy of the Work by the Owner shall constitute an acceptance of any portion of the Work or Materials which are not in accordance with the requirements of the Contract Documents.

.4 Builder's Lien Holdback

.1 Invoice for the builder's lien holdback separately when it comes due. The invoice shall be submitted to the (Consultant) (Project Manager) with Statutory Declaration and a WorkSafe BC Clearance Letter.

.2 When applying for release of Holdback, the Contractor shall submit a Statutory Declaration Form 1 and a Statutory Declaration Form 3 from each of the Subcontractors plus Statutory Declaration Statement of Claims Form 4 and Workers’ Compensation Board Letter of Good Standing, and certificates of the Contractor addressed to the Owner and the Consultant in form and covering subject matter reasonably prescribed by the Owner.

***END OF SECTION***
1.0 GENERAL

Spec. Note: Include this section on projects with extensive work by Owner or Owner supplied products, as required.

1.1 FIRST PROJECT MEETING

.1 As soon as possible following the acceptance of the Contractor's Tender a first meeting will be set up in order to review the project requirements with all concerned and to turn over the site to the Contractor. The following are required to attend the first meeting as appropriate for the size, location and type of project:

.1 SFU Project Manager (chair)
.2 Consultant and Subconsultants
.3 Contractor and major Subtrades
.4 Permits & Inspections representative (if required)
.5 Building Operations representative
.6 SFU IT Services representative (if required)
.7 SFU Risk Manager/Analyst representative
.8 SFU Environmental Health and Research Safety representative (EHRS)
.9 User's representative (if required)

.2 At the end of the first meeting the Project Manager may turn over the chair of the meeting to the Consultant who will a) review the Project, b) review the schedule of work, c) take and distribute minutes and d) establish date and time of the next meeting.

1.2 REGULAR SITE MEETINGS AND SITE REVIEWS

.1 The Contractor will schedule and administer project meetings throughout progress of the Work. Frequency, location and date of the first of the regular site meeting is to be established at the first meeting. The Contractor will be responsible for generating agenda, as well as taking and distributing minutes of site meetings.

.2 The Consultants are required to make regular site reviews, and distribute their site reviews for follow-up action to the project team.

1.3 COORDINATION OF WORK

.1 Refer to the General Conditions and the Supplementary Conditions of the construction contract.

.2 Refer to Section 01 11 00 Summary of Work.
.3 Document coordination amongst disciplines:

.1 All IFT drawings will be yellow in color, and all IFC drawings will be blue in color.

.4 Work by Owner and Work by Other Contractors

.1 For all work not included in Contract, but which is part of the overall Project and which will be carried out by Other Contractors under Separate Contracts or Owner's own forces.

.1 The Contractor is responsible for:

.1 Obtaining and the review of information required for the Work and provided by Other Contractors and by the Owner. Prior to proceeding with the Contractor’s related work, Contractor shall confirm proper interface and coordination of all work.

.2 Review of shop drawings, product data, samples, and other submittals, and notification to both SFU Project Manager and to Consultant of any observed discrepancies or problems anticipated due to non-conformance with Contract Documents.

.3 Completing SFU EHRS Contractor Orientation

.4 Site and task specific health and safety plan

.5 Job site safety inspections. To be carried at the beginning of a project and a minimum of every 2 weeks following project start.

.6 Scheduling.

.7 Setting out.

.8 Coordination, including all service requirements.

.9 Provide and connect all services forming part of the Work, including related cutting, drilling, coring, and doing all necessary patching and making good.

.10 Disconnect and/or capping off existing services for existing equipment to be relocated by Other Contractors or Owner, including all necessary patching and making good.

.11 Provide suitable storage for other contractors’ pre-delivered products and equipment when available on site and/or building.

.12 Security.

.13 Damage caused by the Contractor.

.14 Arranging installation inspections required by public authorities.
.2 The Owner is responsible for:

.1 Providing information required of Other Contractors for the Work.

.2 Ensuring the timing of information and the work of Other Contractors and Owner's own forces conforms to the agreed construction schedule.

.3 Testing and placing in operation.

.5 OWNER-SUPPLIED PRODUCTS

.1 For all products not included in Contract (NIC or similar designation), but which are part of the overall Project and which will be supplied by the Owner.

.1 The Contractor, in addition to the same responsibilities described by 1.3.1 above for Other Contractor work, is responsible for:

.1 Obtaining and the review of information required for the Work and provided by product manufacturers.

.2 Move to location, and install required anchors; similarly, for existing equipment to be relocated by the Contractor. Work to manufacturers' recommendations.

.2 The Owner, in addition to the same responsibilities described by 1.3.1 above, is responsible for:

.1 Arrange for delivery of shop drawings, product data, samples, manufacturer's instructions, and certificates to Consultant and Contractor.

.2 Ensuring the timing of information and the delivery of N.I.C. products conforms to the agreed construction schedule.

.3 Deliver supplier's bill of materials to Contractor.

.4 Arrange and pay for delivery FOB site in accordance with Progress Schedule.

.5 Inspect deliveries jointly with Contractor.

.6 Submit claims for transportation damage.

.7 Arrange for replacement of damaged, defective or missing items, and determine responsibility for costs.

.8 For NIC products installed by the Owner: unload, store, uncrate, and move into location, and supply and install required anchors to adequately support weight, resist vibration, and provide lateral and seismic restraint.
.9 For NIC products installed by the Contractor, supply all required anchors to adequately support weight, resist vibration, and supply lateral and seismic restraints

.10 The design and installation review of lateral and seismic restraints noted above shall be by a Professional Engineer Registered in British Columbia.

.11 Arrange for manufacturer’s field representatives to clarify installation and carry out placing in service and testing, when required by the particular product and equipment.

.12 Testing and placing in operation all N.I.C. products. Additional requirements or conditions related to Owner-supplied products:

.13 (Description, or state:) To be issued by Addendum if applicable

***END OF SECTION***
1.0 REGENERAL

1.1 SECTION INCLUDES

.1 Schedules, form, content, submission.
.2 Critical path scheduling.
.3 Progress photographs [and video].
.4 Submittals schedule.

1.2 RELATED SECTIONS

.1 Section 01 33 00 Submittal Procedures
.2 Section 01 78 39 Project Record Documents
.3 This section describes requirements applicable to all Sections within Divisions 01 to 33.

1.3 SCHEDULES

.1 Submit schedules as follows:

.1 Submittal Schedule for Shop Drawings, Product Data and Safety Data Sheets.
.2 Submittal Schedule for Samples.
.3 Submittal Schedule for timeliness of Owner-furnished Products.
.4 Product Delivery Schedule.
.5 Cash Allowance Schedule for acquiring Products only or Products and Installation, or Installation only.
.6 Shutdown or closure activity.

.2 Schedule Format

.1 Prepare schedule in form of a MS PROJECT horizontal [Gantt] bar chart.
.2 Provide a separate bar for each major [item of work] [subcontract] [or]
[operation].
.3 Split horizontally for projected and actual performance.
.4 Provide horizontal time scale identifying [first] [last] Working Day of each week.
.5 Format for listings: [Table of Contents of the Project Manual] [chronological order
of start of each item of work].
.6 Identification of listings: By [specification Section numbers] [specification
subjects] [systems description].

.3 Schedule Submission

.1 Submit initial format of schedules within [15] [working] days after award of
Contract.
.2 Submit schedules in electronic format, forward [on disc] [through e-mail] [through
.3 Submit [one (1)] [_____ (___)] opaque reproduction, plus [two (2)] [_____] copies
to be retained by Consultant.
.4 Consultant will review schedule and return review copy within [10] [_____] days
after receipt.
.5 Resubmit finalized schedule within 7 days after return of review copy.
.6 Submit revised progress schedule with each application for payment.
.7 Distribute copies of revised schedule to:
   .1 Job site office.
   .2 Subcontractors.
   .3 Other concerned parties.

.8 Instruct recipients to report to Contractor within 10 days, any problems anticipated by timetable shown in schedule.

1.4 CONSTRUCTION PROGRESS SCHEDULING

.1 Submit initial schedule in duplicate within [fifteen (15)] [twenty (20)] [_____] days after date [of Owner-Contractor Agreement.] [established in Notice to Proceed.]

.2 Revise and resubmit as required.

.3 Submit revised schedules with [each] [_______] Application for Payment, identifying changes since previous version.

.4 Submit a [computer generated] [horizontal bar] [_________] chart with separate line for each [major portion of Work or operation] [section of Work], identifying first work day of each week.

[OR]

.5 Submit [computer generated] network analysis diagram using the [critical path] [PERT] method.

.6 Show complete sequence of construction by activity, identifying Work of separate stages and other logically grouped activities. Indicate the early and late start, early and late finish, float dates, and duration.

.7 Indicate estimated percentage of completion for each item of Work at each submission.

.8 Indicate submittal dates required for shop drawings, product data, samples, and product delivery dates, including those furnished by Owner and required by Allowances.

.9 Incorporate owner supplied items for coordination with construction schedule.

.10 Include dates for commencement and completion of each major element of construction [as follows].

   .1 Site clearing.
   .2 Site utilities.
   .3 Foundation Work.
   .4 Structural framing.
   .5 Special Subcontractor Work.
   .6 Equipment Installations.
   .7 Finishes.

.8 [______].

.11 Indicate projected percentage of completion of each item as of first day of month.

.12 Indicate progress of each activity to date of submission schedule.

.13 Indicate changes occurring since previous submission of schedule:

   .1 Major changes in scope.
   .2 Activities modified since previous submission.
.3 Revised projections of progress and completion.
.4 Other identifiable changes.

.14 Provide regular two week look-ahead schedules to plan manpower, tools and material to meet target milestones.

.15 Provide a narrative report to define:
.1 Problem areas, anticipated delays, and impact on schedule.
.2 Corrective action recommended and its effect.
.3 Effect of changes on schedules of other prime contractors.

1.5 CRITICAL PATH SCHEDULING

.1 Include complete sequence of construction activities. Ensure SFU EHRS policies are followed and adhered as these can have an impact on contractor schedule.

.2 Include dates for commencement and completion of each major element of construction [as follows].
.1 Site clearing.
.2 Site utilities.
.3 Foundation Work.
.4 Structural framing.
.5 Special Subcontractor Work.
.6 Equipment Installations.
.7 Finishes.
.8 

.3 Show projected percentage of completion of each item as of first day of month.
.4 Indicate progress of each activity to date of submission schedule.
.5 Show changes occurring since previous submission of schedule:
.1 Major changes in scope.
.2 Activities modified since previous submission.
.3 Revised projections of progress and completion.
.4 Other identifiable changes.

.6 Provide a narrative report to define:
.1 Problem areas, anticipated delays, and impact on schedule.
.2 Corrective action recommended and its effect.
.3 Effect of changes on schedules of other prime contractors.

1.6 PROGRESS VIDEO

.1 [Provide internet-capable camera and an active web site, allowing off-site viewing of the Place of the Work 24 hours a day, 7 days a week. Submit web site address and security access codes to Consultant.]

.2 Submit [black and white] [colour] video [tapes] [files] in [VHS] [digital] format.

.3 Frequency: [monthly with progress statement] [at completion of: excavation] [foundation] [framing and services before concealment] [building]] [as directed by Consultant].
1.7 **SUBMITTALS SCHEDULE**

.1 Include schedule for submitting shop drawings, product data, samples.

.2 Indicate dates for submitting, review time, resubmission time, and last date for meeting fabrication schedule.

.3 Include dates when [submittals] [delivery] will be required for Owner-furnished products.

.4 Include dates when reviewed submittals will be required from Consultant.

***END OF SECTION***
1.0 GENERAL

1.1. INSURANCES AND BONDS

.1 Promptly submit Bond and Insurance Certificates as required to the Project Manager. Progress draws will not be paid before these documents have been submitted. Insurance Certificates shall name SFU as additional insured.

.2 All other submittals required to be submitted within 15 days of award of contract.

1.2. RELATED SECTIONS

.1 Section 01 11 00 Summary of Work
.2 Section 01 31 00 Project Management and Coordination
.3 Section 01 32 16 Construction Progress Schedule

1.3. CONSTRUCTION SCHEDULE

.1 Promptly submit a construction schedule covering the full scope of the contract to the Project Manager. The construction schedule will include any special schedule requirements established by the Consultant and incorporated in the Instructions to Tenderers and the Tender Form. The Contractor shall prepare the schedule as follows:

.1 After award of contract and before commencement of the Work, a first project meeting will be held with the Project Manager, EHRS, Consultant, Contractor, and Subcontractors in attendance. The Contractor shall prepare a preliminary and proposed sequence of construction and construction schedule, for presentation at this meeting. Timing of service interruptions, phases and sequence of the Work, etc., and any clarifications with respect to scheduling will be brought forward and discussed at this time.

.2 Following this meeting the Contractor shall submit their construction schedule, to include required staging and sequencing of the Work and also detailed scheduling for mechanical, plumbing and electrical work, etc., to the Project Manager for final acceptance. The construction schedule shall include any instructions resulting from the first project meeting.

.3 In order to improve the work schedule or eliminate unforeseen problems, modifications to the construction schedule may be suggested by the Project Manager, Consultant or the Contractor during the contract and such modifications may be implemented by mutual agreement. Schedules must be updated and reissued monthly to reflect the agreed changes.

.4 The contractor shall submit monthly project schedule updates, both in hard copy and electronic form. Electronic format to be Microsoft Project 98 or later. The schedule shall detail task start, duration, and completion dates, and percent complete of each task. It shall highlight critical tasks, task linkages, and order/delivery dates for major equipment components. An up-to-date construction schedule, submitted both in print and electronically, is required with all progress claims.
.5 Full details of construction schedule to be coordinated with details from Construction Progress Schedule Section 01 32 16.

1.4. PROGRESS REPORTS/DAILY REPORTS

.1 The Contractor shall, from the date of commencement of the Work, maintain a careful daily record of the progress of the Work. This record shall be open to inspection by the Consultant or the Owner at all reasonable times and shall, if requested, be turned over to the Consultant at Substantial Performance of the Work. The record shall show all pertinent data such as:

.1 if applicable, the daily weather conditions,
.2 commencement, progress and completion of various portions of the work,
.3 dates of all meetings and their purpose,
.4 dates of visits by government authorities, inspectors, utility companies and the like,
.5 record of work force employed,
.6 materials causing delay,
.7 clarifications or questions, and
.8 safety program records (inspections, corrective actions, incidents, near misses modified work program, WorkSafe BC inspection reports/orders, etc.)

1.5. SUBMITTALS, SAMPLES AND PRODUCT DATA

.1 All Submittals are to be submitted to the Consultant (unless otherwise instructed) for review. After the Consultant has reviewed the Submittals, the Consultant shall submit one copy of the Reviewed Submittals to the Project Manager, unless otherwise specified. Except for the Finish Hardware Schedule, SFU does not review Submittals prior to the Consultant returning them to the Contractor unless specifically requested by Project Manager or SFU Facilities.

.2 Unless specifically requested Samples need not be submitted to SFU. Product data is not normally required to be submitted to SFU. The exception to this is the Safety Data Sheet (SDS) for all hazardous materials. SDS are to be submitted to the Project Manager and Environmental Health and Research Safety (EHRS) department. Additional product information may be requested by EHRS on a case by case basis.

.3 All submittals and each document within single submittal shall be clearly identified with a relevant MasterFormat 2014, Division and Section number under which they are required. Refer to the Construction Specifications Institute (CSI) for details about MasterFormat 2014 Numbers and Titles.

.4 Project specific equipment identification matching SFU naming convention shall be included on submittal e.g.41-01-002 (South Sciences Building Fan Unit 002). Full detail on equipment naming can be found in the latest SFU Identification and Labeling Standard document.

.5 Submittal format is to be in PDF only. Distribution is to be via FTP or similar file sharing site for organizing and tracking submittals logically.
.6 Critical submittals such as those for Substations, fire alarms, life safety and controls should be updated to as-built/ record drawings for eventual inclusion in O&M’s.

1.6. FINISH HARDWARE SCHEDULE

.1 The Finish Hardware Supplier’s Schedule shall be submitted in accordance with Section 08 71 00.

1.7. INSPECTION & TEST REPORTS

.1 Copies of Electrical, Gas and Plumbing permits shall be forwarded to the Project Manager and also maintained in the site office for reference by interested parties.

.2 Testing Reports shall be submitted to the Contractor with copies to the Consultant and the Project Representative. Copies shall also be kept in the temporary construction office for reference by interested parties.

1.8. REVIEWED SHOP DRAWINGS

.1 One complete set of reviewed Shop Drawings is to be kept on the construction site for reference by Consultants and Inspectors.

***END OF SECTION***
1.0 GENERAL

1.1 RELATED SECTIONS

.1 Refer to Section 01 14 00 Work Restrictions.

.2 For general waste management and recycling requirements, refer to Division 01 Section 01 74 19 Construction Waste Management and Disposal.

1.2 PROTECTION OF EXISTING BUILDINGS AND SERVICES

.1 When working within an existing occupied building the following requirements apply:

.1 Notify SFU Facilities before any major renovation work or alteration project is planned.

.2 Ensure that a Pre-Demolition assessment have been conducted on the area that construction work will begin. Any hazardous building materials identified will be removed in accordance to WorkSafe BC and SFU requirements.

.3 Contractors are responsible for any damages caused to the facility.

.4 The Contractor shall provide temporary enclosures for securing off of work and the maintenance of any services necessary to the proper and efficient operation of the Project.

.5 The Contractor shall conduct construction operations with minimum interference to existing building operations, adjacent buildings, adjacent public or private roadways, parking lots, sidewalks and access facilities in general.

.6 The contractor shall provide signage to indicate “This is a construction site”.

.7 Prior the start of any work causing smoke, SFU Facilities must be contacted in regards to temporarily disabling smoke detectors.

.8 The Contractor shall provide protection against smoke propagation emanating from welding operations by use of temporary smoke barriers and/or temporary local ventilation of areas involved and shall provide a fire extinguisher at all areas where welding is being carried out. A hot work permit must be obtained from SFU.

.9 Special provisions shall be made by the Contractor to protect existing building areas when exposed by removal of existing roofing and walls or other exterior surfaces. All necessary precautions and measures shall be taken by the Contractor to ensure the interior of existing building is weathertight and fully secured at all times.
.10 All work in areas to receive renovations shall be completely sealed off by the Contractor from the remainder of the building. Noise and dust containment will be through the use of rigid, continuous partitions. All debris shall be removed daily from these areas, as well as from all areas of the site, to maintain clean, safe and efficient site conditions. **Control of dust is critical.** Take all necessary precautions and schedule Work to ensure adjoining occupied areas are completely dust free at all times. Where required, exposure control plans to be developed e.g. work activities generating silica dust, lead dust, etc.

.11 The Contractor shall take all necessary precautions to fully protect the existing equipment and furnishings against damage from water, dust or the like, during installation of new work, including cutting of existing roof and walls. Dust screens and/or platforms shall be provided as specified above. Cover and protect existing furnishings, equipment, etc., by means acceptable to the Owner whenever Work is to be carried on above or beside such existing items.

.12 Where material or equipment is being transported within the existing building on carts or pallets, such carts or pallets shall have rubber tires that are in good working and clean condition.

.13 The Contractor shall provide temporary hoarding to maintain unobstructed access to exits, entrances, pathways and to prevent access to construction areas in accordance with all Safety Regulations and good practice.

.14 The Contractor shall seal, supply and return ducts and chases or temporary filters installed to prevent migration of dust and noise through existing air systems. Contractor will coordinate and request ventilation system shut-off with the Project Manager or Facilities Services.

.15 Where work is confined inside a room, the door shall be temporarily weatherstripped to prevent dust from leaving the room.

.16 The Contractor shall make good, at no expense to the Owner, any damage or disruption caused to the existing building contents and to the adjoining property, utilities and services not called for as part of the Work of this contract. All repair work shall only be done after consultation with the Owner, Consultant, appropriate parties and authorities and to standards and codes or the authorities having jurisdiction.

.17 Making good shall mean restoration to at least the original condition in terms of strength, safety, workmanship and appearance.

.18 The Contractor shall protect existing exterior finishes, interior finishes, floor finishes, windows, doors, etc., at all times from damage from hoists, chutes, materials handling equipment, or new construction.

.19 The Contractor shall obtain the Consultant's approval prior to cutting openings through structural members.

***END OF SECTION***
1.0 GENERAL

1.1 GENERAL

.1 The responsibility for safety on construction sites shall rest with the Contractor(s). The regulations of the Worker’s Compensation Board (WorkSafe BC) and the British Columbia Building Code apply as a minimum. For the purpose of Part 8 of the British Columbia Building Code the following definitions apply:

.1 service company: shall mean SFU Facilities for water, gas, sanitary sewers and storm sewers, and SFU Services for telephone, communications and cable television.

.2 street: shall mean any thoroughfare uses by the public, service vehicles or pedestrians.

.3 public property: shall mean all property on the SFU campus outside the area defined or shown as the project site - normally delimited by the hoarding line.

.2 All Contractors and Subcontractors must be registered employers with the Workers Compensation Board and must conform to all WorkSafeBC requirements for construction safety.

.3 SFU Project Manager and SFU EHRS will provide the Contractor with any known information regarding hazards to the health or safety of persons in the workplace.

1.2 PRE-DEMOLITION ASSESSMENT

.1 Before any demolition, alteration, modification, change or renovation can begin a Pre-Demolition Assessment must be conducted by a qualified person (as per WorkSafe BC definition). The Pre-Demolition Assessment report must be submitted to the Project Manager and Environmental Health and Research Department (EHRS) within 2 weeks before the start of work. At a minimum the report must meet WorkSafe BC and SFU requirements.

1.3 CONSTRUCTION SAFETY PROGRAM

.1 The Prime Contractor or contractors shall have in place a site-specific safety program acceptable to the Worker’s Compensation Board and SFU. At the start of a job the Contractor shall submit a Notice of Project to WorkSafeBC, with copies to SFU. The Prime Contractor or contractors must complete the SFU Contractor Safety Checklist and submit to the Project Manager and EHRS along with any relevant safety documentation.

.2 The implementation of the safety program shall be monitored through monthly safety meetings with the Prime Contractor, contractors and subcontractors. Minutes of these meetings shall be posted in the site office for view by the public. The Prime Contractor shall report to the Project Manager safety program activities such as safety committee meetings held, inspections performed and the results of any incident or near miss investigations. Issues which require coordination with SFU Facilities, such as lock-out (refer to SFU Lockout Program in Facilities Services Health and Safety Manual for further details), power line contact control or tie in of services (Shutdown Request) shall also be included in these reports.
.3 The contractor shall coordinate with SFU Facilities if services such as power or water may be shut off (Shutdown Request).

.4 The contractor shall abide by the latest version of the SFU Contractor Safety Manual.

1.4 SITE SAFETY PLAN

.1 A Site Safety Plan is required for all additions, renovations and all new buildings regulated under Part 3 of the British Columbia Building Code or when required by WorkSafeBC.

.2 The Prime Contractor shall conduct a job hazard assessment and prepare a Site Safety Plan giving the names and emergency telephone numbers of the Prime Contractor or contractors, the Project Manager, the Consultant, the Trades Safety Coordinator, SFU Campus Safety & Security Services, SFU Safety and Risk Services, and SFU Parking and Sustainable Mobility Services. The Plan shall also show the details of the construction procedure relating to site access, maintenance of any required exits, barricades, traffic control, scaffolding and swing stages, hoisting equipment, fire protection facilities, emergency shut-off locations, material storage, waste materials, control of dust and debris, protection of the edges of each floors and any other items required by the Chief Building Inspector. The Site Safety Plan will be presented to the Project Manager and Environmental Health and Research Safety department at the first Project Meeting.

.3 The Site Safety Plan shall be adjusted to reflect the current stage of construction activities. The Site Safety Plan shall be posted on the job site on a 600mm by 600mm piece of plywood protected from the weather and staked into the ground so as to be visible from the street. Alternatively, it may be posted and protected from the weather on the principal construction site entrance or shelter provided for workers or equipment.

.4 A separate Fire Safety Plan for the construction site shall also be submitted to the SFU Facilities and EHRS in accordance with the BC Fire Code.

1.5 CONTRACTOR SAFETY ORIENTATION

.1 Prior to the start of any work at SFU the Prime Contractor, contractors and subcontractors must complete SFU Contractor Safety Orientation. Orientation can be scheduled and coordinated with the Environmental Health and Research Department (EHRS).

1.6 PROXIMITY TO OVERHEAD POWER LINES

.1 Where work must be conducted in an area which is in close proximity to overhead power lines, SFU Facilities will provide assurance in writing that the power lines are de-energized, or require guarding. The Contractor shall contact SFU Facilities to coordinate appropriate procedures and to obtain the WorkSafeBC form 30M33. All work procedures must be in conformance with Part 19 of the WorkSafeBC Regulations.
1.7 ROOF TOP ACCESS

.1 Roof top access is restricted without prior notification to SFU Facilities.

Prior to working on any roof top the contractor must submit a site specific Fall Protection Plan to the Project Manager and EHRS. Contractors and others requiring roof top access on these buildings are required to provide their own safety equipment that meets Canadian Standard Association (CSA) and/or American National Standard Institute (ANSI) requirements.

1.8 WORKING AT HEIGHTS

.1 Any work that expose a person to a fall of 10’ or greater, fall protection system must be in place. Any person working at 10’ or greater using a fall protection equipment must be adequately trained to use, maintain and dismantle the equipment. Fall Protection equipment used on site must meet CSA or ANSI requirements.

Prior to working at heights of 10’ or greater, a site-specific Fall Protection Plan must be submitted to the SFU Project Manager and EHRS. The Fall Protection Plan must be readily available on site and updated as site changes.
1.9 MOBILE EQUIPMENT AND CRANES

.1 Mobile Equipment (i.e. forklifts, scissor lifts, aerial lifts, man lifts, etc)

.1 Mobile equipment must be requested and approved by the Project Manager. Prior to requesting the mobile equipment, the Prime Contractor, contractors or subcontractors must submit the equipment specifications to the Project Manager.

.2 Any person operating a mobile equipment on site must be trained with a valid training record(s). Mobile equipment used on site must be meet WorkSafe BC the Manufacturer, CSA and ANSI requirements.

.2 Crane (tower crane, mobile crane and boom trucks)

.1 Crane(s) must be requested and approved by the SFU Project Manager. Prior to requesting the crane, the Prime Contractor, Contractor(s) or Subcontractor(s) must submit the equipment specifications to the SFU Project Manager and EHRS.

.2 Crane work or activity that will affect the roadway, walkway or pathway will require a Traffic Management Plan (including pedestrians). Traffic Management Plan for SFU Burnaby Campus must be submitted (within 1 week of crane work) to the SFU Traffic Manager for approval. Traffic Management Plan for SFU Surrey and Vancouver Campus are approved by the local municipal government and submitted to the SFU Project Manager after approval from the municipal.

.3 All crane operators must be certified by the British Columbia Association for Crane Safety (BCACS), Fulford Harbour Group Ltd (FHG) or the Industry Training Association (ITA). Riggers must be trained (documented) and competent to conduct rigging work.

.4 Crane setup, dismantle and use on site must be in accordance to WorkSafe BC, the Manufacturer, CSA, ANSI and/or Professional Engineer requirements. A Crane Lift Plan must be submitted to the SFU Project Manager and EHRS within 72 hours before the start of any crane work. On the day of the lift, a Pre-Lift Meeting must be conducted and documented. The meeting must be submitted to the SFU Project Manager and EHRS by the end of the workday.

.5 Any crane that is left un-supervised must be secured in a manner that un-authorized personnel(s) cannot operate, climb (i.e. secured ladder access point), alter or use in a way that can pose a threat to the public, workers and SFU.
1.10 PROCEDURE FOR ENTERING CONFINED SPACES

.1 Contractors must conform to the WorkSafe BC regulations with respect to entering confined spaces such as manholes, service tunnels, etc. Contractors must submit the following site-specific safety documentation:

.1 Risk Assessment on the confined space(s) from a qualified person (as per WorkSafe BC definition).

.2 Entry, Monitor, Rescue and other applicable Safe Work Procedure for the confined space(s) from a qualified person.

1.11 PROTECTIVE CLOTHING & EQUIPMENT

.1 Contractors are required to provide their own protective clothing and equipment when required for access to any restricted location on the SFU Campus. This would include, but not be limited to items such as, hard hats, safety footwear, eye protection, ear plugs, respirators and protective coveralls. Items which require custom fitting, such as respirators, shall not be made available for use by more than one person. All protective clothing and equipment must meet CSA, ANSI or other recognized standards from the Board.

1.12 BARRICADES AND BARRIERS

.1 All barricades and barriers on construction sites shall conform to all safety practices required by regulations and good practice. Barriers for work outside the construction site must be visible both day and night.

.2 All walkways in close proximity to job sites shall be built with overhead protection where overhead work is being performed in close proximity.

.3 In pedestrian areas adequate warning must be provided for visually impaired pedestrians. Chain link fencing or hoarding is preferred as it allows blind persons to feel the base of the barricade with their canes. Audible or tactile warning devices may also be required. Depending on the illumination on site and campus, additional lighting may also be required to illuminate pedestrian areas. Before setting up barricades in pedestrian areas the Owner must be notified at least 48 hours in advance to inform visually impaired people.

.4 In vehicular areas barriers shall conform to the requirements of Part 8 of the B.C. Building Code. The placement of all barriers in vehicular areas must be approved by Traffic Safety and, if applicable, the Ministry of Transportation and Highways.

1.13 FIRST AID

.1 The Contractor shall arrange for the provision of first aid facilities and an Accident Prevention Program to the requirements of the Workers' Compensation Board of B.C.
1.14 LOCKOUT PROCEDURES

.1 All Contractors shall conform to the newest SFU EHRS Lockout Procedure, as well as the SFU Lockout Program in Facilities Services Health and Safety Manual.

1.15 X-RAYS AND OTHER CONSTRUCTION TESTING

.1 Non-destructive testing involving x-ray sources or x-ray emitting devices shall be in accordance with the Canadian Nuclear Safety Commission Regulations and Health Canada Safety Code 34 to minimize radiation exposure to workers, other building occupants and passersby. All testing of this nature must be reported in writing, at least 3 days in advance, to EHRS Program Manager, Ionizing Radiation (Radiation Safety Officer): 778-782-3633).

.2 The following must be provided to SFU Project Manager and Radiation Safety Officer within 72 hour before the start of work:

.1 Complete SFU Industrial Radiographer Checklist,
.2 Canadian Nuclear Safety Commission (CNSC) license,
.3 Documentation to show the device is certified by the CNSC,
.4 Certification/License of the Industrial Radiographer,
.5 A control plan to prevent ingress during testing and how the organization will implement the plan,
.6 Plan that specify their barriers and signage for the radiation generating work,
.7 Site specific emergency procedures,
.8 The organization's Radiation Safety Officer,
.9 Leak test result for all radiation generating device that will be brought onto campus (valid for 12 months),
.10 TDG class 7 certificate. and
.11 A briefing on the safety issues related to the use of the industrial radiographer.

1.16 FIRE PROTECTION DURING CONSTRUCTION & DEMOLITION

.1 Refer to Part 8 of the B.C. Building Code and the requirements of the Fire Services Act, Regulations and Bulletins.

1.17 EXCAVATION AND GROUND DISTURBANCE

.1 Before excavation or any type of ground disturbance, it is critical to check with SFU Records in Facilities Services for utilities drawings and engineering information on SFU utilities.

***END OF SECTION***
1.0 GENERAL

1.1. HAZARDOUS BUILDING MATERIALS (ASBESTOS, DUST, LEAD, SILICA, MOULD)

1.1. All activities concerning hazardous building materials handling, removal, and disposal shall conform to WorkSafeBC Occupational Health and Safety Regulations (OH&S) and related guidance documents (current edition) and to any additional requirements indicated by SFU EHRS.

1.2. SFU EHRS has an inventory of all hazardous materials in buildings; any hazardous materials work should be coordinated with SFU EHRS.

1.3. A detailed hazardous materials report, written by a qualified person, must be provided as part of the Contract Documents. The report must be available on site and reviewed by the worker prior to commencing work.

1.4. The Contractor shall review the Contract Documents and site and promptly report to the Owner's representative any errors, inconsistencies or omissions she/he may discover, concerning the presence of asbestos-containing materials. If suspect hazardous material is discovered during the normal progress of the project, the Contractor shall not proceed with the affected portion of the Work until direction from the Owner's Representative has been received. The presence of asbestos-containing material must be reported to the Project Manager and the SFU EHRS.

1.5. Should there be hazardous building materials present on the site, either specifically stated in the Contract Documents or discovered during the project, all work with these materials must be performed by a qualified Hazardous Materials Abatement Contractor. The scheduling of the work is the responsibility of the Contractor. All applicable regulatory requirements such as WorkSafeBC and SFU regulations and guidelines as provided by SFU EHRS must be strictly adhered to.

1.6. All air monitoring and inspections will be conducted by a qualified OH&S Consultant who must be independent from the Owner's Retained Consultant engaged on the project.

1.7. At least 48 hours prior to commencing work, the Abatement Contractor will file a “Notice of Project” (NOP) and Site-Specific Work Procedures intended for use on the project to WorkSafeBC. A copy of the NOP, risk assessment and procedures must also be emailed to the SFU EHRS and the Project Manager.

1.8. Only approved asbestos abatement contractors and hazardous material consultants (independent from the Owner's Retained Consultant engaged on the project) can be used. Confirm company viability with SFU Facilities and SFU EHRS.

1.2. POLYCHLORINATED BIPHENYLS (PCB)

1.2.1. The procedure for the removal and disposal of PCB containing light fixtures shall be carried out in accordance with requirements in Division 16.

1.2.2. All activities involving handling, storage and transportation of PCB containing materials must be carried out in accordance with all Provincial and Federal regulations and documents:
1.3. RADIOISOTOPES

.1 New construction or major renovation of facilities designated for radioisotope use shall be reviewed and approved in writing by SFU EHRS.

.2 Radioisotope laboratories shall be designed and constructed in accordance with the Canadian Nuclear Safety Commission document GD-52 - *Design Guide for Nuclear Substance Laboratories and Nuclear Medicine Rooms*. Note that all new intermediate lab designs must be approved in advance of construction by the CNSC. This approval process may take up to four months.

.3 In the case of renovations in laboratories designated for radioisotope use, the Consultant will contact SFU EHRS at least 10 working days prior to project start up, to arrange for the safe removal of radiation hazards by the occupants. Radiation warning signs will be removed only by the RSO.

.4 Prior to commencement of renovation construction, a complete set of contamination control records (wipe tests) will be generated by the principal investigator responsible for the space. These records must be submitted to the RSO for approval.

.5 The Contractor must obtain written assurance from the RSO prior to commencement of construction that the area if free of radioactive contamination.

1.4. WORKPLACE HAZARDOUS MATERIAL INFORMATION SYSTEM (WHMIS 2015)

.1 The Contractor, Subcontractors and Suppliers shall comply with Workers Compensation Boards' Workplace Hazardous Materials Information System (WHMIS 2015). Regulations pertaining to labeling, provision of Safety Data Sheets (SDS), education and training programs, safe handling and emergency procedures for "Controlled Products" being used in the Project. This includes handling hazardous materials so that project workers, the public, the SFU community and property, and the environment are not at risk.

.2 Operations producing odours such as the application of adhesives and painting shall be carried out in a safe manner and in a manner to prevent the spread of fumes to occupied areas of the building or to adjacent buildings. The consultant must submit Safety Data Sheets for all chemical treatments, adhesives and potentially harmful products to be used to the Project Manager.

1.5. BIOSAFETY AND OTHER HAZARDS

.1 The Project Manager will notify the occupants and EHRS at least 10 working days before project startup to arrange for the safe removal and/or disposal from within and adjacent to the project area of all hazardous materials including but not limited to chemicals, radioactive materials, biohazardous materials and glass laboratory equipment. Signs warning of the presence of hazardous materials may also be removed as required at the discretion of EHRS. Other laboratory equipment, which cannot be moved and which presents a potential for injury will be locked out and sealed. EHRS will provide written confirmation to the Contractor and Consultant that the project area is ready for construction.
1.6. **SPILLS & CLEANUP**

.1 The Contractor, subcontractors and suppliers must comply with the B.C. Ministry of the Environment Regulations involving the required response to spills of hazardous materials that could result in contamination of the environment (air, water, ground).

.2 The Contractor, subcontractors and suppliers must be able to respond to spills of a hazardous or unknown material while working at SFU. Procedures would include isolating the area to prevent further exposure to the material and immediately informing the on-site superintendent and the SFU Project Manager, SFU EHRS and/or the Burnaby Fire Department.

.3 The Contractor, subcontractors and suppliers must have available the material, procedures and trained personnel required to clean up spills of any material they use in their work at SFU.

1.7. **STORAGE AND HANDLING**

.1 Coordinate storage of hazardous materials with the Project Manager and abide by internal requirements for labeling and storage of materials and wastes.

.2 Store and handle hazardous materials and wastes in accordance with applicable federal and provincial laws, regulations, codes, and guidelines.

.3 Store and handle flammable and combustible materials in accordance with current British Columbia Fire Code of Canada requirements.

.4 Keep no more than 45 litres of flammable and combustible liquids such as gasoline, kerosene and naphtha for ready use. Store all flammable and combustible liquids in approved safety cans bearing the Underwriter's Laboratory of Canada or Factory Mutual seal of approval. Storage of quantities of flammable and combustible liquids exceeding 45 litres for work purposes requires the written approval of the Consultant.

.5 Transfer of flammable and combustible liquids is prohibited within buildings.

.6 Transfer of flammable and combustible liquids will not be carried out in the vicinity of open flames or any type of heat-producing devices.

.7 Flammable liquids having a flash point below 38°C, such as naptha or gasoline, will not be used as solvents or cleaning agents.

.8 Store flammable (flash point < 37.8°C) and combustible (flash point < 37.8°C) waste liquids for disposal in approved containers located in a safe, ventilated area. Keep quantities to a minimum.

.9 Observe smoking regulations at all times. Smoking is prohibited in any area where hazardous, flammable, and/or combustible materials are stored, used, or handled.

.10 Abide by the following storage requirements for hazardous materials and wastes:
.1 Store hazardous materials and wastes in closed and sealed containers which are in good condition.

.2 Label containers of hazardous materials and wastes in accordance with WHMIS 2015.

.3 Store hazardous materials and wastes in containers compatible with that material or waste.

.4 Segregate incompatible materials and wastes.

.5 Ensure that different hazardous materials or hazardous wastes are not mixed.

.6 Store hazardous materials and wastes in a secure storage area with controlled access.

.7 Maintain a clear egress from storage area.

.8 Store hazardous materials and wastes in a manner and location which will prevent them from spilling into the environment.

.9 Have appropriate emergency spill response equipment available near the storage area, including personal protective equipment.

.10 Maintain an inventory of hazardous materials and wastes, including product name, quantity, and date when storage began.

.11 Ensure personnel have been trained in accordance with Workplace Hazardous Materials Information System (WHMIS 2015) requirements.

.12 Report spills or accidents immediately to SFU Project Manager, Campus Security and EHRS. Submit a written spill report to Project Manager and EHRS within 24 hours of incident.

1.8. TRANSPORTATION

.1 Transport hazardous materials and wastes in accordance with federal Transportation of Dangerous Goods Act, Transportation of Dangerous Goods Regulations, and applicable provincial regulations.
2.0 PRODUCTS

2.1. MATERIALS

.1 Only bring on site the quantity of hazardous materials required to perform work.

.2 Maintain SDSs in proximity to where the materials are being used. Communicate this location to personnel who may have contact with hazardous materials.

3.0 EXECUTION

3.1. DISPOSAL

.1 Dispose of hazardous waste materials in accordance with applicable federal and provincial acts, regulations, and guidelines.

.2 Recycle hazardous wastes for which there is an approved, cost effective recycling process available.

.3 Send hazardous wastes only to authorized hazardous waste disposal or treatment facilities.

.4 Burning, diluting, or mixing hazardous wastes for purpose of disposal is prohibited.

.5 Disposal of hazardous materials in waterways, storm or sanitary sewers, or in municipal solid waste landfills is prohibited.

.6 Dispose of hazardous wastes in a timely fashion in accordance with applicable provincial regulations.

.7 Dispose of aerosol cans in accordance with applicable regulations.

.8 Dispose of gas (propane/butane/other) cylinders in accordance with applicable regulations.

***END OF SECTION***
SPEC NOTE: Include this section only where new construction or major renovations are involved.

1.0 GENERAL

1.1. ENVIRONMENTAL CONTROLS

.1 Comply with Federal, Provincial and Campus regulations pertaining to waste, air, solid waste, hazardous waste, sanitary waste, sediment and noise pollution.

.2 Protection of natural resources: Preserve the natural resources within the project boundaries and outside the limits of permanent work performed under this Contract in their existing condition or restore to an equivalent or improved condition upon completion of the Work.

.1 Confine demolition and construction activities to areas defined by public roads, easements, and work area limits indicated on the Drawings.

.1 Temporary construction: Remove indications of temporary construction facilities, such as haul roads, work areas, structures, stockpiles of excess or waste materials, and other vestiges of construction as directed by Project Manager.

.2 Water resources: Comply with applicable regulations concerning the direct or indirect discharge of pollutants to the underground and natural waters.

.1 Oily substances: Prevent oily or other hazardous substances from entering the ground, drainage areas, or local bodies of water in such quantities as to affect normal use, aesthetics, or produce a measurable ecological impact on the area. Store and service construction equipment at areas designated for collection of oil wastes.

.2 Storm water management procedures should be followed during landscape design and the construction phase, see at http://www.sfu.ca/fs/planning/stormwater-management-strategy.html

.3 Land resources: Prior to construction, identify all land resources to be preserved within the work area. Do no remove, cut deface, injure, or destroy land resources including trees, shrubs, vines, grasses, top soil, and land forms without permission from the Project Manager.

.1 Erodible soils: Plan and conduct earthwork to minimize the duration of exposure of unprotected soils. Clear areas in reasonably sized increments only as needed to use the areas developed. Immediately protect side slopes and back slopes upon completion of rough grading.

.4 Erosion and sedimentation control: Construct or install temporary and permanent erosion and sedimentation control features as required to meet the City of Burnaby’s most up to date Sediment Control Measures and Information document.
ENVIRONMENTAL PROCEDURES

.5 Dust control, air pollution, and odor control: Prevent creation of dust, air pollution and odors.

.1 Use water sprinkling, temporary enclosures, and other appropriate methods to limit dust and dirt rising and scattering in air to lowest practical level. Do not use water when it may create hazardous or other adverse conditions such as flooding and pollution.

.2 For all projects including exterior work, a Dust Control Plan must be submitted to SFU Facilities.

.3 Store volatile liquids, including fuels and solvents, in closed containers.

.4 Properly maintain equipment to reduce gaseous pollutant emissions.

.6 Noise Control: Perform demolition and construction operations to minimize noise. Perform noise producing work in less sensitive hours of the day or week as directed by the SFU Facilities. Noise pollution should not be so severe as to affect cause discomfort to those in the vicinity. For full noise control requirements, refer to Division 01 Section 01 14 00 Work Restrictions, as well as City of Burnaby Noise or Sound Abatement Bylaw.

.7 Disposal operations:

.1 Promptly and legally transport and dispose of removed and demolished items and waste materials that are not identified to be recycled or reused.

.2 Do not burn, bury or otherwise dispose of rubbish and waste materials on project site.

1.2. FIRES

.1 Fires and burning of rubbish on SFU property is not permitted.

1.3. CONSTRUCTION SITE WASTES

.1 Do not bury rubbish and waste materials on site unless approved by Engineer.

.2 Do not dispose of waste or volatile materials, such as mineral spirits, chemicals, oil or paint thinner into waterways, storm or sanitary sewers.

.3 For general waste management and recycling requirements, refer to Division 01 Section 01 74 19 Construction Waste Management and Disposal.

1.4. DRAINAGE

.1 Provide temporary drainage and pumping as necessary to keep excavations and site free from water.

.2 Do not pump water containing suspended materials into waterways, sewer or drainage systems.
Control disposal or runoff of water containing suspended materials or other harmful substances in accordance with local authority requirements.

1.5. SITE CLEARING AND PLANT PROTECTION

.1 Protect trees and plants on site and adjacent properties where indicated.

.2 Protect roots of designated trees to dripline during excavation and site grading to prevent disturbance or damage. Avoid unnecessary traffic, dumping and storage of materials over root zones.

.3 Minimize the stripping of topsoil and vegetation.

.4 Restrict tree removals to areas indicated or designated by Engineer.

1.6. WORK ADJACENT TO WATERWAYS

.1 Do not operate construction equipment in waterways.

.2 Do not use waterway beds for borrow material [without Engineer's approval].

.3 Do not dump excavated fill, waste material or debris in waterways.

.4 Design and construct temporary crossings to minimize erosion to waterways.

.5 Do not skid logs or construction materials across waterways.

.6 Avoid indicated spawning beds when constructing temporary crossings of waterways.

.7 Do not blast under water or within 100 m of indicated spawning beds.

1.7. POLLUTION CONTROL

.1 Maintain temporary erosion and pollution control features installed under this contract.

.2 Control emissions from equipment and plant according to local authorities' emission requirements.

.3 Prevent sandblasting and other extraneous materials from contaminating air beyond application area, by providing temporary enclosures.

.4 Cover or wet down dry materials and rubbish to prevent blowing dust and debris. Provide dust control for temporary roads.

***END OF SECTION***
1.0 GENERAL

1.1 BUILDING PERMITS

.1 The British Columbia Building Code applies to all buildings on land on Burnaby Campus of Simon Fraser University. A Building Permit and Trade Permits are required from the City of Burnaby. No construction/demolition work may be started without a Building Permit and the applicable Trade Permits.

.2 A Building Permit has been applied for and will be obtained by the Consultant.

1.2 AUTHORITY HAVING JURISDICTION

.1 The "authority having jurisdiction" with respect to the Building Permit is the City of Burnaby.

.2 The "authority having jurisdiction" with respect to the British Columbia Fire Code is the Burnaby Fire Department.

1.3 SOIL DEPOSITION AND SOIL REMOVAL PERMITS

.1 These permits allow soil to be imported from an outside location and placed on a site within Burnaby, or removed from a location within Burnaby.

.2 These permits help ensure:

   .1 Environmental regulations are not contravened.

   .2 City bylaws and registered covenants or Rights of Way agreements are complied with.

   .3 Existing and planned City utility infrastructure is not adversely affected.

   .4 There are no adverse impacts on adjoining properties during, and on completion of, the deposition.

   .5 The Federal and Provincial regulatory responsibilities that the City is responsible for are satisfied.

1.4 DAMAGE DEPOSITS

.1 Contractors are required to protect all surrounding roadways, sidewalks, walkways and other site features outside the construction site boundary. A damage deposit is payable by the Contractor to SFU Facilities Services who is the sole authority to determine the amount of such deposits and if and how the deposits will be used to repair damage to the SFU Campus. A receipt for the damage deposit must be presented to the Permits & Inspections group before a Building Permit will be issued.

1.5 TRADE PERMITS

.1 Trade Permits must be obtained by the applicable Trade Contractor before any work is started. Such permits include but are not limited to:

   .1 Health Department (where applicable)
.2 Sprinkler Permit (where applicable)
.3 Plumbing Permit
.4 Electrical Permit

.2 The Contractor(s) shall provide a copy of the permit to the Facilities Services Representative prior to commencement of work.

.3 Evidence of applicable permits and approvals must be posted at the site prior commencement of the work.

1.6 FINAL INSPECTION

.1 No building or part thereof may be occupied without the prior written authorization of the City of Burnaby Building Inspector in the form of a Final Building Inspection Report, as well as the review of the Burnaby Fire Department and BC Safety Authority.

***END OF SECTION***
1.0 **GENERAL**

1.1 **SECTION INCLUDES**

.1 Inspection and testing, administrative and enforcement requirements.

.2 Mock-ups.

1.2 **RELATED SECTIONS**

.1 *Section 01 21 00 Allowances*

.2 *Section 01 91 00 Commissioning*

.3 This section describes requirements applicable to all Sections within *Divisions 01 to 33*.

1.3 **INSPECTION BY AUTHORITY**

.1 Allow Authorities Having Jurisdiction access to Work. If part of Work is in preparation at locations other than Place of Work, allow access to such Work whenever it is in progress.

.2 Give timely notice requesting inspection whenever portions of the Work are designated for special tests, inspections or approvals, either when described in the Contract Documents or when required by law in the Place of the Work.

.3 If Contractor covers or permits to be covered Work that has been designated for special tests, inspections or approvals before such is made, uncover such Work, have inspections or tests satisfactorily completed and make good such Work.

.4 The Contractor shall arrange for all inspections by Provincial authorities including, but not necessarily limited to, the Provincial Electrical Inspector, the Provincial Gas Inspector, the Provincial Elevator Inspector.

1.4 **REVIEW BY CONSULTANT**

.1 *Consultant* may order any part of Work to be reviewed if Work is suspected to be not in accordance with Contract Documents.

.2 If, upon review such work is found not in accordance with Contract Documents, correct such Work and pay cost of additional review and correction.

.3 If such Work is found in accordance with Contract Documents, [Owner] [Consultant] will pay cost of review and replacement.

1.5 **INDEPENDENT INSPECTION AGENCIES**

.1 The *Consultant* (unless otherwise instructed) will make recommendation to the *Owner* on the required Inspection Services, beyond those provided as part of the *Consultant’s basic services*, to assure construction quality and Code compliance. The recommendation will indicate which inspection services will be included in the Construction Contract and which will be performed under a direct contract between the *Owner* and the Testing Agency.

.2 Provide equipment required for executing inspection and testing by appointed agencies.

.3 Employment of inspection and testing agencies does not relax responsibility to perform Work in accordance with Contract Documents.

.4 If defects are revealed during inspection and/or testing, appointed agency will request additional inspection and testing to ascertain full degree of defect. Correct defect and
1.6 ACCESS TO WORK

.1 Allow inspection and testing agencies access to Work, off site manufacturing and fabrication plants.

.2 Co-operate to provide reasonable facilities for such access.

1.7 PROCEDURES

.1 Ensure adherence to the most up to date SFU Quality Control Standard.

.2 For major projects (> $2 Million), a Quality Control Program should be submitted by the contractor.

.3 Notify appropriate agency [and Consultant] in advance of requirement for tests, in order that attendance arrangements can be made.

.4 Submit samples and materials required for testing, as specifically requested in specifications. Submit with reasonable promptness and in an orderly sequence so as not to cause delay in Work.

.5 Provide labour and facilities to obtain and handle samples and materials on site. Provide sufficient space to store and cure test samples.

1.8 REJECTED WORK

.1 Remove defective Work, whether result of poor workmanship, use of defective products or damage and whether incorporated in Work or not, which has been rejected by Consultant as failing to conform to Contract Documents. Replace or re-execute in accordance with Contract Documents.

.2 The Consultant and Owner shall have the right to reject any item of work that does not conform to the Contract Documents and accepted standard of performance, quietness of operation, finish, and appearance.

.3 Make good other Contractor's work damaged by such removals or replacements promptly.

.4 If in opinion of Consultant it is not expedient to correct defective Work or Work not performed in accordance with Contract Documents, Owner may deduct from Contract Price the difference in value between Work performed and that called for by Contract Documents, amount of which shall be determined by Consultant.

1.9 MOCK-UPS

.1 Prepare mock-ups for Work specifically requested in specifications. Include for Work of all Sections required to provide mock-ups.

.2 Construct in all locations [acceptable to Consultant] [as specified in specific Section].

.3 Prepare mock-ups for [Owner's] [Consultant's] review with reasonable promptness and in an orderly sequence, so as not to cause any delay in Work.

.4 Failure to prepare mock-ups in ample time is not considered sufficient reason for an extension of Contract Time and no claim for extension by reason of such default will be allowed.
.5 If requested, Consultant will assist in preparing a schedule fixing dates for preparation.

.6 Remove mock-up at conclusion of Work or when acceptable to Consultant.

[OR]

.7 Mock-ups may remain as part of Work.

.8 Specification section identifies whether mock-up may remain as part of Work or if it is to be removed and when.

***END OF SECTION***
1.0 GENERAL

1.1 KEYS & ACCESS CONTROL

.1 The Contractor shall complete a Campus Security Card / Fob / Key Requisition form to obtain the appropriate access from Access Control Services, located in Room1300 of Discovery 1. An authorized signing authority is required to grant permission for the key request.

.2 From time of receipt of completed form, 2 business days are required to process the requisition at minimum.

.3 Identification and funds to cover the refundable deposit fee (and service charge if applicable) are required when proceeding to pick up keys/cards. The deposit will be refunded within ten (10) days of the Contractor returning the key to Access Control Services. Keys will not be issued to Subcontractors.

1.2 SECURITY

.1 SFU does not provide any security service for the Contractor. Should the Contractor wish to have his site attended, it will be his responsibility to provide this service at his own expense. The Contractor shall ensure that all openings to buildings are properly closed with secure barricades.

.2 The Contractor should provide SFU with names and phone numbers to contact at night, in case of an emergency. This list should be provided on the contractor’s letterhead and include the name of the project.

1.3 HOARDING

.1 Site Hoarding, barricades and barriers shall be constructed in accordance with good practice and all applicable regulations. Refer to Section 01 35 29 Health, Safety, and Emergency Response Procedures.

1.4 CONSTRUCTION ACCESS AND TRAFFIC MAINTENANCE

.1 Construction access procedures will adhere to SFU Policy AD1-3 Traffic and Parking Regulations.

.2 Construction access to the work areas within existing building for workers and delivery of materials shall be designated by the Project Manager. No other existing exits or entrances shall be used by workers for access or for delivery of materials.

.3 The Contractor shall conduct construction operations with minimum interference to adjacent roadways, sidewalks and access facilities in general and shall keep such areas free from materials, debris and equipment at all times. The Contractor shall not close or obstruct existing roadways, sidewalks, parking areas or delivery points and shall not place or store materials or park cars on same.
4. The Contractor shall cooperate in all ways with the Owner in all matters concerning necessary interference with normal operation of the SFU Campus facilities. Minimizing disruption of normal campus operation and vehicular movements on Campus is an essential requirement of the Contract.

5. The Contractor shall:

1. Include project phasing strategies in the construction schedule to minimize traffic disruption on Campus.

2. Provide one (1) week minimum notice to the Owner, previous to any disruption or alteration of access to the Campus. The Contractor shall provide all signs, pylons and flag persons necessary to direct vehicular traffic around work in progress.

3. The Contractor shall maintain access to existing fire hydrants and Siamese connections and shall keep entrances and exits to existing and adjacent buildings clear at all times.

1.5 CONSTRUCTION PARKING CONTROL

1. Construction parking procedures will adhere to SFU Policy AD1-3 Traffic and Parking Regulations.

2. Any vehicle owner who requires parking outside of the construction site must make arrangements with SFU Parking Services to obtain the correct parking permit, and the vehicles must then be parked in the appropriately designated areas.

3. No parking is allowed outside of the Contractor’s Hoarding unless the area has been designated on the drawings as being reserved for the Contractor. In most cases contractors working on renovations to existing SFU Buildings will not be provided with on-site parking and only time-limited loading permits will be issued.

4. Vehicles to be parked on the Campus shall be governed by the SFU Parking Services.

1.6 SCAFFOLDING & HOISTING

1. Elevators in Existing Buildings may be used, with prior permission, for access and moving of construction materials and equipment. The use of elevators in existing buildings must be coordinated with the Project Manager. In most cases the Contractor’s use of the elevator will be restricted to specified hours throughout the day.

2. Each sub-contractor shall provide all scaffolding necessary for execution of his work, unless alternative arrangements are made with the Prime Contractor in writing prior to tender.

3. The contractor is responsible for the safe use, certification, manpower and permitting for all scaffolding, elevator usage etc., ensuring to not damage SFU property.

1.7 LAYDOWN AREA

1. A dedicated project laydown area shall be coordinated with SFU Project Manager.
1.8 STORAGE SPACE

.1 Site storage space may not be obtainable. There shall be no obligation on the part of the Owner to provide any storage space. If storage space provided, contractors are restricted to premises for storage of all materials, tools and equipment.

1.9 TEMPORARY UTILITIES

.1 Temporary Power.

.1 SFU provides construction power.

.2 The connection point and voltage for the construction power are the responsibility of SFU Facilities.

.3 The Contractor shall pay for all materials and installation of equipment for the provision of temporary construction power.

.4 Consumption costs are typically not billed. Only excessive consumption will be billed at cost.

.2 Temporary Water

.1 A temporary water service can be installed upon consulting with SFU Facilities.

.2 Installation must be inspected before activation of service.

.3 Consumption costs are not billed. Only excessive consumption will be billed at cost.

.3 Temporary Heating and Ventilation

.1 No charge will be made for the cost of fuel for temporary heating when drawn from SFU plant, unless consumption is excessive in which case it will be billed at cost. The Contractor shall provide at his own expense necessary piping, connections, valves, hoses, etc. and make same available to all trades throughout the project. The Contractor shall disconnect and remove temporary service when no longer required.

.2 Provide temporary heat and ventilation in enclosed areas as required to:

.1 Facilitate the progress of the Work.

.2 Protect the Work against dampness and cold.

.3 Prevent moisture condensation on all surfaces.

.4 Provide ambient temperatures and humidity levels for storage, installation, and curing of materials.

.5 Provide minimum temperature of 10°C in areas where construction is in progress.

.6 Provide adequate ventilation to meet health regulations for a safe work environment.

.3 Construction heaters used inside building must be vented to outside or be non-flameless type. Solid fuel salamanders are not permitted.
.4 Sanitary Facilities

.1 For work in existing buildings an existing washroom will be available for use by the Contractor and workers. The Project Manager will designate the washroom to be used. This facility must be kept clean at all times. The washing of paint brushes, mixing of grout etc. in the washroom is strictly prohibited.

.2 For work on new buildings the Contractor shall provide temporary sanitary facilities and maintain in a clean condition.

.5 Fire Protection.

.1 Provide and maintain temporary fire protection equipment during performance of the Work.

.2 Burning of rubbish and construction waste materials is not permitted on site.

***END OF SECTION***
1.0 GENERAL

1.1 Related SFU Owners’ Technical Requirements

.1 Section 12 00 00 Furnishings (Computer Workstations)
.2 Section 12 35 53 Laboratory Casework (Wet Laboratories)
.3 Section 11 82 00 Waste Handling Equipment (Waste Management)
.4 Section 10 00 10 Special Room Requirements (Custodial)

1.2 Coordination Requirements

.1 Coordinate with SFU EHRS Ergonomics Program, and follow SFU Ergonomics Policy.

2.0 DESIGN REQUIREMENTS

2.1 Computer Workstations

SFU Ergonomics Checklist for Computer Workstation for Designers

<table>
<thead>
<tr>
<th>Category</th>
<th>Guideline</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coordination</td>
<td>• Coordinate with SFU EHRS Ergonomics Program</td>
</tr>
<tr>
<td>Desk Depth</td>
<td>• Depth of computer work surface is ≥30” if placing equipment on the desktop&lt;br&gt;• Depth of computer work surface is ≥24” if keyboard tray available</td>
</tr>
<tr>
<td>Desk Height</td>
<td>• Adjustable (electronic/pneumatic preferred): 22” to 48” for sit-stand options&lt;br&gt;• If work surfaces are fixed, set height at 28.5” and provide peg/brackets for height adjustments. Provide option for keyboard tray &amp; ensure installation is possible-avoid bars under desk&lt;br&gt;• Provide ≥1 electronic/pneumatic height adjustable desk as common resource (if using fixed height desks at individual workstations)</td>
</tr>
<tr>
<td>Desk Width</td>
<td>• Front edge of computer work surface (desk) is ≥28” width</td>
</tr>
<tr>
<td>Under desk width</td>
<td>• ≥30” wide for ADA preferred; at minimum ≥26” to provide space for keyboard tray</td>
</tr>
<tr>
<td>Under desk depth</td>
<td>• ≥23.5”–Leg clearance</td>
</tr>
<tr>
<td>Keyboard tray</td>
<td>• ≥26” width (sufficient space for keyboard and mouse)&lt;br&gt;• Mouse level¹ with keyboard; no knob height adjustable; removable palm rest</td>
</tr>
</tbody>
</table>

¹ Articulating swivel up mouse platform may be acceptable if it keeps mouse close and is easy to switch between the right and left
<table>
<thead>
<tr>
<th>Category</th>
<th>Guideline</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monitor</td>
<td>• Height and tilt adjustable</td>
</tr>
<tr>
<td></td>
<td>• User should have control over location on desk</td>
</tr>
<tr>
<td></td>
<td>• If large iMac (high on desk) are used, monitor arms will be necessary</td>
</tr>
<tr>
<td>Monitor-glare</td>
<td>• Provide sufficient blinds with user control</td>
</tr>
<tr>
<td></td>
<td>• Position monitors between banks of lights &amp; perpendicular to window (reduce glare)</td>
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<tr>
<td>Chair</td>
<td>• See pre-approved list or refer to checklist criteria below</td>
</tr>
<tr>
<td></td>
<td>• <strong>Height Adjustable</strong>: 15 to 22” (may need option for taller/shorter chairs)</td>
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<tr>
<td></td>
<td>• <strong>Seat Depth</strong>(^2): depth adjustable preferred (16 to 20”) or option for smaller seat pan</td>
</tr>
<tr>
<td></td>
<td>• <strong>Backrest Height</strong>: ≤17.7”-support for shoulders</td>
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<tr>
<td></td>
<td>• <strong>Lumbar support</strong>: Height adjustable required(^3) &amp; sufficient support so that it does not flatten out with weight against it; depth adjustable preferred</td>
</tr>
<tr>
<td></td>
<td>• <strong>Backrest Angle</strong>: Allow upright and at least 15° reclined posture.</td>
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<td></td>
<td>• <strong>Dynamic recline</strong>: must have tilt lock or sufficient tension control to support the user</td>
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<tr>
<td></td>
<td>• <strong>Seat Width</strong>: 19” (with option for narrower chair or armrests that come in closer)</td>
</tr>
<tr>
<td></td>
<td>• <strong>Armrest Height</strong>: Adjustable (7(^4) to 11”) &amp; removable (unless they can go low enough so as not to interfere with pulling in close to the desk);</td>
</tr>
<tr>
<td></td>
<td>• <strong>Armrest Width</strong>: Adjustable preferred if the distance between armrests can adjust between 15 and 20” or provide option for narrower seat pan</td>
</tr>
<tr>
<td></td>
<td>• <strong>Footrest</strong> must be provided if user’s feet do not rest firmly &amp; comfortably on floor.</td>
</tr>
<tr>
<td>Reception Desk</td>
<td>• Design to allow staff and customer to be at the same height (both seated or both at standing height with a higher chair available for staff)</td>
</tr>
</tbody>
</table>

\(^2\) as measured with the BIFMA chair measuring device

\(^3\) Either lumbar support or backrest height can be adjustable

\(^4\) If armrests do not go lower than 8” they should be removable
2.2 Wet Laboratories

.1 Preferred if work surfaces are height adjustable, electric/pneumatic preferred; peg/crank height adjustable is acceptable.

.2 For fixed height tables consider the work to be performed: large benchtop centrifuges should be placed on lower tables rather than the standard counter height of 36”.

.3 Leg clearance for seated work sections: 24"deep X 30” wide (i.e. no drawers including pencil drawers in this space).

.4 Height adjustable biosafety cabinets.

.5 Preferred if biosafety cabinets can have a 14” opening or as large as possible given other safety concerns, and angled glass to ease.

.6 2-step platform should be provided in front of mid-sized liquid nitrogen dewars and overhead lift for large liquid nitrogen dewars.

.7 Provide comfortable & supportive lab chairs (height adjustable, backrest height and angle adjustable and foot ring height adjustable).

2.3 Building Services (Custodial) Residences

.1 Refer to Section 10 00 10 Special Room Requirements, paragraph 1.11.

.2 Ensure main storage room is large enough to accommodate equipment such as auto floor cleaners and a washer/drier (for mop heads)-consider raised platform for frontload washer.

.3 Accessible service elevators in every building large enough for custodial equipment, such as trash carts, floor scrubbers and large no-touch cleaning systems.

.4 Ease of cleaning/maintenance: provide surfaces that are easy to clean and easy access to equipment for maintenance and ensure flooring is slip resistant.

.5 Ensure materials used for walls and sub-floors support the moisture of no-touch cleaning systems.

.6 Ensure flooring slopes down to drain-avoid placing drain higher than flooring.

.7 Consider installing shower hoses-this will make it easier for building service workers when cleaning showers.

.8 Water and sustainability issues are very important to consider; however, certain types of low water, high-efficiency, dual flush toilets may require additional cleaning and may be more difficult to clean than standard toilets. Install toilet systems that have a high Waste Removal Performance Measure (MaP3) rating to the amount of daily cleaning required. To see ratings, consult [http://www.bewaterwise.com/pdf_rebates_toilets_01.pdf](http://www.bewaterwise.com/pdf_rebates_toilets_01.pdf) or [http://www.map-testing.com/about/maximum-performance/map-search.htm](http://www.map-testing.com/about/maximum-performance/map-search.htm).
.9 Ensure furniture in resident rooms can be moved with <30lbs of force.

.10 Ensure resident room layout provides sufficient space for staff to be able to make beds.

2.4 Food Services

.1 Pass through to customer: Provide barrier free area to allow staff to comfortably pass food to customers; keep frequent reaching to <14" and below chest level.

Rationale: minimize extended frequent reaching (CSA Z1004-12, B.3.3.2 (p.74), frequent reach zone <14").

.2 Pass through between cook and sales attendant: Provide area that requires minimal reach for both staff and sales attendants.

Rationale: minimize extended frequent reaching (CSA Z1004-12, B.3.3.2 (p.74), frequent reach zone <14").

.3 Working Heights: provide height adjustable preferred; if that is not possible other options for varying work heights to accommodate the different types of tasks require.

Rationale: tasks that require precision are best done at a table slightly above elbow height while tasks that require force at best done at a table below elbow height (CSA Z1004-12, tool 3b, p.80; precise work: 1.5 to 2" above elbow; light work: 2 to 4" below elbow; and, heavy work: 7 to 15" below elbow height).

.4 Garbage, compost & recycling: Provide sufficient space for compost bins near to where they will be needed; ensure compost bins are on wheels for transport or if not, the bins should be small for lifting/carrying; ensure there is a clear pathway between point of origin and destination.

.5 Storage area(s): specific square footage will vary; design to provide more than enough space to store all the needed items and allow space for expansion as it is likely that storage requirements will increase over time.

Rationale: Planning for sufficient storage space is critical to reducing musculoskeletal injury risks; insufficient space results in staff working in awkward postures and double handling products which significantly increases the risk of injury.

.6 Ease of cleaning/maintenance: provide surfaces that are easy to clean and easy access to equipment for maintenance and ensure flooring is slip resistant.

2.5 Waste Management

.1 Refer to Section 11 82 00 Waste Handling Management.

.2 Addition to 1.1.2.5: Ramp/Ground level access should be provided near the loading dock or primary point of exit when staff are bringing compost/recycling bins to designated pickup area.

Rationale: ease of access-avoid need for staff to bump bins down a set of stairs or walk long way around building.
.3 Height of waste containers (dumpsters): ≤36” at opening or provide platform/dock.

Rationale: eliminate above shoulder level reaching for staff when throwing out garbage.

.4 Clear/smooth path with minimal distance when pushing compost/recycling bins to designated pickup area.

Rationale: recycling/compost bins, particularly compost bins, can become heavy and/or difficult to push particularly over uneven surfaces.

.5 Compactor. Provide sufficient space for electronic assist tow to remove compactor from building when bringing to designated pick-up (confirm clearance with CAD drawings).

Rationale: Large compactors require >50lbs of pull force; electronic assist tow will need to be provided to reduce musculoskeletal injury risk factors.

***END OF SECTION***
1.0 GENERAL

1.1 SUMMARY

.1 Projects shall generate the least amount of construction and demolition waste possible, by utilizing the following methods:

.1 Plan for waste minimization and diversion before project start-up. A waste management plan is to be provided by Contractor, defining the commitment to SFU’s Zero Waste Philosophy.

.2 Minimize waste due to error, poor planning, breakage, mishandling, contamination, or other factors.

.3 Reuse or salvage as much material as possible.

.4 Recycle all materials that can be feasibly recycled.

.5 Source separation of waste is to be adopted by Contractor.

.2 Waste Diversion Goal

.1 The goal for projects not being certified under LEED green building systems is to divert at least 75% of construction and demolition waste from disposal. For LEED projects, refer to current LEED requirements for waste diversion targets and other waste related requirements.

.3 All projects shall track (via project submittals) the amount of waste and diversion achieved. Tracking and reporting templates are provided in the Submittal Templates section.

.1 Required submittals depend on the type of project. Refer to Section 1.3 Submittals.

.4 Refer to information packages available from SFU and also the Metro Vancouver DLC Waste Management Toolkit for information on how waste diversion targets can be achieved. In many cases, economic savings are possible by reducing, reusing and recycling waste instead of disposing waste.

.5 SFU Facilities Operations waste bins are not to be used for Construction Waste generated in projects.

.6 If construction waste can be managed, construction team should make the effort to do so.

1.2 WASTE MANAGEMENT PLAN

.1 Developing a Waste Management Plan is a simple process achieved by filling out a template. Refer to the template found in section 2.5.

.2 A Waste Management Plan shall contain the following information:

.1 Estimates of the types and amounts of waste expected to be generated on the project, where the wastes will be taken for processing, and the expected diversion rates for each type of material.

.2 Waste manifests must be completed for all projects in accordance with the Ministry of Environment requirements.
.3 Planning for waste management should include determining if demolition and construction waste materials will be source-separated on the project site and/or commingled for later separation at the processing site, and how waste materials will be separated (where applicable) and stored on the project site. Note that commingled waste collection may be restricted in LEED projects.

1.3 **SUBMITTALS**

.1 All projects:

.1 Within 2 weeks of the completion of demolition or deconstruction work and also within 2 weeks of completion of construction or renovation work, submit Waste Tracking forms and Waste Diversion Report(s).

.2 Projects with total demolition/construction value of $200,000 or greater:

.2 In addition to the above submittals, no later than 2 weeks prior to removing any waste from the Project site, submit Waste Management Plan.

.3 Projects applying for LEED certification may utilize the waste tracking and reporting submittals specified under LEED rating systems, as alternatives to the above Waste Diversion Reports and Waste Tracking Templates.

.4 Where SFU provides electronic templates, SFU encourages the creation of submittal documents using these templates, as they include formulas to calculation waste diversion and other reporting information.

.5 SFU may also make available online (web based) electronic construction and demolition waste submittal forms. In this case, submittals through the online system are encouraged, however paper submittals may still be required for LEED projects.

.6 Submit copies of all Waste Manifest to the SFU Project Manager and EHRS within 24 hours after it have been processed.

1.4 **RELATED SECTIONS AND SFU OWNERS’ TECHNICAL REQUIREMENTS**

.1 This section describes requirements applicable to all Sections within Divisions 01 to 33.

1.5 **DEFINITIONS**

.1 Construction and Demolition Waste: Solid wastes typically including but not limited to, building materials, packaging, trash, debris, and rubble resulting from construction, re-modelling, repair and demolition operations.

.2 Commingled Waste: Unlike source separated waste, commingled waste entails collecting multiple types of waste together in a single container for later separation at a waste processing facility.

.3 Disposal: Removal of a waste material that will not be reused, returned, recycled, or salvaged from the project site (see Trash).

.4 Diversion rate: The amount of waste reused, returned, salvaged, and recycled; divided by the total amount of waste generated, in percent; 100% diversion rate means no waste is disposed.

.5 Hazardous: Exhibiting the characteristics of hazardous substances including, but not limited to, flammability, corrosiveness, toxicity or reactivity.

.6 Recyclable: The ability of a product or material to be recovered at the end of its life cycle and re-manufactured into a new product for use by others.
.7 Recycle: To remove a waste material from the Project site to another site for re-manufacture into a new product for use by others.

.8 Return: To give back reusable items or unused products to vendors for credit.

.9 Reuse: To utilize a construction waste material in some manner on the Project site.

.10 Salvage: To remove a waste material from the Project site to another site for resale or use by others.

.11 Sediment: Soil and other debris that has been eroded and transported by storm or well production run-off water.

.12 Source Separation: The act of keeping different types of waste materials separate beginning from the first time they become waste.

.13 Trash: Any product or material unable to be reused, returned, recycled, or salvaged.

.14 Waste: Extra material or material that has reached the end of its useful life in its intended use. Waste includes salvageable, returnable, recyclable, reusable, and trash materials.

2.0 EXECUTION

2.1 PREPARATION

.1 Handle waste materials in accordance with all appropriate regulations and codes and SFU policies and procedures.

2.2 WASTE MANAGEMENT PLAN IMPLEMENTATION AND TRACKING

.1 Designate an on-site party responsible for instructing workers and overseeing and documenting results of the Waste Management Plan for the Project.

.2 Distribute copies of the Waste Management Plan to the Job Site Foreman, each Subcontractor, the Owner, and the Consultant.

.3 Provide on-site instruction of appropriate separation, handling, and recycling, salvage, reuse, and return methods to be used by all parties at the appropriate stages of the Project.

.4 Lay out and label a specific area to facilitate separation of materials for potential recycling, salvage, reuse, and return. Recycling and waste bin areas are to be kept neat and clean and clearly marked in order to avoid contamination of materials.

.5 Manage waste materials

.1 Separate, protect, store and catalogue items to be reused and salvaged.

.2 Separate, store, and dispose of hazardous wastes according to local regulations.

.3 Transport and deliver non-salvageable items to licensed reuse, recycling or disposal facility.

.6 Track the types, amounts, destination, and diversion rates for all waste materials throughout the project, including both demolition and construction phases.

.1 For each shipment of waste material from the site or materials reused on the site, track the types, amount shipped, destination (facility name and location), and amount diverted (reused, salvaged or recycled).

.1 Request and retain all weight tickets and receipts from all waste destinations such as transfer stations, recycling facilities, etc., showing
material weights both disposed and diverted. Retain these for a period of at least two years.

.2 Use the Waste Tracking template provided to assist in collecting waste diversion data.

.3 Based on the Waste Tracking information, complete and submit the Waste Diversion Report as described in the Submittals section.

.7 Maintain at job site, one copy of following documents:

.1 Waste Management Plan, where required under Submittals.
.2 Waste Tracking forms.

2.3 STORAGE, PROTECTION AND DISPOSAL

.1 Protect structural components not removed for demolition from movement or damage.

.2 Support affected structures. If safety of building is endangered, cease operations and immediately notify Consultant.

.3 Protect surface drainage, storm sewers, sanitary sewers, and utility services from damage and blockage.

.4 Waste must be delivered to licensed waste and recycling facilities as per applicable local regulations.

.5 Burying of rubbish and waste materials is prohibited unless approved by the authority having jurisdiction. Examples of such unacceptable practice include hiding drywall or other waste within the wall spaces.

.6 Disposal of volatile materials, mineral spirits, oil, paint thinner and hazardous waste materials into waterways, storm, or sanitary sewers is prohibited.

2.4 CLEANING

.1 Remove tools and waste materials on completion of work, and leave work area in clean and orderly condition.

.2 Clean-up work area as work progresses.

2.5 SUBMITTAL TEMPLATES

.1 Construction and demolition waste submittals shall include the information shown in the following templates.

.1 LEED projects may require additional or slightly different submittals – consult those standards for more information.

.2 Table A – Waste Management Plan Template

.1 Where required under Submittals, to be completed prior to project start-up.

.3 Table B – Waste Tracking Form Template

.1 This template can be used to easily record waste diversion by entering information from weight tickets or receipts provided by transfer stations, recycling or processing facilities.

.4 Table C – Waste Diversion Report

.1 The waste tracking report provides the calculated waste diversion information that SFU needs for each project. It is filled out based on the data entered in the
waste tracking form. In electronic versions (i.e., spreadsheet or web-based), this report can be automatically generated.
## A. Waste Management Plan

### A.1. Waste Estimation

<table>
<thead>
<tr>
<th>Project Name:</th>
<th>Date:</th>
<th>Prepared By:</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Type of Waste Material</th>
<th>Recycle / Disposal Facility to be used</th>
<th>Total Waste to be Generated</th>
<th>Percentage of Waste to be Diverted</th>
<th>Total Waste to be Diverted</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Reuse on-site</td>
<td>Total</td>
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<td></td>
<td></td>
<td></td>
<td>Reuse off-site</td>
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<td></td>
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<td>Recycle</td>
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<tr>
<th>(Name)</th>
<th>(Tonnes)</th>
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<tr>
<td>1</td>
<td>Appliances</td>
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<td>2</td>
<td>Bricks</td>
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<td>3</td>
<td>Cable &amp; Wiring</td>
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<td>4</td>
<td>Cardboard</td>
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<td>5</td>
<td>Carpeting &amp;</td>
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<tr>
<td>6</td>
<td>Ceramic (e.g.)</td>
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<tr>
<td>7</td>
<td>Clean fill &amp; Soil</td>
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<td>8</td>
<td>Concrete</td>
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<tr>
<td>14</td>
<td>Mixed Waste</td>
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<td>15</td>
<td>Paper</td>
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<td>16</td>
<td>Plastic (rigid)</td>
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<tr>
<td>17</td>
<td>Plastic (soft)</td>
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<tr>
<td>18</td>
<td>Plumbing Fixture</td>
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<td>19</td>
<td>Roofing (shingles,)</td>
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<tr>
<td>20</td>
<td>Windows in</td>
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<tr>
<td>21</td>
<td>Wood (plywood,)</td>
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<td>22</td>
<td>Wood</td>
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<td>Total</td>
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<tr>
<td>28</td>
<td>Percentage (%) (From total waste to be divert)</td>
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<table>
<thead>
<tr>
<th>Weight (Tonnes)</th>
<th>Sum (Column)</th>
<th>Sum(Di*Ci) /100</th>
<th>Sum(Ei*Ci) /100</th>
<th>Sum(Fi*Ci) /100</th>
<th>D27+E27+F27</th>
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</thead>
<tbody>
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</table>

<table>
<thead>
<tr>
<th>Sum (Column)</th>
<th>D27/C27</th>
<th>E27/C27</th>
<th>F27/C27</th>
<th>H27/C27</th>
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### A.2. Calculations *(based on information entered on Section A.1)*

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<th>Date:</th>
<th>Prepared By:</th>
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<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Expected Waste to be Generated and Diverted</strong></td>
<td><strong>Total Waste to be Generated (Tonnes)</strong></td>
<td><strong>Percentage of Waste to be Diverted (%)</strong></td>
</tr>
<tr>
<td>29 Demolition Waste</td>
<td>C 27 <em>(Demolition Stage)</em></td>
<td>H 27 <em>(Demolition Stage)</em></td>
</tr>
<tr>
<td>30 Construction Waste</td>
<td>C 27 <em>(Construction Stage)</em></td>
<td>H 27 <em>(Construction Stage)</em></td>
</tr>
<tr>
<td>31 All Waste</td>
<td>B 29 + B 30</td>
<td>(C 29 + C 29) / B 31 * 100</td>
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</table>
# B. Waste Tracking Form

<table>
<thead>
<tr>
<th>#</th>
<th>Weight ticket, receipt or bin reference</th>
<th>Date Load Hauled</th>
<th>Recycle/Disposal Facility</th>
<th>Type of Waste Materials</th>
<th>Total Waste Generated</th>
<th>Percentage of Waste Diverted</th>
<th>Reuse on-site</th>
<th>Reuse off-site</th>
<th>Recycle</th>
<th>Total</th>
<th>Total Waste Diverted</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(from recycling or disposal facility)</td>
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<td>DD/MM/YYYY</td>
<td>(Name)</td>
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</tbody>
</table>
### C. Waste Diversion Report

*(The calculations may refer to the cells in Form B or the cells in this form.)*

<table>
<thead>
<tr>
<th>Project Name:</th>
<th>Date:</th>
<th>Prepared By:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>C.1. Waste Generated and Diverted</td>
<td>Total Waste Generated</td>
<td>Total Waste Diverted</td>
<td>Percentage of Waste Diverted</td>
<td></td>
</tr>
<tr>
<td>(Tonnes)</td>
<td>(Tonnes)</td>
<td>(%)</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Demolition Waste</td>
<td>Form B (Demolition Stage): Sum (Column F)</td>
<td>Form B (Demolition Stage): Sum (Column K)</td>
<td>C1/B1*100</td>
</tr>
<tr>
<td>2</td>
<td>Construction Waste</td>
<td>Form B (Construction Stage): Sum (Column F)</td>
<td>Form B (Construction Stage): Sum (Column K)</td>
<td>C2/B2*100</td>
</tr>
<tr>
<td>3</td>
<td>All Waste</td>
<td>B1 + B2</td>
<td>C1 + C2</td>
<td>C3/B3*100</td>
</tr>
</tbody>
</table>
**SPEC NOTE:** This Section is meant to be a sample close-out for most projects. Review all clauses/requirements and edit/remove/add as appropriate for specific project.

### 1.0 RELATED SECTIONS

[1. Section 01 77 00 Closeout Procedures]

<table>
<thead>
<tr>
<th>Project #:</th>
<th>Project Description:</th>
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<table>
<thead>
<tr>
<th>Check Item</th>
<th>YES</th>
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<th>N/A</th>
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<tbody>
<tr>
<td>1 Final Cleaning Completed (Construction Filters Removed, Final Filters and Strainers Installed)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 Adequate Flushing of Domestic Water Services Has Been Completed</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 Underground Piping Camera (Scope) Tests Completed and Videos/pictures Turned Over</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 Fire Safety Plan Submitted with all Fire Protection Specialties Requirements Fulfilled and Coordinated</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 Final Total Building Commissioning Plan Submitted</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 Demonstration and Training Sessions Completed and Accepted by Facilities</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7 Final Deficiency List Agreed to By Project Team with Action Items and Timelines for Completion</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8 Record Drawings Submitted According to Requirements in 01 77 00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9 Final Operating/Maintenance Manuals with Supplier Contacts Complete with Final Review Comments/ Deficiencies Addressed</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10 Spares Delivered Including Signed Itemized List</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11 Labelling and Identification Completed and Accepted by Facilities</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12 Maintenance/Test Equipment/Tools Delivered</td>
<td></td>
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</tr>
<tr>
<td>13 Warranty Statements Received According to Requirements in 01 77 00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14 Warranty Procedure Established (Refer to 01 77 00 for sample)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15 All Change Orders Resolved</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>16 No Outstanding Claims</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>17 Backcharges Satisfied</td>
<td></td>
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<tr>
<td>18 Deposits Redeemed</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>19 Owner - Furnished Equipment and Surplus Material Returned</td>
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<td></td>
</tr>
<tr>
<td>20 All Safety Incidents Resolved</td>
<td></td>
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</tr>
<tr>
<td>21 Building Permits Closed</td>
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</tr>
<tr>
<td>22 Occupancy Permit Issued</td>
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</tr>
<tr>
<td>23 Lien Search Completed</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>24 Lessons Learned Meeting Held Following Warranty End Review</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25 All Other Stakeholders Informed of Project Completion</td>
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<td></td>
</tr>
<tr>
<td>26 Final Invoice Approved</td>
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</table>
**SPEC NOTE:** This Section is meant to be a sample close-out for most projects. Review all clauses/requirements and edit/remove/add as appropriate for specific project.

### 1.0 RELATED SECTIONS

1. Section 01 77 00 Closeout Procedures

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<tr>
<td>1. Final Cleaning Completed (Construction Filters Removed, Final Filters and Strainers Installed)</td>
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<tr>
<td>10. Spares Delivered Including Signed Itemized List</td>
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<td>11. Maintenance/Test Equipment/Tools Delivered</td>
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<tr>
<td>25. Final Invoice Approved</td>
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</tbody>
</table>
1.0 GENERAL

1.1 SECTION INCLUDES

.1 Administrative procedures preceding preliminary and final inspections of Work. It may be advantageous to refer to the CSA link found in this Section under 1.3.2.1.
.2 As-built drawings, material overages, and specifications.
.3 Equipment and systems.
.4 Product data and related information.
.5 Spare parts, special tools and special/unique maintenance materials.
.6 Final site survey.
.7 Cleaning.
.8 Closeout submittals.

1.2 RELATED SECTIONS

.1 Section 01 33 00 Submittal Procedures
.2 Section 01 45 00 Quality Control
.3 Section 01 77 00.1 Project Close-Out Checklist
.4 Section 01 77 00.2 Building Transition Plan Checklist
.5 Section 01 78 23 Operation and Maintenance Data
.6 Section 01 78 39 Project Record Documents
.7 Section 01 78 45 Maintenance Materials
.8 Section 01 79 00 Demonstration and Training
.9 Section 01 91 00 Commissioning
.10 Section 09 65 00 Resilient Flooring
.11 Section 27 05 00 Common Work Results for Communications

1.3 REFERENCES

.1 Canadian Construction Documents Committee (CCDC)
  .1 CCDC 2-2008, Stipulated Price Contract.
  .2 The Builders Lien Act latest edition.

.2 Canadian Standards Association (CSA)
  .1 Building Commissioning Standard & Check Sheets

2.0 INSPECTION & DECLARATION

SPEC NOTE: Ensure that the wording of this Section conforms to the intent of The Builders Lien Act. The Builders Lien Act supersedes items in this document.

2.1 CONTRACTOR’S INSPECTION: Contractor and all Subcontractors shall conduct an inspection of Work, identify deficiencies and defects, and repair as required to conform to Contract Documents.
.1 Notify Owner’s Representative in writing of satisfactory completion of Contractor’s Inspection and that corrections have been made.

.2 Request Owner’s Representative Inspection.

.3 Owner’s Representative to contact SFU’s Custodial Services, regarding floor cleaning guidelines.

2.2 **Owner’s Representative Inspection:** Owner’s Representative and Contractor will perform inspection of Work to identify obvious defects or deficiencies. Contractor shall correct Work accordingly.

.1 Owner’s Representatives must ensure that, as part of their duties at the time of Handover/Occupancy, the required building keys etc. have been installed into the building’s new lockbox.

2.3 **Procedure for Turnover of New Buildings:**

.1 Review Section 01 77 00.1 Project Close-Out Checklist.

.2 Review Section 01 77 00.2 Building Transition Plan Checklist

.3 Review Section 01 91 13 Commissioning General Requirements

.4 Allow a holdback set in place for the completion of commissioning, which will occur after declarations required by the Builders Lien Act.

2.4 **Completion:** Submit written certificate that following have been performed:

.1 Work has been completed and inspected for compliance with Contract Documents.

.2 Defects have been corrected and deficiencies have been completed.

.3 A list of deficiencies shall be sent to the Owner’s Representative.

.4 Equipment and systems have been tested, adjusted, balanced, commissioned and are fully operational.

.5 Flushing of domestic water systems has been completed.

.6 Certificates required by Boiler Inspection Branch and Burnaby Fire Department have been submitted.

.7 Operation of systems has been demonstrated to Owner’s personnel, and training has been provided.

.8 Work is complete and ready for Final Inspection.

.9 Construction clean by contractors (dust, debris, etc.) has been completed.

.10 Completion of SFU Project Closeout Checklist.

.11 Record drawings have been submitted (maximum 4 months for completion)

.12 O&M manuals have been submitted and reviewed by Owner.

.13 Itemized list signed by Contractor and SFU Representative.
.14 Specific warranty letters must be received from each discipline – a blanket letter is not sufficient.

2.5 **Final Inspection:** When items noted above are completed, request final inspection of Work by Owner’s Representative and Contractor. If Work is deemed incomplete by Owner’s Representative, complete outstanding items and request re-inspection.

3.0 **Cleaning**

1.1 **Project Cleanliness**

.1 Maintain Work in tidy condition, free from accumulation of waste products, debris and dust, including that incidentally caused by Owner or other Contractors, and similarly notify Owner’s forces or other Contractors carrying out work. Control dust migrating to occupied areas and isolate ventilation systems during renovations.

.2 Remove waste materials from site at regularly scheduled times, or dispose of as directed by Owner’s Representative. Do not burn waste materials on site.

.3 Clear snow and ice from access to building, bank/pile snow in designated areas only.

.4 Provide on-site dump containers for collection of waste materials and debris. SFU waste containers are **not** to be utilized by Contractors.

.5 Provide and use clearly marked separate bins for recycling.

.6 Remove waste material and debris from site and deposit in waste container at end of each working day.

.7 Dispose of waste materials and debris off site.

.8 Clean interior areas prior to start of finish work, and maintain areas free of dust and other contaminants during finishing operations.

.9 Store volatile waste in covered metal containers, and remove from premises at end of each working day.

.10 Provide adequate ventilation during use of volatile or noxious substances. Use of building ventilation systems is not permitted for this purpose.

.11 Use only cleaning materials recommended by manufacturer of surface to be cleaned, and as recommended by cleaning material manufacturer.

.12 Schedule cleaning operations so that resulting dust, debris and other contaminants will not fall on wet, newly painted surfaces nor contaminate building systems.

1.2 **Final Cleaning**

.1 At completion of the Work, just prior to final inspection and takeover by the Owner, a general cleaning of the areas affected shall be carried out by the Contractor’s forces.

.2 Upon handover and before occupancy, SFU Project Manager will initiate SFU Facilities ‘trade assist’ for final clean prior to occupancy. Execute final cleaning employing only skilled workers.
.3 Examine and adjust all doors, sash and hardware; leave all in perfect working order, cleaned and polished.

.4 Examine and clean all fixtures to produce intended appearance and use.

.5 Remove all paint spots, stains, rubbish, debris, tools and equipment from all areas and broom clean.

.6 Brush off, dust and polish all ledges, stairs, glazed walls, etc.

.7 Wash down and dry all floors. Sealing and waxing resilient flooring will be carried out by SFU Custodial Services, unless otherwise noted.

.8 Prior to final completion or Owner occupancy, the Contractor shall conduct an inspection of sight-exposed surfaces, and all work areas, to verify that the entire work is clean.

.9 The Contractor shall clear roof, grounds and exterior paved areas and walks of all construction debris, dirt and dust and shall replace any damaged grass or landscaping, leave in condition to the satisfaction of the Consultant and the Owner.

.10 For SFU Custodial Floor Cleaning Standards, refer to Division 09, Section 09 00 10 Finishes – General Requirements.

1.3 Cleaning Materials

.1 Use products which minimize environmental impact, including indoor air quality.

.2 Avoid VOC’s (Volatile Organic Compounds) or give preference to Low VOC’s whenever possible

.3 Obtain recommendations for cleaning
   .1 new materials affected: from manufacturers of product installed.
   .2 existing materials affected: from SFU Custodial Services, through the Owner’s Representative.

1.4 Handover or Turnover Procedures

.1 The project Manager must contact SFU Custodial Services before the handover by the Contractor, and before User Occupancy, to allow the general cleaning to take place as per SFU Custodial Floor Cleaning Guidelines.
4.0 CLOSEOUT SUBMITTALS

.1 Submittals are to be submitted in the proper format and manner before project closeout. Refer to Section 01 33 00 – Submittal Procedures and 01 77 00.1 Close-out Checklist.

1.1 O&M Data

.1 For detailed instructions on the preparation and submission of operating and maintenance manuals, refer to Section 01 78 23 Operation and Maintenance Data of the Technical Guidelines.

.2 Ensure spare parts, maintenance materials and special tools provided are new, undamaged or defective, and of same quality and manufacture as products provided in Work.

.3 If requested, furnish evidence as to type, source and quality of products provided.

.4 Defective products will be rejected, regardless of previous inspections. Replace products at own expense.

1.2 Format and Contents

.1 Refer to Sections 01 78 39 Project Record Documents and 01 78 23 Operation and Maintenance Data for information on the format/contents of drawings and operating & maintenance manuals.

1.3 As-Builts and Record Documents

.1 [In addition to requirements in General Conditions.] maintain [at the site for [Engineer][Consultant][Owner’s Representative]] one record copy of:

.1 As-built Drawings (replaced with record drawings created from redline as-built drawings, inclusive of any site instructions/ change orders/ RFI, when available)

.2 Updated BIM/ non-cad files as applicable depending on project.

.3 Specifications.

.4 Addenda.

.5 Change Orders and other modifications to the Contract.

.6 Reviewed shop drawings, product data, and samples.

.7 Field test records.

.8 Inspection certificates.

.9 Manufacturer's certificates.

.2 Store record documents and samples in field office apart from documents used for construction. Provide files, racks, and secure storage.
.3 Label record documents and file in accordance with Section number listings in List of Contents of this Project Manual. Label each document “PROJECT RECORD” in neat, large, printed letters.

.4 Maintain record documents in clean, dry and legible condition. Do not use record documents for construction purposes.

.5 Keep record documents and samples available for inspection by [Engineer] [Consultant].

.6 Complete Records Submission Checklist prior to record submissions (refer to section 01 78 39)

1.4 **Final Survey**

.1 Submit final site survey certificate in accordance with *Section 01 78 39 Project Record Documents* - Preparation, certifying that elevations and locations of completed Work are in conformance, or non-conformance with Contract Documents.

1.5 **Materials and Finishes**

.1 Building Products, Applied Materials, and Finishes: include product data, with catalogue number, size, composition, and color and texture designations. Provide information for re-ordering custom manufactured products.

.2 Instructions for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.

.3 Moisture-protection and Weather-exposed Products: include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.

.4 Additional Requirements: as specified in individual specifications sections.

1.6 **Spare Parts**

.1 Provide spare parts, in quantities specified in individual specification sections.

.2 Provide items of same manufacture and quality as items in Work.

.3 Deliver to Owner’s Representative.

.4 Receive and catalogue all items. Submit inventory listing to Owner’s Representative. Include approved listings in Maintenance Manual.

.5 Obtain receipt for delivered products and submit prior to final payment.

1.7 **Maintenance Materials**

.1 Provide maintenance and extra materials, in quantities specified in individual specification sections.

.2 Provide items of same manufacture, finish, colour and quality as items in Work.

.3 Deliver to Owner’s Representative.

.4 Receive and catalogue all items. Submit inventory listing to Owner’s Representative. Include approved listings in Maintenance Manual.
.5 Obtain receipt for delivered products and submit prior to final payment.

1.8 Special Tools

.1 Provide special tools, in quantities specified in individual specification section.

.2 Provide items with tags identifying their associated function and equipment.

.3 Deliver to [site] [location as directed]; place and store.

.4 Receive and catalogue all items. Submit inventory listing to Owner’s Representative. Include approved listings in Maintenance Manual.

1.9 Warranties and Bonds

.1 Separate each warranty or bond with index tab sheets keyed to Table of Contents listing.

.2 List subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.

.3 Obtain warranties and bonds, executed in duplicate by subcontractors, suppliers, and manufacturers, within ten days after Substantial Completion of the applicable item of work.

.4 Except for items put into use with Owner's permission, leave date of beginning of time of warranty until the Date of Substantial Performance is determined.

.5 Verify that documents are in proper form, contain full information, and are notarized.

.6 Co-execute submittals when required.

.7 Retain warranties and bonds until time specified for submittal.

.8 Warranty Procedure for the project shall be established prior to close-out. Typical SFU Warranty Procedure is as follows [Edit to be project specific as required]:

The General Contractor shall remain at the service of the owner to address any commissioning related issues throughout the warranty period. This may include coordination of deferred testing/commissioning, deficiency resolution and sign-off, and addressing specific occupant or owner concerns. Near the end of the warranty period, the Contractor shall participate in a review meeting/workshop of warranty issues and their resolution during the warranty period.

Owner and Occupant concerns for warranty related items shall be communicated through the appropriate channels. These concerns shall be reported to the PM and then vetted and relayed to the project team, including the Contractor, Subs, Consultants, and Commissioning Authority for energy and water and occupant comfort items (or those under the CxA scope). An investigation process to address concerns shall be lead by the responsible contractors with support from the CxA. Subsequent action may include additional commissioning, deficiency resolution, and tuning of the systems with the contractor team and equipment manufacturers, under supervision and direction of CxA. Upon resolution of the issue, the occupants are informed through the appropriate channels.

***END OF SECTION***
1.0 GENERAL

1.1 PURPOSE

.1 To guide those responsible for the design, construction and commissioning of building systems in the preparation and delivery of operating and maintenance (O&M) documentation that:

.1 is simple to prepare and update

.2 is delivered on time

.3 is easy to use, and

.4 provides accurate and relevant information

.5 The information contained in this section is applicable to all major divisions within the project scope of work: Architectural, Mechanical, Electrical, Communications, and Security.

1.2 GENERAL

.1 All information within operation and maintenance manual to be written in Canadian English.

.2 Provide SFU Facilities with 3 hard copies of operation and maintenance data in separate hard post expandable binders.

.1 Binders shall be ‘hard-post, expandable’ type with embossed cover and spine, available from Vancouver Bookbinding or equivalent. Vinyl binders are unacceptable.

.2 Binders to be 2/3 maximum full.

.3 Provide index to full volume in each binder.

.4 Identify contents of each manual on cover and spine.

.3 Provide table of contents in each manual. Assemble each manual to conform to Table of Contents with tab sheets placed before instructions covering subject.

.4 Provide SFU Facilities with a soft copy version in a labeled USB storage device or similar. The operation and maintenance data should be in the form of a booked marked and searchable PDF. Scanned copies of documents are not permitted, unless only hard copies were issued – and in such cases should be scanned, straightened/aligned and formatted with text recognition software to facilitate searching.

.5 Furnish one complete set of hard and soft copies in Draft format 6 weeks prior to substantial completion. Furnish the remainder upon Project Turn-Over.

.6 Operation and Maintenance data must be reviewed by consultants, Commissioning Authority and then SFU Facilities.
.7 Major Sections

1. System Description
2. Maintenance Schedule
3. Spare Part Inventory
4. Equipment Suppliers
5. Guarantees, Warranties and Bonds
6. Permits, Licenses, Test and Certificates
7. Product Data
8. Record Drawings and Specifications
9. Commissioning and Balance Report

1.3 System Description

.1 Building overview including occupancy, function, location and brief description should be included

.2 All mechanical and electrical systems will be described from a top down approach (describe major systems first, then the individual subsystems at the zone level).

.3 A brief description should be provided describing the operation and controls of major mechanical and electrical equipment.

1.4 Maintenance Schedule

.1 Provide maintenance schedule detailing regular maintenance intervals for building envelope, finished surfaces, as well as equipment.

.2 Schedule should be divided to capture major and minor intervals with different scopes and instructions of maintenance.

.3 Key pieces of equipment which are to be captured include fan and motor bearing lubrication, belt schedule and air filter schedule.

1.5 Spare Part Inventory

.1 Provide an inventory list of spare parts and specials tools identical to those installed, manufactured by original equipment manufacturer. Typical parts in this inventory include belts, pulleys, bearings, filters and fuse types. Paint formulas should also be included in this section.

.2 Indicate on inventory whether spare parts and special tools are on hand or not (supplied as part of project or not).

.3 Indicate where spare parts are currently stored if they are on hand.
.4 Identify spare parts by the following:
   .1 Include proper naming and part numbers wherever applicable.
   .2 Include system and piece of equipment to which part belongs.
   .3 Include location and room number where spare parts are associated to (location of equipment and systems).
   .5 Provide maintenance materials identical to those installed.

1.6 Equipment Suppliers
   .1 Provided organized list of company, name of contact, phone numbers and email addresses of all subcontractors and suppliers. Additionally, the contact information for local support of each company should be listed.
   .2 Indicate systems and materials for which the subcontractor/suppliers are responsible for.

1.7 Guarantees, Warranties and Bonds
   .1 All items should be indexed properly for easy access.
   .2 Guarantee, Warranties and Bonds documentation should indicate the following:
      .1 Name and address of project.
      .2 Warranty/Guarantee/Bond commencement date and duration.
      .3 Clear indication of what is being guaranteed and what remedial action will be taken under guarantee.
      .4 List subcontractor, supplier, and manufacturer with name, address and telephone number of responsible principal.
      .5 Documents are to be in proper form, contain full information, and notarized where applicable.
      .6 Signature and seal of Trade Contractor.
      .7 For warranties, instructions should be provided on how to make warranty claims.

1.8 Permits, Licenses, Tests and Certificates
   .1 Tests and certificate documentation should be coordinated with Commissioning Authority wherever possible.
   .2 All items should be indexed properly for easy access.
Tests and Certificates documentation should indicate the following:

.3 Applicable system or equipment.
.2 Date testing or certification occurred.
.3 Indication of result of test and/or achievement of certification.
.4 Signature and seal of applicable parties.

The first certificate in this section must be the Substantial Completion Certificate.

1.9 Product Data

.1 As-Installed Product Data

.1 Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.
.2 Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
.3 Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
.4 If possible, a Change Order proposal should include resubmitting updated Product Data. This eliminates the need to mark up the previous submittal.
.5 Note related Change Orders, Record Specifications, and Record Drawings where applicable.
.6 Include manufacturer operation and maintenance data wherever possible.

.2 Materials and Finishes

.1 Building Products, Applied Materials, and Finishes: include product data, with catalogue number, size, composition, and color and texture designations. Provide information for re-ordering custom manufactured products.
.2 Instructions for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.
.3 Moisture-protection and Weather-exposed Products: include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.

.3 Record Shop Drawings

.1 Provide two copies of final reviewed set of Shop drawings.
1.10 Record Drawings and Specifications

.1 Record drawings and specifications are to be included as part of the Operation and Maintenance Data in digital format only. Hard copy is not required.

.2 A drawing schedule is to be provided at the beginning of the documentation.

.3 A valve tag schedule is to be included in this section with key information such as valve number, system, flow, type and size.

.4 When applicable, include a labeling and identification schedule for pipe identification (symbol, color), as well as ceiling access (symbol, color).

1.11 Commissioning and Balance Report

.1 Commissioning and Balance Report are to be included as part of the Operation and Maintenance Data.

1.12 Standard Operating Procedures

.1 Standard Operating Procedures (SOP’s) are to be included as part of the Operation and Maintenance Data.
1.0 GENERAL

1.1 GENERAL

.1 Guarantees, Warranties and Bonds shall be submitted in accordance with the requirements for Manuals. Extended warranty shall be clearly indicated.

.2 Clearly indicate Building name and Building number.

.3 Standard one year warranties start from Substantial Performance.

.4 Contractors are responsible for all equipment during warranty period regardless of manufacturer warranty/ shipping date etc.

1.2 RELATED SECTIONS

.1 Section 01 77 00 - Closeout Procedures

.2 Section 01 78 23 – Operation and Maintenance Data

1.3 PROCEDURES FOR WARRANTY CLAIMS

.1 If at any time during the warranty period the Owner discovers a defect that, in the Owner’s opinion, is or could be covered under the warranty provisions of the Contract the Owner will send a Warranty Report to the Consultant with a copy to the Contractor. Where the claim involves primarily the work of a subcontractor or work covered by a third party guarantee the subcontractor and/or guarantor may also be copied. The Consultant will promptly investigate the claim and direct the Contractor as to the appropriate method to correct the defect.

.2 All stakeholders are informed with substantial notice of project completion to clearly mark when equipment is no longer under warranty.

***END OF SECTION***
Records Submission Checklist / Transmittal

Refer to Project Record Submission Requirements - Section 01 78 39 Project Record Documents

<table>
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<tr>
<th>Trade</th>
<th>100% Construction Drawings</th>
<th>RECORD Drawings</th>
<th>O&amp;M Manuals</th>
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Instructions:
1. Attach this checklist with Submittals. Fill out items submitted.
2. All electronic files can be emailed at records@sfu.ca or submitted as labeled CD's to Record Coordinator.
3. Review Record Submission Checklist below before submitting to ensure the submittals meet requirements.

Records Submission Checklist

Electronic Files (Submit both PDFs and original application files)

- All BIM, ArcGIS and Civil3D in native file formats & data files
- Extraneous blocks deleted
- Shape files, Xrefs, Plot files, GDB files, etc. included
- O & M manual on CDs (in PDF format)
- CDs labeled with contents listed

PDF Functionality and Completeness

- PDFs are unencrypted (no password required)
- Fonts and shape files are embedded
- Files indexed, CDs labeled
- Transmittal submitted with CDs list contents

Hard Copy Submissions (full size)

- 2 copies full size drawings
- 2 copies O&M manuals (bound hard copy)

Consultant Name: ________________________________

Consultant Signature: ____________________________

Contact Phone /E-mail: ____________________________

Date: ____________________________

017839.1-2018_Record_Data_Submission_Checklist.xls
10/29/2018
1.0  **GENERAL**

1.1  RELATED SECTIONS

1.1.1  *Section 01 77 00 Closeout Procedures*
1.1.2  *Section 01 78 23 Operation and Maintenance Data*
1.1.3  *Section 33 00 10 Underground Utilities Services*
1.1.4  *Section 26 05 00 Electrical – General Requirements*
1.1.5  *Section 01 78 39.1 Record Data Submission Checklist*

1.2  INFORMATION AVAILABLE AT FACILITIES SERVICES RECORDS MANAGEMENT

1.2.1  Floor Plans / Key Plans / Space Inventory Functional Uses
Architectural key plans are available for each building. Key plans are related to an
Archibus space inventory database include occupancy (departments) and space
functional. Plans are generally available in .dwg and PDF.

1.2.2  Consultant As-built/Record Drawings (Electronic and Print)
Facilities Services maintains record drawings database for all building projects and
renovations. Drawings are searchable by building number and division code
(architectural, structural, mechanical, electrical, landscape, etc.). Consultants and
contractors can access off the dedicated drawing search station in the records plan area
in the Facilities Services building. Permissions can be required from the Project Manager.

1.2.3  SFU Legal Description

1.2.3.1  Legal Map and Legal Description (Burnaby Campus Only)
1.2.3.2  Survey control monuments (Burnaby Campus Only) follow the City of Burnaby
monument (see Part 1.5)

1.2.4  Other Burnaby Campus Information
Building maps / Land Survey / Topographic contour map/ Ortho-rectified aerial
photography/LIDAR imagery/GIS interactive Maps/ Space Inventory data/VFA.Facility
Building Condition Data

1.2.5  Burnaby Campus Utility Services

1.2.5.1  Utility services include Central District Heat/ Water Distribution/ Sanitary Sewer /
Storm Water/Natural Gas / Electrical Distribution/ Compressed Air.  Information on
these utility systems is available in CAD Civil3D drawings as well as in Geospatial
Information Systems (GIS) database.  Data & Communication provided by IT
services.

1.2.5.2  Due to reliance on legacy documents, geospatial accuracy of utilities information is
not verified.  It is the responsibility of the Consultant/ Contractor to site verify all
utilities information.

1.2.5.3  SFU Burnaby utilities infrastructure drawings and GIS utilities databases are
georeferenced and aligned with City of Burnaby Data Exchange Standards.  Refer to
SFU MMCD Infrastructure Data Standards based on Master Municipal Construction
Documents (MMCD) standards recommendations.  For further details on
infrastructure data standards, refer to *SECTION 01 00 00 GENERAL
REQUIREMENTS* Part 1.5.9.  Request SFU Utilities CAD Standards & Templates
from Facilities Services Record Services.
1.2.6 Printing Drawings

Copying & plotting of full size drawings can be arranged through the Records Management unit. Note printing is done by an external printer, and costs are charged back to the project. Authorization of the project manager is required. Some limited printing can be done in house at self-serve printers in the Records area.

1.3 REQUIREMENTS FOR RECORDS SUBMISSIONS

It is critical that the University maintains a complete and accurate record of all construction on campus. Record Submissions must meet the requirements stated below. Where records are not submitted or incomplete, a deficiency holdback will be assessed.

1.3.1 Issued for Construction

1.3.1.1 These drawings have been updated to incorporate major design changes and approved room numbers before construction commences.

1.3.1.2 "Issued for Construction" drawings are NOT intended to be Record drawings but only serve as SFU Facilities Services internal project record.

1.3.1.3 One (1) PDF and (1) set of architectural floorplans in AutoCAD format files to be submitted to SFU Facilities Records Department prior to the start of construction.

1.3.2 All Underground Utility project CAD drawings submitted to SFU must adhere to Section 33 00 10.1 SFU MMCD Infrastructure Data Standards.

1.3.3 Submit Records with SFU Record Data Submission Checklist for record detail of final submission requirements. Refer to Section 01 78 39.1 Record Data Submission Checklist.

1.3.4 Drawing Sheet Requirements

Standard sheet size:
ARCH D  24” x 36” (Preferred)
Mandatory Title Block Information:
Building Name, floor and room numbers as applicable
Owner’s Project Name and Number
Sheet Number
Drawing File Number
Revision History – revision number and date
Drawing Phase (IFT, IFC, Records, etc.)
Consultant Name, address

1.3.5 Where site work requires locating and mapping of underground utility infrastructure, records deliverable should be in accordance with the CI/ASCE Standard 38-02: Standards Guideline for the Collection and Depiction of Existing Subsurface Utility. Where ever reasonable, Quality Level "B" surveys should be required.

Quality Level B - Information obtained from the use of geophysical survey equipment that searches for utilities. The surface geophysics is interpreted, and the location of the utility is marked on the ground for subsequent survey and review by utility owners.
Accuracy of measurements (average) to be within +/- 0.5 metres (horizontal) and within 10-20% error (vertical)
1.3.6 At project completion, the consultant must create Record drawings from redline as-builts submitted both electronically and in hardcopy, which replaces IFC drawings.

1.3.7 The use of the Architect or engineering seal for record drawings will follow AIBC & APEGBC guidelines.

1.3.8 Record Submission Requirements – Coordination Meeting

1.3.8.1 The Onus is on the Consultant/Contractor to contact a Records Technologist to arrange a meeting when in doubt on the technical or compatibility requirements.

1.3.8.2 Prior to starting design work, obtain the most current utility infrastructure base map and geodatabase from Planning Services GIS department as well as drawing CAD templates (Civil 3D) and database standards. To facilitate integration of the project infrastructure changes for updating the campus utility base map, consultants are advised to follow the SFU MMCD data exchange standards in the drawing templates. SFU reserves the right to require re-submittal if records are not acceptable.

1.3.9 Utilities Record Requirements

1.3.9.1 Utilities records including land surveys must be referenced to UTM NAD83 (CSRS) Zone 10N – 4.0.0 BC.1.GVRD. All surveys requires to provide the survey control monuments and conversion formulas (from ground to grid coordinates based on an origin of 0, 0) in all survey submission.

1.3.9.2 Utilities Record submittals must follow SFU MMCD Infrastructure Data Standards (refer to 1.3.2 above) and submitted in their native file formats, both in Geodatabase files (.gdb or .shp) and in CAD (.dwg) formats.

1.3.9.3 Post-construction as-built surveys of utilities records are required in major projects, and must be reviewed and certified as correct by the engineer of record.

1.3.9.4 Record documents must be submitted including piping as-builts surveys, duct bank locations, etc.

1.3.9.5 See Section 33 00 10 Underground Utilities Services for Utilities Records requirements.

1.4 FORMAT REQUIREMENTS

1.4.1 Drawing List

1.4.1.1 Architectural
To include site plan, floor plans, furniture layouts, sections, elevations and details.

1.4.1.2 Structural
To include floor plans, sections, and details.

1.4.1.3 Mechanical – HVAC
To include site plan, floor plans, sections, elevations, and details.

1.4.1.4 Mechanical - Plumbing
To include site plan (showing individual services connections from the mains to the building), floor plans, sections, elevations, and details.
1.4.1.5 Electrical
   .1 To include site plan (showing service connection from the main to the building), floor plans, sections, elevations, details.
   
   .2 Must show the following, where applicable:
      .1 All conduit or duct work located below ground level and in or below a building slab.
      
      .2 All service, sub-service, and main riser conduits, all spare conduits stubbed in concealed spaces, and the location of all electrical equipment essential for safe system operation, such as end of line resistors, etc.
      
      .3 All service ducts and cables for voltages above 705 volts, and for main communications cables.
      
      .3 See also: Section 26 05 00 Electrical – General Requirements, 2.6 Project Record Drawing Requirements.

1.4.1.6 Civil
   To include site plan, elevations, and details.

1.4.1.7 Landscape
   To include site plan (showing lawn sprinkler services with connections), sections, elevations, and details.

1.4.1.8 Survey
   .1 Must show construction context in relation to the existing nearest official SFU monument, both in spatial locating (horizontal dimensions), as well as vertical reference – SFU Datum based elevations. (see Part 1.5 Survey Control Monument Information)
   
   .2 To be created in UTM (Universal Transverse Mercator) and using NAD 83 Datum for compatibility with standard GIS functionality.

1.4.1.9 Demolition
   .1 Drawings should clearly show the existing buildings, civil features and infrastructure in the vicinity of the project.
   
   .2 The drawings should include clear definition of features and underground services to be demolished as well as the ones to be retained including horizontal and vertical survey dimensions relative to the nearest official SFU monument (see Part 1.5 Survey Control Monument Information).

1.4.2 Electronic Deliverables

1.4.2.1 When a large number of files are to be submitted, files may be compressed and submitted in ZIP format. Drawings are organized as a searchable database in Facilities Records system. Submit all electronic files to detailed information below:

1.4.2.2 CAD Format
   Submit all drawing records in AutoCAD native format (.dwg, similarly for utilities information produced in Civil3D format). Each sheet should be saved in an individual file with all data exchange format files (.dxf) provided. SFU Vault is used by Facilities Services to transmit large files. Contact a Records Technologist to arrange access. On projects using Building Information Modelling (BIM) software (e.g. Revit), native
files (.rvt)/ drawings/ databases form part of the SFU project records submissions.

Files must be purged of extraneous information prior to submitting. External reference (x-ref) files must be included with each submittal and be located in the same folder as the dependent files.

Deliver all CAD support files necessary to recreate output that matches hard copy submittals. Support files include: external references (.xref), plot configuration (.ctb), blocks, write blocks, images and logos, shape files (.shx), fonts and photographs if integrated into the drawings.

These files are to be delivered to SFU free of any copyright and become the property of the Owner available for distribution.

For submission of Civil 3D files, Consultants are highly encouraged to use the “ETransmit” command to include all the external references in a ZIP file.

1.4.2.3 Geospatial Information Systems (GIS)
The deliverables for utilities information include all underlying datasets that were associated in producing CAD (Civil3D or other) and/or 3D imagery such as CCTV data for the project. All GIS data must be GEOREFERENCED using Coordinate System: UTM NAD83 (CSRS) Zone 10N – 4.0.0.BC.1.GVRD

Deliverables include:
All 2D and 3D CAD source files (.dwg) (.dxf) (.ctb)
All Geodatabase files
Digital Elevation Maps (DEM)
LiDAR, RADAR, and other related remote sensing data
Photos and Video files

1.4.2.4 Revit (or other Building Information Modelling 3D software)
Submit native (.rvt or similar format) files as well as Save As .dwg files.

1.4.2.5 Digital PDF Format
All record drawings should be created using the latest version of Adobe acrobat (.pdf) and match each individual pages of hardcopy drawings as submitted for the record drawings.

1.4.2.6 Operations and Maintenance (O&M) Manuals
O&M manuals are to be submitted as hard copies (requirements below) as well as converted into PDFs and fully indexed.

1.4.2.7 Other Supporting Documentation
Text support documentation e.g. drawing list with CAD file names, corresponding to the drawing sheets, or instructions required to interpret and use the digital files.

NOTE TO PROJECT MANAGERS:
Confirmation of acceptance of the e-files must be requested from the records department prior to closing out the project and releasing the deficiency holdback.

1.4.3 Hard (Print) Copy Documentation

1.4.3.1 Submit two (2) complete sets of full-size drawings, stamped, signed and sealed by the Consultant/Sub-Consultant

1.4.3.2 Submit two (2) bound copies of all specifications to Records at the completion of a
1.4.3.3 As-built site markups
As-built (redline) markups are not acceptable as Record Drawings. However, the Consultant (or Contractor) is responsible for certifying the accurate and complete transfer of all as-built information on to the electronic record files.

1.4.3.4 O & M Manuals, Warrantees, Schedules
Provide complete O&M Manuals in accordance with 01 78 23.

1.4.3.5 Certification of Record drawings for Underground Utility Services
Record drawings are to be signed and sealed by the Professional Engineer and shall contain a certification conforming to the following:

“I CERTIFY THAT THE LOCATION, ELEVATION, DEPTHS, AND AS-BUILT COMMENTS, REFLECT MATERIALS ACTUALLY USED DURING CONSTRUCTION AND ACCURATELY REFLECT EXISTING FIELD CONDITIONS AS DETERMINED BY ME OR UNDER MY DIRECT SUPERVISION ON THIS DATE.”

Professional Stamp, Expiration Date, Date Signed & Signature

1.5 LAYERING GUIDELINES – CODES AND GROUP

SFU Record Key Plan layering guidelines are based upon the AIA National CAD Standards. This is designed to easily translate As-built drawings in CAD format submitted to Planning Services, Records Section by consultants contracted by SFU for new building construction and renovation. This standard allows our key plans to be used for in-house project renovations and facility planning purposes.

The CAD Layer Guidelines are organized as hierarchy. This arrangement accommodates expansion and addition of user-defined extensions to the layer list. Layer names are alphanumeric and use abbreviations that are easy to remember. This legibility is particularly important when CAD files are distributed among architects, consultants, and clients.

<table>
<thead>
<tr>
<th>DISCIPLINE</th>
<th>MAJOR GROUP</th>
<th>MINOR GROUP</th>
<th>STATUS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Required</td>
<td>Required</td>
<td>Optional</td>
<td>Optional</td>
</tr>
</tbody>
</table>

1.5.1 Discipline Code

Discipline is the primary method of classification for layer names. The discipline code is intended to identify the author of the graphic information. Thus, a structural column placed by an architect would be A-COLS rather than S-COLS. This accommodates the use of "I" as a discipline code, allowing doors and walls to be recognized in both the Architectural and the Interiors disciplines. The Discipline Code is a two character field with the second character, either a hyphen or a user-defined modifier. The discipline codes are listed below.
1.5.2 Major Group

The major group designation is a four-character field that identifies the building system, such as doors, walls, windows, etc. Although most major groups are logically associated with specific discipline codes, it is possible to combine major group codes with any of the discipline codes.

```
A-WALL       Walls
A-DOOR       Doors
A-GLAZ       Glass
```

1.5.3 Minor Group

This is an optional, four-character field for further differentiation of major groups. For example, partial height walls (A-WALL-PART) might be differentiated from full height walls (A-WALL-FULL). The following common modifiers defined by the AIA can also be used in the minor group field:

```
IDEN        Identification
PATT        Pattern
AREA        Area
```

1.5.4 Status Field

The Status Field is an optional four-character designator that differentiates new construction from remodeling and existing to remain. It is only needed when phases of work must be differentiated. Defined values for these fields are listed below.

The Status Field is always placed as the last field of the layer name. In a simple layer name such as A-WALL, the Status Field would be the third field (A-WALL-D). In a more detailed layer name, the Status Field would be the fourth field (A-WALL-FULL-D).
1.6 SFU LAYERS IN USE

The following layer list is the current layers in use within SFU floor plans and campus maps. If additional layers are needed for drafting purposes, please refer to the AIA CAD Layer guidelines. New layer names may be added using the formatting rules listed in this section. For the Civil & Site drawings, refer to the MMCD CAD layer guidelines.

<table>
<thead>
<tr>
<th>LAYER NAME</th>
<th>DESCRIPTION</th>
<th>COLOR</th>
<th>LINETYPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>A-ANNO-DIMS</td>
<td>DIMENSIONS</td>
<td>RED</td>
<td>CONTINUOUS</td>
</tr>
<tr>
<td>A-ANNO-NOTE</td>
<td>LABELS/CONSTRUCTION DATES/INFO</td>
<td>CYAN</td>
<td>CONTINUOUS</td>
</tr>
<tr>
<td>A-ANNO-REDL</td>
<td>FLOOR/BLDG OUTLINES</td>
<td>CYAN</td>
<td>CONTINUOUS</td>
</tr>
<tr>
<td>A-ANNO-SYMB</td>
<td>ARCHITECTURAL SYMBOLS / NORTH ARROWS</td>
<td>RED</td>
<td>CONTINUOUS</td>
</tr>
<tr>
<td>A-ANNO-TEXT</td>
<td>TITLE BLOCK AND TEXT/INFO</td>
<td>CYAN</td>
<td>CONTINUOUS</td>
</tr>
<tr>
<td>A-ANNO-TTBL</td>
<td>TITLE SHEET BORDER</td>
<td>CYAN</td>
<td>CONTINUOUS</td>
</tr>
<tr>
<td>A-AREA-DESC</td>
<td>ROOM NAMES/DESCRIPTION</td>
<td>RED</td>
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<tr>
<td>A-AREA-IDEN</td>
<td>ROOM NUMBERS</td>
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<tr>
<td>A-AREA-PATT</td>
<td>AREA HATCHES</td>
<td>BLUE</td>
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<tr>
<td>A-DOOR</td>
<td>DOORS</td>
<td>10</td>
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</tr>
<tr>
<td>A-DOOR-IDEN</td>
<td>DOOR NUMBERS</td>
<td>10</td>
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<tr>
<td>A-EQPM</td>
<td>HVAC EQUIPMENT</td>
<td>11</td>
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<tr>
<td>A-FLOV</td>
<td>ELEVATORS/SKYLIGHTS/OVERHANGS</td>
<td>9</td>
<td>HIDDEN</td>
</tr>
<tr>
<td>A-FLOR-PFIX</td>
<td>TOILET/PLUMBING FIXTURES</td>
<td>12</td>
<td>CONTINUOUS</td>
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<tr>
<td>A-FLOR-STRS</td>
<td>STAIRS/HANDRAILS /RAMPS/BALCONY AND GUARD RAILS</td>
<td>RED</td>
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<tr>
<td>A-FLOR-WDWK</td>
<td>MILLWORK/BUILT IN CABINETS &amp; COUNTERS/TOILET PARTITIONS</td>
<td>MAGENTA</td>
<td>CONTINUOUS</td>
</tr>
<tr>
<td>A-FURN</td>
<td>FREESTANDING FURNITURE/WORKSTATIONS/CHAIRS</td>
<td>MAGENTA</td>
<td>CONTINUOUS</td>
</tr>
<tr>
<td>A-GLAZ</td>
<td>WINDOWS/GLAZED PARTITIONS/SILLS</td>
<td>10</td>
<td>CONTINUOUS</td>
</tr>
<tr>
<td>A-PKNG</td>
<td>PARKING LINES AND STALL NUMBERS</td>
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</tr>
<tr>
<td>A-ROOF</td>
<td>FLOOR/BLDG OUTLINES</td>
<td>CYAN</td>
<td>CONTINUOUS</td>
</tr>
<tr>
<td>A-ROOF-PATT</td>
<td>ROOF SYMBOLS/ HATCHING</td>
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<td>CONTINUOUS</td>
</tr>
<tr>
<td>A-WALL</td>
<td>INTERIOR WALL LINES</td>
<td>YELLOW</td>
<td>CONTINUOUS</td>
</tr>
<tr>
<td>L-SITE-WA</td>
<td>WALKS AND STEPS</td>
<td>RED</td>
<td>CONTINUOUS</td>
</tr>
<tr>
<td>S-GR</td>
<td>BUILDING GRID LINE/BUBBLE</td>
<td>254</td>
<td>CENTRELINE</td>
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<tr>
<td>S-GRDI</td>
<td>BUILDING GRID DIMENSIONS</td>
<td>RED</td>
<td>CONTINUOUS</td>
</tr>
</tbody>
</table>
1.7 **SFU SURVEY CONTROL MONUMENTS**

1.7.1 **CAMPUS UTM Coordinates**

Here is a list of campus control monuments including City of Burnaby survey control monuments and their associated UTM coordinates. This information is for reference use only. The provider of information accepts no responsibility for its use or accuracy.

**Control Monument Coordinates**

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>NORTHING (GROUND)</th>
<th>EASTING (GROUND)</th>
<th>ELEVATION</th>
<th>NORTHING (UTM GRID)</th>
<th>EASTING (UTM GRID)</th>
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<td>73H2080</td>
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<td>90H6710</td>
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<td>MON 1</td>
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<td>MON 11</td>
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<td>MON 12</td>
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<td>333.482</td>
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</tbody>
</table>

Notes:
All surveys requires to provide the survey control monuments and conversion formulas (from ground to grid coordinates based on an origin of 0, 0) in all survey submission. To calculate UTM grid coordinates, scale ground coordinates using scale factor 0.9995540 at monument 73H2071 (UTM).
Control Monuments Location

***END OF SECTION***
1.0 GENERAL

1.1 SPARE PARTS AND MAINTENANCE MATERIALS

.1 Spare parts and maintenance materials for all mechanical and electrical systems and equipment shall be turned over to the Owner. A detailed itemized list must be provided to SFU, outlining all required spare parts and maintenance materials as specified.

.2 A list of manufacturer recommended critical spares or long delivery times should be included.

.3 Handover, acceptance, and documentation of this itemized list should be coordinated with SFU Project Manager and Facilities/ Central Stores.

.4 One year supply (2 sets) of new filters in addition to new construction filters must be provided.

.5 Directory to be provided for required equipment in fuse and sprinkler cabinets.

.6 Maintenance materials for architectural finishes and other similar items shall be carefully labeled and delivered as instructed by the Owner’s Representative. An itemized receipt shall be obtained for all items and shall be submitted to the Consultant. The Consultant will confirm that the correct materials have been delivered. Refer to Divisions 02 through 14 of these specifications for specific requirements.

1.2 RELATED SECTIONS

.1 Section 01 77 00 Closeout Procedures

.2 Section 01 78 23 Operation and Maintenance Data

1.3 KEYS

.1 Keys for door hardware shall be turned over as indicated in Section 08 71 00. Keys for thermostats, mechanical access panels, electrical panels and the like shall be turned over to the Owner’s Representative. Keys for cabinets, furniture, shutters etc. shall be turned over to the user’s representative and an itemized receipt shall be obtained for these items or they shall be turned over to the Owner’s Representative.

***END OF SECTION***
1.0 **GENERAL**

1.1 **SUMMARY**

.1 Building commissioning is an intensive quality assurance process that spans the entire concept, design, construction, and start-up process – including the first year of operation – helping ensure that the new building’s operation and energy, water, and indoor environmental quality performance meets owner requirements.

.2 The Commissioning Authority will direct the commissioning of the building systems. Building Systems will include the following systems as applicable and defined in the contract documents:

.1 Mechanical (Fire Protection, Plumbing, HVAC, Compressed Air and Controls)
.2 Electrical (Normal and Emergency Power Distribution, Lighting and Controls)
.3 Renewable Energy
.4 Communications
.5 Audio Visual
.6 Fire Alarm and Integrated Life Safety
.7 Controls, Metering and Integration for All Disciplines
.8 Building Envelope
.9 Horizontal and Vertical Transportation (Elevators, Escalators, Lifts, Etc)
.10 Laboratory Equipment (Fumehoods, Biosafety Cabinets, and others)

.3 Commissioning during the design phase is intended to achieve the following specific objectives:

.1 Verify the Owner’s Project Requirements (OPR) and Basis of Design (BOD) are clearly documented and they meet the Owner’s goals and objectives.

.2 Verify commissioning intent for the construction phase is adequately reflected in the contract documents.

.4 Commissioning during the construction phase is intended to achieve the following specific objectives, according to the Contract Documents:

.1 Provide resolution to issues and details not fully developed during design.

.2 Verify and document that applicable equipment and systems are installed according to the contract documents and manufacturer’s recommendations, and that they receive adequate start-up and functional testing by installing contractors.

.3 Verify and document performance of equipment and systems against design intent. Detail where performance is not met and facilitate the Commissioning Team to create resolutions.

.4 Verify that Operations and Maintenance (O&M) handover documentation is complete.

.5 Verify that owner’s operating personnel have adequate time to be familiar with the project, received demonstrations and training, provide comment regarding the handover to the owner and any additional support that maybe required.
1.2 COMMISSIONING TEAM

.1 The Commissioning Team shall consist of representatives of each contractor, including project superintendent, installers, suppliers, and specialists deemed appropriate for performing tasks related to the commissioning process. In general, the team will consist of:

- Owner’s Representative/Project Manager (PM)
- Commissioning Authority (CxA),
- Architect and Design Engineers (A/E)
- Construction Manager or General Contractor (CM/GC)
- Mechanical Contractor (Sub-Contractor)
- Electrical Contractor (Sub-Contractor)
- Communications Contractor (Sub-Contractor)
- Security and Access Control Contractor (Sub-Contractor)
- Equipment vendors
- Any other installing contractors or supplier of equipment.
1.3 RELATED SECTIONS AND REFERENCES

.1 Section 01 General Requirements
.2 Section 20 Mechanical – General Requirements
.3 Section 21 Fire Suppression
.4 Section 22 Plumbing
.5 Section 23 Heating, Ventilation, and Air Conditioning (HVAC)
.6 Section 25 Building Management System
.7 Section 26 Electrical
.8 Section 27 Communications
.9 Section 28 Electronic Safety and Security
.10 ASHRAE Handbook – HVAC Applications
.11 ASHRAE Guideline 0 – The Commissioning Process
.12 ASHRAE Guideline 1.1 – HVAC&R Technical Requirements for the Commissioning Process
.13 ASHRAE Standard 202 – Commissioning Process for Buildings & Systems
.15 CSA Z320-11 – Building Commissioning
.16 CSA Z5000-18 Building Commissioning for Energy Using Systems
.17 IES DG-29-11 – The Commissioning Process Applied to Lighting and Control Systems
.18 This section includes general requirements for the commissioning process, to supplement other sections in Division 01 and 20 through 28, which specify testing of components, systems, and assemblies, controls and control sequences and demonstration of integrated systems.
.19 This section is intended to compliment the overarching Commissioning Requirements and shall be read in conjunction with the Commissioning Plan.

1.4 ROLES AND RESPONSIBILITIES

.1 Commissioning observation and witnessing of contractor demonstrated pre-functional, and functional testing is the responsibility of the CxA and Design Engineer.
.2 All commissioning team members’ will work together to fulfill their contracted responsibilities and meet the objectives of the contract documents. The CxA shall coordinate the reports to the owner.
.3 The CM/GC, Sub-Contractors and CxA shall have responsibility for implementing the commissioning plan, with leadership, coordination, consultancy and review from the CxA.
.4 The CxA and CM/GC with assistance from trade contractors and vendors are responsible for producing a final commissioning plan, with all required commissioning tests and sequences. The CM/GC shall obtain from the contractors and vendors all commissioning related documentation and submit it to the CxA for incorporation into the final version of the Commissioning plan.
.5 The commissioning team shall attend commissioning meetings, cooperate with the CxA and participate in commissioning coordination and scheduling.
.6 A Quality Assurance/Quality Control (QA/QC) representative for each contractor is to be
named to the CM/GC, the responsibilities of this person includes:

.1 Review equipment upon delivery onsite.
.2 Quality of installation work and report on progress.
.3 Review quality of paperwork, ensure timely delivery and collate to deliver to the CM/GC.
.4 Verify that commissioning tasks are complete and systems are functional, prior to turn over to CM/GC.

.7 Documentation required as part of the commissioning plan shall be exchanged between the CxA and the CM/GC but not to be limited to:

.1 Pre-start, and start-up procedures (CM/GC & CxA).
.2 Progress and status reports, including issues noted (CM/GC & CxA).
.3 Minutes from commissioning meetings (CxA).
.4 Commissioning reports (CxA).
.5 As-built records (CM/GC).
.6 Demonstration agenda and materials (CM/GC & CxA).
.7 Operation and Maintenance (O&M) manuals (CM/GC).
.8 Deferred and Seasonal Testing Plan (CxA).

2.0 THE COMMISSIONING PROCESS

2.1 SUMMARY

.1 This specification section is to be used in conjunction with all other contract documents. The commissioning process does not relieve contractors from the obligations to complete all portions of work in satisfactory and fully operational manner.

.2 Furnish labor and material to accomplish and complete commissioning as specified herein. Complete interim commissioning of systems during initial season operation and follow-up with seasonal testing to complete commissioning and ensure correct operation.

.3 System installation, start-up testing, calibration, functional tests, integrated tests, performance testing, preparation of O&M manuals, demonstration and training, deferred and seasonal testing is the responsibility of the CM/GC, Division 20 through 28 contractors and equipment suppliers/vendors.

.4 The commissioning plan shall include the following tasks and actions:

.1 Documentation of the construction process.
.2 Ensuring the basis of design as well as the design intent is carried out.
.3 Reporting and communicating the project schedule progress.
.4 Installation review with QA/QC verification

.1 Orientation and integrity checks.
.2 Point to point testing.
.3 Pressure and integrity testing.
.4 Water fill and treatments.
.5 Review of manufacturer’s recommendations.
.5 Equipment start-up procedures:
  .1 Using the commissioning schedule, coordinate equipment start-up.
  .2 Ensure multiple trades are aware of tasks being performed and their attendance requirement.

.6 Functional tests:
  .1 Coordinate trades, tasks and systems, so that dedicated time can be spent with minimal interference of conflicting tasks and trades.
  .2 Ensure all equipment is effectively communicating with systems.

.7 Provide on-site demonstrations for the systems specified, with reference to the Demonstrations and Training section.

.8 Seasonal and Deferred Testing.

.9 Confirmation of Performance.

2.2 COMMISSIONING DOCUMENTATION

.1 The CM/GC and CxA shall oversee and maintain the development of commissioning documentation, which is required to be converted into a PDF format and delivered to an electronic filing system. The documentation shall be organized by system and sub-system, which shall include, but is not limited to, the following:

  .1 Reviewed contractor submittals.
  .2 Installation review record.
  .3 Equipment start-up procedures.
  .4 Functional tests.
  .5 Integrated system tests.
  .6 Demonstrations and Training record.
  .7 Seasonal and deferred testing.
  .8 Confirmation of performance.

.2 Any installation, start-up or commissioning reports for equipment or systems, shall be issued to the CM/GC within 14 days of works being carried out by any contractor.

.3 The Commissioning Report compiled by the CxA shall be issued to SFU as an independent document to the O&M manuals at the time of handover.
3.0 EXECUTION

3.1 SUMMARY

.1 The CxA and CM/GC has overall responsibility to ensure that QA/QC is upheld by all contractors and that systems are commissioned in a coordinated and complete manner.

.2 Commissioning process / work shall be a team effort to ensure that all equipment and system have been completely and properly installed and function together correctly to meet the design intent. System performance parameters shall be documented for fine tuning of control sequences and operational procedures, coordinate system documentation, equipment start-up, control system calibration, and performance testing.

.3 The CxA shall lead the Commissioning Team to facilitate solutions while implementing the Cx Plan. Where issues are realized, the Commissioning Team shall document, track, discuss and implement resolutions. The Commissioning Team is to present issues with suggested resolutions, the responsibility to accept, direct or create a resolution for implementation is the joint responsibility of relevant Design Team member and CxA and/or Owners Representative required.

.4 Detailed testing shall be performed on all installed equipment and system to ensure that operation and performance conform to contract documents. All tests shall be performed by the responsible trade contractor, accepted for quality by the CM/GC, evaluated and witnessed by CxA and Design Engineer. After each grade of checklist and test are complete the system will be upgraded to the next test. Once a system(s) has been completed and passed all functional and integration tests it will be ready for acceptance by the CM/GC, with recommendation to begin turn-over process from the construction team to the Owner.

3.2 MEETINGS

.1 Initial Meeting: The CxA, through the CM/GC, will schedule, plan and conduct an initial commissioning meeting. The contractor and its responsible parties are required to attend. The meeting will review commissioning intent, with relation to the project and align expectations on how the process will be delivered. The meeting shall be held prior to any contractor submittals being gathered and issued to the design team for review.

.2 Design Intent Meetings: Prior to any substantial sequence programming, a meetings shall take place and be documented between the engineer of record, CxA, and the hands on programmer(s), to review the following items:

.1 Functional intent
.2 Sequence of operation
.3 BACnet/communication points that are available between devices
.4 System graphical interface
.5 Alerts, alarms and reporting

.3 Commissioning Meetings. Other meetings will be planned and conducted by the CxA as construction progresses. These meetings will cover coordination, deficiency resolution, and planning issues. These meetings will be held at least bi-monthly, becoming more frequent as the project demands, as frequently as once per week.
3.3 COMMISSIONING PLAN

.1 The commissioning plan is intended to be the documented intent of how the commissioning process is to be coordinated, scheduled, documented and implemented.

.2 The CxA will develop a project specific commissioning plan framework and lead the effort to completion. All contractors are to allocate time for their commissioning representative to supply information in a collaborative effort, with agreement to a logical and successful plan execution. The plan shall include, but is not, limited to, the following items.

.1 Detail of project team, organizational chart, with agreed coordination and communication protocol
.2 Team allocation of responsibilities
.3 Commissioning stages and milestones
.4 Project specific listing of systems that are to be commissioned
.5 Issues Log
.6 Commissioning Schedule
.7 Expected commissioning documentation list
.8 Installation Inspection forms
.9 Start up plans
.10 Functional testing procedures and checklists
.11 Integration testing procedure
.12 Performance testing procedure
.13 Training, orientation and demonstration schedule
.14 Phased handover procedures
.15 Deferred and seasonal testing plan

3.4 SUBMITTALS

.1 The contractors are to provide Cx specific information when collecting and issuing a submittal for review. At minimum, submittal package will include:

.1 Manufacturer and model number
.2 Manufacturer installation and operation manual
.3 Sequences of operation
.4 Control drawings, points list and communication protocol
.5 Performance data
.6 Manufacturer testing forms, including factory testing where applicable

.2 The CxA will review submittals related to the commissioned equipment for the consideration of items as follows:

.1 Special requirements for the installation and operation and risk to warranty of the equipment
.2 Communication protocol, note of points available and points that are of importance for system operation and performance
.3 Manufacturers start-up requirements and notice periods for site attendance
3.5 INSTALLATION CHECK AND STARTUP: PRE-FUNCTIONAL CHECKS

.1 Application: The following procedures apply to all equipment to be commissioned as outlined in this Section. Some systems that are not comprised so much of actual dynamic machinery, e.g., architectural systems, electrical distribution panels, may have very simplified checks and startup documentation.

.2 General: Pre-functional checklists are important to ensure that the equipment and systems are hooked up and operational. It ensures that functional performance testing (in-depth system checkout) may proceed without unnecessary delays. Each piece of equipment receives full pre-functional checkout. No sampling strategies are used. The pre-functional testing for a given system must be successfully completed prior to formal functional performance testing of equipment or subsystems of the given system.

.3 Start-up and Initial Checkout Plan: The CxA shall assist the commissioning team members responsible for startup of any equipment in developing detailed start-up plans for all equipment. The primary role of the CxA in this process is to ensure that the contractor provides written documentation that each of the manufacturer-recommended procedures have been completed. Parties responsible for prefunctional checklists and startup are identified in the commissioning scoping meeting and in the checklist forms (typically contractors, vendors and/or their authorized representative(s)).

The CxA obtains manufacturer installation, startup and checkout data, including actual field checkout sheets used by the field technicians from the contractor (through an RFI) or shop drawings.

The CxA copies all pages with important instructional data and procedures from the startup and checkout manuals not covered in manufacturer field checkout sheets and adds a signature line in the column by each procedure.

The copied pages, along with the pre-functional checklist provided by the CxA and the manufacturer field checkout sheets become the “Startup and Checkout Plan.”

For systems that may not have adequate manufacturer startup and checkout procedures, particularly for components being integrated with other equipment, the Sub should provide the added necessary detail and documenting format to the CxA for approval, prior to execution.

The CxA transmits the full Startup Plan to the GC/CM, who designates which trade or contractor is responsible to fill out each line item on the Prefunctional Checklist from the CxA. The GC then transmits the full start-up plan to the Subs for their review and use. (This usually means that the Prefunctional Checklist, alone, will go to more than one Sub, while the full plan will go to the primary installing contractor.)

.4 The Subs shall clearly list any outstanding items of the initial start-up and prefunctional procedures that were not completed successfully, at the bottom of the procedures form or on an attached sheet.

.5 Items left incomplete, which later cause deficiencies or delays during functional testing may result in backcharges to the responsible party.
3.6 EXECUTION OF PREFUNCTIONAL CHECKLISTS AND STARTUP

.1 Four weeks prior to startup, the Subs and vendors schedule startup and checkout with the GC and CxA. The performance of the prefunctional checklists, startup and checkout are directed and executed by the Sub or vendor. When checking off prefunctional checklists, signatures may be required of other Subs for verification of completion of their work.

.2 The Subs and vendors shall execute startup and provide the CxA with a signed and dated copy of the completed start-up and prefunctional tests and checklists. The CxA may review pre-functional checklists in progress, as necessary.

.3 The site technician performing the line item task initials and dates on the prefunctional and manufacturer field checkout sheets, as they are completed. Only individuals that have direct knowledge and witnessed that a line item task on the prefunctional checklist was performed shall initial or check that item off. It is not acceptable for supervisors to fill out these forms unless they have directly witnessed the specific task.

3.7 FUNCTIONAL TESTING

.1 This sub-section applies to all commissioning functional testing for all divisions.

.2 The general list of equipment/systems to be commissioned is found in Part 1 of this Section. Specific equipment and modes to be tested are found in relevant equipment sections of the specifications. If specific testing requirements were not included in the bid documents and original specifications, they should be developed for this project for each piece of commissioned equipment.

.3 Objectives and Scope: The objective of functional performance testing is to demonstrate that each system is operating according to the documented design intent and Contract Documents. Functional testing includes validation of completed systems in all modes of operation. Additionally, during the testing process, areas of deficient performance are identified and corrected, improving the operation and functioning of the systems.

.4 In general, each system should be operated through all modes of operation (seasonal, occupied, unoccupied, warm-up, cool-down, part- and full-load) where there is a specified system response. Verifying each sequence in the sequences of operation is required. Proper responses to such modes and conditions as power failure, freeze condition, low pressure, no flow, equipment failure, etc. shall also be tested. Specific modes required in this project are included in relevant sections of the contract documents.

.5 The CxA shall witness at a minimum, contractor functional testing for each piece of primary equipment, unless there are multiple units, in which case a sampling strategy may be used. In no case will the number of units witnessed be less than four on any one building, nor less than 20% of the total number of identical or very similar units. Sampling strategy is discussed further in this Section.

.6 Development of Test Procedures: Before test procedures are written, the CxA shall obtain all requested documentation and a current list of change orders affecting equipment or systems, including an updated points list, program code, control sequences and parameters. Using the testing parameters and requirements in contract documents, the CxA shall develop specific test procedures and forms to verify and document proper operation of each piece of equipment and system. CxA obtains clarification, as needed, from contractors and the A/E regarding sequences and operation to develop these tests. Each Sub or vendor responsible to execute a test, shall provide assistance to the CxA in developing the procedures (answering questions about equipment, operation, sequences, etc.). Prior to execution, the CxA shall provide a copy of the primary equipment test procedures to the Subs (via the GC) who shall review the tests for
feasibility, safety, equipment and warranty protection. The CxA may submit the tests to
the A/E for review, if requested.

.7 The CxA shall review owner-contracted, factory testing or required owner acceptance
tests which the CxA is not responsible to oversee, including documentation format, and
shall determine what further testing or format changes may be required to comply with
the Specifications. Redundancy of testing shall be minimized.

.8 The purpose of any given specific test is to verify and document compliance with the
stated criteria of acceptance given on the test form.

.9 Test Methods: Functional performance testing and verification may be achieved by
manual testing (persons manipulate the equipment and observe performance) or by
monitoring the performance and analyzing the results using the control system’s trend log
capabilities or by stand-alone dataloggers. The CxA follows the Specifications when
given and uses judgement where needed to determine which method is most
appropriate. The CxA may substitute specified methods or require an additional method
to be executed, other than what was specified, with the approval of the Owner. This may
require a change order and adjustment in charge to the Owner. The CxA will determine
which method is most appropriate for tests that do not have a method specified.

.1 Simulated Conditions. Simulating conditions (not by an overwritten value) shall
be allowed, though timing the testing to experience actual conditions is
encouraged wherever practical.

.2 Overwritten Values. Overwriting sensor values to simulate a condition, such as
overwriting the outside air temperature reading in a control system to be
something other than it really is, shall be allowed, but shall be used with caution
and avoided when possible. Such testing methods often can only test a part of a
system, as the interactions and responses of other systems will be erroneous or
not applicable. Simulating a condition is preferable. e.g., for the above case, by
heating the outside air sensor with a hair blower rather than overwriting the
value, or by altering the appropriate setpoint to see the desired response. Before
simulating conditions or overwriting values, sensors, transducers and devices
shall have been calibrated.

.3 Simulated Signals. Using a signal generator which creates a simulated signal to
test and calibrate transducers and DDC constants is generally recommended
over using the sensor to act as the signal generator via simulated conditions or
overwritten values.

.4 Altering Setpoints. Rather than overwriting sensor values, and when simulating
conditions is difficult, altering setpoints to test a sequence is acceptable. For
example, to see the AC compressor lockout work at an outside air temperature
below 55F, when the outside air temperature is above 55F, temporarily change
the lockout setpoint to be 2F above the current outside air temperature.

.5 Indirect Indicators. Relying on indirect indicators for responses or performance
shall be allowed only after visually and directly verifying and documenting, over
the range of the tested parameters, that the indirect readings through the control
system represent actual conditions and responses. Much of this verification is
completed during prefunctional testing.

.6 Setup. Each function and test shall be performed under conditions that simulate
actual conditions as close as is practically possible. The Sub executing the test
shall provide all necessary materials, system modifications, etc. to produce the
necessary flows, pressures, temperatures, etc. necessary to execute the test
according to the specified conditions. At completion of the test, the Sub shall
return all affected building equipment and systems, due to these temporary
modifications, to their pre-test condition.

.7 Sampling. Not all pieces of identical equipment receive in-depth testing; multiple identical pieces of non-life-safety or otherwise non-critical equipment may be functionally tested using a sampling strategy. Significant application differences and significant sequence of operation differences in otherwise identical equipment invalidates their common identity. A small size or capacity difference, alone, does not constitute a difference. It is noted that no sampling by Subs is allowed in prefunctional checklist execution.

A common sampling strategy is the “xx% Sampling—yy% Failure Rule” is defined by the following example.

1. \( xx \) = the percent of the group of identical equipment to be included in each sample.
2. \( yy \) = the percent of the sample that if failing, will require another sample to be tested.

The example below describes a 20% Sampling—10% Failure Rule, which is applicable to most distributed equipment:

1. Randomly test at least 20% (\( xx \)) of each group of identical equipment. In no case test less than three units in each group. This 20%, or three, constitute the “first sample.”
2. If 10% (\( yy \)) of the units in the first sample fail the functional performance tests, test another 20% of the group (the second sample)
3. If 10% of the units in the second sample fail, test all remaining units in the whole group.
4. If at any point, frequent failures are occurring and testing is becoming more troubleshooting than verification, the CxA may stop the testing and require the responsible Sub to perform and document a checkout of the remaining units, prior to continuing with functionally testing the remaining units.

3.8 EXECUTION OF FUNCTIONAL PERFORMANCE TESTS

.1 Coordination and Scheduling: The Subs shall provide sufficient notice to the CxA regarding their completion schedule for the prefunctional checklists and startup of all equipment and systems. The CxA will schedule functional tests through the GC and affected Subs. The CxA shall direct, witness and document the functional testing of all equipment and systems. The Subs shall execute the tests.

In general, functional testing is conducted after prefunctional testing and startup has been satisfactorily completed. For any given system, prior to performing functional testing, the CxA waits until the prefunctional checklist has been submitted with the necessary signatures, confirming that the system is ready for functional testing.

The control system is sufficiently tested by the installing contractor before it is used for TAB or to verify performance of other components or systems. The air balancing and water balancing is completed and debugged before functional testing of air-related or water-related equipment or systems. Testing proceeds from components to subsystems to systems. When the proper performance of all interacting individual systems has been achieved, the interfaces, integration and/or coordinated responses between systems is tested.
.2 **Problem Solving:** The CxA will recommend solutions to problems found, however the burden of responsibility to solve, correct and retest problems is with the contractors, Subs and A/E.

.3 **Owner Engagement:** The Owner’s facilities operating staff are encouraged to attend and participate in the testing process. The CxA will notify the Owner/PM, who will then notify the facility staff when the commissioning events will occur.

3.9 **DOCUMENTATION, NON-CONFORMANCE AND APPROVAL OF TESTS**

.1 **Documentation:** The CxA shall witness and document the results of all functional performance tests using the specific procedural forms developed for that purpose. Prior to testing, these forms are provided to the GC for review and approval and to the Subs for review. The CxA will include completed forms in the Commissioning Report.

.2 **Non-Conformance:** The CxA will record the results of the functional test on the procedure or test form. All deficiencies or non-conformance issues shall be noted and reported to the GC/CM on a standard non-compliance form.

.3 Corrections of minor deficiencies identified may be made during the tests at the discretion of the CxA. In such cases the deficiency and resolution will be documented on the procedure form.

.4 Every effort will be made to expedite the testing process and minimize unnecessary delays, while not compromising the integrity of the procedures. However, the CxA will not be pressured into overlooking deficient work or loosening acceptance criteria to satisfy scheduling or cost issues, unless there is an overriding reason to do so at the request of the GC/CM.

.5 As tests progress and a deficiency is identified, the CxA discusses the issue with the executing contractor.

.6 When there is no dispute on the deficiency and the Sub accepts responsibility to correct it:

1. The CxA documents the deficiency and the Sub’s response and intentions and they go on to another test or sequence. After the day’s work, the CxA submits the non-compliance reports to the GC/CM for signature, if required. A copy is provided to the Sub and CxA. The Sub corrects the deficiency, signs the statement of correction at the bottom of the non-compliance form certifying that the equipment is ready to be retested and sends it back to the CxA.

2. The CxA reschedules the test (through the GC/CM) and the test is repeated.

.7 If there is a dispute about a deficiency, regarding whether it is a deficiency or who is responsible:

1. The deficiency shall be documented on the non-compliance form with the Sub’s response and a copy given to the GC/CM and to the Sub representative assumed to be responsible.

2. Resolutions are made at the lowest management level possible (preferably between CxA or GC/CM and the Sub). Other parties are brought into the
discussions as needed. Final interpretive authority is with the A/E. Final acceptance authority is with the Owner.

.8 The CxA documents the resolution process.

.9 Once the interpretation and resolution have been decided, the appropriate party corrects the deficiency, signs the statement of correction on the non-compliance form and provides it to the CxA. The CxA reschedules the test and the test is repeated until satisfactory performance is achieved.

.10 Cost of Retesting: The cost for the Sub to retest a prefunctional or functional test, if they are responsible for the deficiency, shall be theirs. If they are not responsible, any cost recovery for retesting costs shall be negotiated with the GC/CM.

.11 For a deficiency identified, not related to any prefunctional checklist or start-up fault, the following shall apply:

1. The CxA and GC/CM will direct the retesting of the equipment once at no "charge" to the contractors for their time. However, the CxA’s and GC/CM’s time for a second retest will be charged to the contractors, who may choose to recover costs from the responsible Sub.

2. The time for the CxA and GC/CM to direct any retesting required because a specific prefunctional checklist or start-up test item, reported to have been successfully completed, but determined during functional testing to be faulty, will be backcharged to the contractor, who may choose to recover costs from the party responsible for executing the faulty prefunctional test.

3. Refer to the Sampling Section for requirements for testing and retesting identical equipment.

.12 The Contractor shall respond in writing to the CxA and GC/CM at least as often as commissioning meetings are being scheduled concerning the status of each apparent outstanding discrepancy identified during commissioning. Discussion shall cover explanations of any disagreements and proposals for their resolution.

.13 The CxA retains the original non-conformance forms until the end of the project.

.14 Any required retesting by any contractor shall not be considered a justified reason for a claim of delay or for a time extension by the prime contractor.

.15 Failure Due to Manufacturer Defect: If 10%, or three, whichever is greater, of identical pieces (size alone does not constitute a difference) of equipment fail to perform to the Contract Documents (mechanically or substantively) due to manufacturing defect, not allowing it to meet its submitted performance spec, all identical units may be considered unacceptable by the GC or PM. In such case, the Contractor shall provide the Owner with the following:

1. Within one week of notification from the GC or PM, the Contractor or manufacturer's representative shall examine all other identical units making a record of the findings. The findings shall be provided to the GC or PM within two weeks of the original notice.
2. Within two weeks of the original notification, the Contractor or manufacturer shall provide a signed and dated, written explanation of the problem, cause of failures, etc. and all proposed solutions which shall include full equipment submittals. The proposed solutions shall not significantly exceed the specification requirements of the original installation.

3. The GC or PM will determine whether a replacement of all identical units or a repair is acceptable.

4. Two examples of the proposed solution will be installed by the Contractor and the GC will be allowed to test the installations for up to one week, upon which the GC or PM will decide whether to accept the solution.

5. Upon acceptance, the Contractor and/or manufacturer shall replace or repair all identical items, at their expense and extend the warranty accordingly, if the original equipment warranty had begun. The replacement/repair work shall proceed with reasonable speed beginning within one week from when parts can be obtained.

.16 Approval: The CA notes each satisfactorily demonstrated function on the test form. Formal approval of the functional test is made later after review by the CA and by the Owner, if necessary. The CA recommends acceptance of each test to the Owner using a standard form.

3.10 SEASONAL AND DEFERRED TESTING

.1 Unforeseen Deferred Tests: If any check or test cannot be completed due to the building structure, required occupancy condition or other deficiency, execution of checklists and functional testing may be delayed upon approval of the PM. These tests will be conducted in the same manner as the seasonal tests as soon as possible. Services of necessary parties will be negotiated.

.2 Seasonal Testing: During the warranty period, seasonal testing (tests delayed until weather conditions are closer to the system’s design) shall be completed as part of this contract. The CxA shall coordinate this activity. Tests will be executed, documented and deficiencies corrected by the appropriate Subs, with facilities staff and the CxA witnessing. Any final adjustments to the O&M manuals and as-builts due to the testing will be made.

3.11 DEMONSTRATIONS TO OWNER PERSONNEL

.1 The CM/GC and contractors shall be responsible providing qualified personnel, coordination, scheduling, documentation and ensuring that “optimum” demonstrations to the Owners facility staff is completed.

.2 The CM/GC shall organize the demonstration to the Owner’s personnel for commissioned equipment and systems. The CxA will be in attendance to aid in facilitation and consider further requirements of SFU.

.3 Provide, to the Owner and CxA through the CM/GC, a demonstration plan 6 weeks before the planned demonstrations covering the following elements:

.1 Equipment.
.2 Intended audience.
.3 Objectives.
.4 Subject covered (special operation, log in/out, alarms, resets, etc).
.5 Duration of demonstrations on each subject.
.6 Instructor for each subject.
.7 Methods of demonstration (classroom lecture, manufacturer's quality video, site walk through, actual operational demonstrations, written handouts, etc.).

3.12 FINAL COMMISSIONING REPORT

.1 The Commissioning Report is intended to be a standalone document. The Commissioning Report will be a complete report containing all commissioning related documents from the project.

.2 The Commissioning Report compiled by the CxA shall be issued to SFU as an independent document to the O&M manuals at the time of handover.

.3 The CxA is responsible to compile, organize and index the project commissioning documents as detailed in this section. The Commissioning Report shall include, but not be limited to:

.1 Basis of Design Review.
.2 The Commissioning Plan.
.3 Commissioning Reports: Startup Records, Pre-Functional Checks and Functional Checks
.4 Commissioning Meeting Minutes.
.5 Demonstration and Training Record.

3.13 COMMISSIONING HOLDBACK AMOUNTS

.1 A commissioning Holdback Amount shall be established at the beginning of the project for all disciplines having commissioning scope. Holdback amounts shall be reviewed and approved by the designated payment certifier to ensure adequate funds are allocated for completion of commissioning activities.

.2 In general, payment certification shall not exceed 90% (NINETY PERCENT) of the value of the total construction cost until commissioning has been satisfactorily completed and the preliminary commissioning report, project record drawings and preliminary Maintenance Manuals have been submitted and FULLY ACCEPTED in writing by CA and responsible consultants.

***END OF SECTION***
1.1 **GENERAL**

1.2 **Related Technical Requirements**

.1 *Section 01 74 19 Construction Waste Management and Disposal*

1.3 **Description**

.1 Demolition of Buildings and Site Works.

1.4 **Definitions**

.1 “Remove” - Remove and legally dispose of items and materials off-site except those indicated to be reinstalled, salvaged, or to remain the owner’s property.

.2 “Remove and Salvage” - Items and materials indicated to be removed and salvaged remain the Owner's property. Remove, clean, and pack or crate items to protect against damage. Identify contents of containers and deliver to Owner.

.3 “Remove and Re-Install” - Remove items and materials indicated; clean, service, and otherwise prepare them for reuse; store and protect against damage. Re-install items in locations indicated.

.4 “Existing to Remain” - Protect construction indicated to remain against damage and soiling during demolition. When authorized in writing by the Owner at the contractor’s request, items and materials may be removed to a suitable and bonded storage location as determined by the Owner and at the contractor’s cost and then cleaned and reinstalled in their original locations.

1.5 **Site Survey**

.1 SFU require consideration for a site survey for completion on all projects – a full site survey is not required for all projects. Survey information should be provided to SFU Records as soon as available.

2.1 **MATERIAL AND DESIGN REQUIREMENTS**

2.2 **Submissions**

.1 Fire Safety Plan conforming to the BC Fire Code Section 2.14 as required by Part 8 of the BC Building Code, Clause 8.2.2.2 demolition sites, for review and approval by the Burnaby Fire Department prior to commencement of building demolition.

.2 Submit to the Project Manager

.1 Proposed dust-control measures.

.2 Noise-Control Measure plan and vibration-control measure plan.

.3 Demolition Activities indicating the following:

.1 Detailed sequence of demolition and removal work, with starting and ending dates for each activity.

.2 Dates for shutoff, capping, and continuation of utility services.

.3 Phasing and dates for sectional shutoff of sprinkler system serving existing buildings which are to remain.
.4 Inventory of items to be removed and salvaged.
.5 Inventory of items to be removed by owner.
.6 Photos or videotape, sufficiently detailed, of existing conditions of adjoining construction and site improvements that might be misconstrued as damage caused by demolition operations.

.7 Record drawings at Project closeout, which also identify and accurately locate capped utilities and other subsurface structural, electrical, or mechanical conditions.

.4 Hazardous material report (required for all projects), performed in compliance with WCB regulations and in consultation with SFU EHRS.

.3 Submit to SFU Facilities records of:
   .1 Storage tanks decommissioning and removal; and
   .2 Manifest records indicating the transportation (green copy) and acceptance (brown copy) of hazardous waste in an authorized facility. Demolition hazardous waste may include asbestos, lead paint/piping, equipment containing PCB or ozone depleting substances (refrigerants), animal dropping/fece, mould, PCB ballasts, mercury thermostat or lightbulbs and radioactive sources. Refer to the latest SFU Facility Service Health and Safety Manual for additional details.

.4 Notify your SFU Project Manager, the site superintendent, Burnaby Fire Department and SFU Facilities immediately of any spill or release of hazardous material or waste to the environment.

2.3 Quality Control

.1 The contractor to engage or have on staff a professional engineer registered in BC to review and give written instructions on the layout and proposed methods of temporary supports, demolition and remedial work at all structural components so as to maintain structural integrity. The engineer shall submit reports and Letters of Assurances in the form established by Municipal Regulation.

.2 Prior to the start on site the Project Manager is responsible for contacting SFU Facilities regarding: work that is about to start, regarding any demolition materials that need to be saved (especially locks for security), plus any details regarding the necessary removal of obstructing street furniture, signs in the landscape, lamp post sign blades, bollards etc, including access to the site and site-related signage etc.

.3 Demolition projects to consider all services running through site including life safety, mechanical, and electrical.

.4 Demolition projects to respect all site control measures and standards set out in Section 31 22 00 Grading and Section 32 00 10 Landscaping Design Requirements.

2.4 General

.1 Before removal from site, the contractor shall ascertain from the Project Manager what is to be salvaged. This is to be coordinated with appropriate SFU Facilities and faculty staff on a per project basis for items including locksets, hardware, and lab equipment. General policy is to sustainably reuse equipment whenever possible. The owner reserves the right to require the contractor to salvage any removed materials, fixtures, fittings or components. Items selected by the Project Manager shall be transported and handed over to the Project Manager as determined during the course of construction, or at the end of the project.
.2 Except for items or materials indicated to be reused, salvaged, or otherwise indicated to remain the owner’s property, demolished materials shall become the contractor’s property and shall be removed from the site with further disposition at the Contractor’s option.

Historical items, relics, and similar objects include, but are not limited to, cornerstones and their contents, commemorative plaques and tablets, antiques, and other items of interest or value to the owner or authorities having jurisdiction, which may be encountered during the work of this section, remain the owner's property. Carefully remove and salvage each item or object in a manner to prevent damage and deliver promptly to the Project Manager or as directed.

.3 Storage or sale of removed items or materials on or adjacent to the site shall not be permitted.

2.5 Use of Explosives

.1 Use of explosives shall not be permitted.

2.6 Hazardous Materials

.1 Stop work around an area where existing previously unidentified hazardous material is discovered (refer to Section 01 35 43.13), including materials suspected of containing asbestos, and immediately contact the Project Manager for direction before continuing with the work affected.

2.7 Construction Site Waste Management, Storage and Disposal

.1 For general waste management and recycling requirements, refer to Division 01 Section 01 74 19 Construction Waste Management and Disposal.

***END OF SECTION***
*Note this is not an exhaustive list, and is based on survey information available September 2019. There may be other buildings that also contain pre-stressed concrete members. There has also been new construction since this list was prepared. Note also that prestressed concrete may have been used in non-structural or secondary structural elements (cladding, etc) and this would not always be indicated on the structural drawings.

**Building:** Central Mall Area (CM)/ West Mall Centre (WMC)

**SFU Building ID:** 003/ 041

**Seismic Overview Report ID:** SOR-003-CM-2014

### 1.0 BUILDING DESCRIPTION, CONSTRUCTION PHASING AND DRAWINGS
## 2.0 KEY STRUCTURAL INFORMATION

<table>
<thead>
<tr>
<th>Phase #</th>
<th>Major Structural System</th>
</tr>
</thead>
</table>
| PHASE III (WMC) | - PT Cast-in-place concrete and steel structure.  
- **Foundations**: RC slab on grade; RC spread footings under columns and RC strip footings under walls.  
- **Floor**: RC PT flat slab supported on RC columns and walls.  
- **Roof**: RC PT flat slab supported on RC columns and walls; roof above stairs consists of concrete topping on steel deck supported on steel beams and RC walls.  
- **Lateral load-resisting system**: concrete slab and steel deck act as diaphragms that transfer lateral forces to concrete shear walls. |
1.0 BUILDING DESCRIPTION, CONSTRUCTION PHASING AND DRAWINGS

2.0 KEY STRUCTURAL INFORMATION

<table>
<thead>
<tr>
<th>Phase #</th>
<th>Major Structural System</th>
</tr>
</thead>
</table>
| PHASE I | - Cast-in-place concrete structure  
|          |  - Foundations: RC slab on grade; spread footing under columns and walls  
|          |  - Floor: RC slab supported on RC concrete pan joist or post- tensioned beams and RC columns and walls  |
| PHASE II | - Concrete structure  
|          |  - Foundations: RC slab on grade; spread footing under columns and walls  
|          |  - Floor: RC slab supported on concrete joist or post-tensioned beams and RC columns and walls  |
| PHASE III | - Concrete structure  
|          |  - Foundations: RC slab on grade; spread footing under columns and walls  
|          |  - Floor: RC slab supported on RC beam, Post-tension beams, concrete joist and RC columns and walls  |
1.0 DESCRIPTION, CONSTRUCTION PHASING AND DRAWINGS

2.0 KEY STRUCTURAL INFORMATION

<table>
<thead>
<tr>
<th>Phase #</th>
<th>Major Structural System</th>
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<tbody>
<tr>
<td>PHASE I</td>
<td>- Cast-in-place concrete structure.</td>
</tr>
<tr>
<td></td>
<td>- Foundations: perimeter RC walls; pad and strip footings under concrete columns and walls; RC slab on grade.</td>
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<td></td>
<td>- Suspended Slabs &amp; Roof: 4 1/2&quot; RC slab with PT concrete beams and girders.</td>
</tr>
<tr>
<td></td>
<td>- Lateral load-resisting: RC floor and roof slabs act as diaphragms; there is long perimeter and interior concrete shear walls below grade; walls around stairs and elevator shafts act as shear walls and transfer the lateral load to the foundation.</td>
</tr>
</tbody>
</table>
1.0 BUILDING DESCRIPTION, CONSTRUCTION PHASING AND DRAWINGS

2.0 KEY STRUCTURAL INFORMATION

<table>
<thead>
<tr>
<th>Phase #</th>
<th>Major Structural System</th>
</tr>
</thead>
</table>
| PHASE I  | - Reinforced Concrete structure with steel reinforcing and grouted PT strands.  
|          | - Foundation: slab on grade; strip footing under concrete walls; concrete caisson support  
|          | - Upper structure: cast-in-place concrete bearing walls in both outer and inner shafts; cast-in-place concrete room at the top.  
|          | - Roof: concrete roof deck. |
1.0 BUILDING DESCRIPTION, CONSTRUCTION PHASING AND DRAWINGS

Second Floor: PT box beams

PHASE I (2008)
## 2.0 KEY STRUCTURAL INFORMATION

<table>
<thead>
<tr>
<th>Phase #</th>
<th>Major Structural System</th>
</tr>
</thead>
</table>
| PHASE I | - Cast-in-place concrete structure.  
- **Foundations**: RC retaining walls and RC walls on strip footings; spread footing under concrete columns.  
- **Main Floor**: 125mm concrete slab on grade.  
- **Second Floor**: Framing consists of either a 203mm or 305mm deep hollow core supported by RC beams on columns or suspended slab flat slab supported by RC walls. Framing at the link bridge consists of a 225mm RC slab on PT box beams.  
- **Roof**: Framing consists of a 203mm deep hollow core supported by RC beams on columns. The roof of the lecture halls and courtyard consists of a steel deck on Douglas Fir Glulam beams supported by RC walls. Framing above the link bridge consists of wood joists on glulam columns.  
- **Lateral load-resisting system**: Main system consists of RC suspended slabs and hollow core that act as diaphragms that help to transfer lateral forces to concrete moment frames that consist of RC beams and columns. |
1.1 **GENERAL**

1.2 Related Sections

.1 03 00 00.1 Seismic Master Plan and Overview Post Tension Structure Report

1.3 **Concrete Construction – Structural Requirements**

.1 Design building structures and their structural components for a 100 year service life.

.2 Structural design shall conform to the latest editions of the following:

   a) BC Building Code
   b) CSA-A23.1, Concrete Materials and Methods of Concrete Construction
   c) CSA-A23.2, Methods of Test for Concrete.

.3 QA and QC Plans to be provided and written in detailed specifications for every project.

.4 Ensure that drawings include a summary of the structural systems and provide supplementary information as required.

.5 Ensure that sustainable design principles have been considered for the project. Ensure that LEED requirements selected by SFU Facilities have been satisfied.

.6 Increase live loads for specific SFU occupancies.

.7 SFU snow load factors should reflect latest BC Building Code.

.8 Design light roofs for a minimum net factored uplift of 1.0 kPa.

.9 Ensure that the design and field review of non-structural components is covered in the contract documents (drawings and/or specifications).

.10 Conduit should not be embedded in concrete unless approved by SFU Facilities on a per project basis.

.11 Ensure that the independent structural concept review has been completed. Concept reviewer to submit a sealed letter to SFU Facilities confirming completion of the review.

.12 Refer to SFU Exterior Concrete Standard Specification for guidance on exterior concrete products.

1.4 **Materials**

.1 Treat exposed concrete elements with beveled edges or tooling, as appropriate.

.2 Slabs-on-grade are to be 150 mm minimum thickness, reinforced and provided with well-spaced control joints in an approximately square pattern, spacing less than 4000 mm on centre.

.3 Reinforcing steel, which is part of the seismic load-resisting system, must be weldable conforming to CAN/CSA G30.18W.

.4 Do not use calcium chloride (in any form) in concrete mixes.
.5 Post-tensioned slabs/floor systems are strongly discouraged by SFU. Any use on projects must be reviewed and approved by SFU.

.6 Consult with SFU regarding status of SFU ‘Preventative Maintenance Inspections’ for all pre and post tensioned members. An inventory of all SFU members across the campus will be updated as part of this project – latest documentation is available in Section 03 00 00.1 Seismic Master Plan and Overview Post Tension Structure Report.

1.5 Inspection by the Consultant

.1 Provide adequate notice to the Consultant to ensure that he has the opportunity of inspecting all prepared areas prior to placement of concrete.

.2 Contractor to pay all costs incurred for uncovering and making good any Work covered before required inspection is completed and approved by the Consultant.

.3 Payment for inspection and specified testing to be provided by the Owner except for the following and as noted above:
   a) Testing required by laws, ordinances, rules, regulations or orders of the public authorities.
   b) Inspection and testing performed exclusively for the Contractor's convenience.

.4 Where tests or inspections by the Consultant reveal Work not in accordance with Contract requirements, the Contractor shall pay costs for additional tests or inspections that the Consultant may require to verify acceptability of the corrected Work.

1.6 Defective Concrete And Patching

.1 Concrete surfaces to be free from open texturing, voids, and projections.

.2 For repair of defective concrete Work:
   a) Repair defective areas while concrete is still plastic, otherwise wait until curing is completed. Use repair methods approved by Consultant.
   b) Grind off high surface variations where directed and re-texture surface to match adjoining concrete as closely as possible.

.3 Remove and replace defective concrete where directed. Removal and replacement procedures will be detailed by the Consultant.

.4 Repair of defective concrete Work and/or removal and replacement of defective concrete prior to final acceptance of the deck to be carried out at Contractor's expense.

.5 Immediately after the removal of forms, all bolts, ties, nails or other metal not specifically required for construction purposes shall be removed or cut back to a depth of 25 mm (1") from the surface of the concrete.

1.7 Protection

.1 All freshly placed and consolidated concrete shall be suitably protected during the curing period against damage from adverse weather conditions. Protection of the concrete from adverse weather conditions is the sole responsibility of the Contractor and shall be conducted in strict accordance with CSA-A23.1.
1.8 Tolerances

.1 Tolerances shall conform to CSA-A23.1 (current edition) or the requirements of these specifications, whichever are more rigorous.

***END OF SECTION***
1.0 GENERAL

1.1 REFERENCE STANDARDS
.1 Concrete Work shall conform to the requirements current edition of the following standards unless otherwise required by this specification.
   - BC Building Code
   - CSA-A23.1, Concrete Materials and Methods of Concrete Construction.
   - CSA-A23.2, Methods of Test for Concrete.

1.2 SCOPE OF WORK
.1 Provide all labour materials services and equipment necessary and incidental for new concrete for exterior curbs, sidewalks, toppings, exterior concrete repairs and miscellaneous concrete Work in areas shown on the Drawings and as directed by the Consultant.

1.3 PROTECTION
.1 Provide and maintain all legal and necessary guards, railings and warning signs during the execution of the Work to fully protect all persons and Owner from loss, damage, death or injury through the neglect or carelessness of the Contractor or the condition or handling of equipment. Ensure that employees have WHMIS training for materials being handled on site and that material safety data sheets for all materials being used are available for use and inspection on site.

1.4 MEASUREMENT FOR PAYMENT
.1 Removal and replacement of all concrete curbs, sidewalks, medians or topping shall be paid on a Unit Rate or Lump Sum basis, as detailed in the Bid Form, for areas authorized by the Consultant.
.2 Include all costs necessary and incidental for Concrete Work including demolition, labour, materials, equipment, temporary protection, and cleanup in the Unit Rates and/or Lump Sum Price.

1.5 INSPECTION BY THE CONSULTANT
.1 Provide adequate notice to the Consultant to ensure that he has the opportunity of inspecting all prepared areas prior to placement of concrete.
.2 Contractor to pay all costs incurred for uncovering and making good any Work covered before required inspection is completed and approved by the Consultant.
.3 Payment for inspection and specified testing to be provided by the Owner except for the following and as noted above:
   a) Testing required by laws, ordinances, rules, regulations or orders of the public authorities.
   b) Inspection and testing performed exclusively for the Contractor's convenience.
.4 Where tests or inspections by the Consultant reveal Work not in accordance with Contract requirements, the Contractor shall pay costs for additional tests or inspections that the Consultant may require to verify acceptability of the corrected Work.
2.0 PRODUCTS

2.1 CONCRETE REPAIR MATERIALS - GENERAL

.1 Type GU Portland cement in accordance with CAN/CSA-A5.

.2 Supplementary cementing materials in accordance with CAN/CSA-A23.1/A23.5, Type F, Type CI/CH or Type SF.

.3 Concrete Aggregates in accordance with CAN/CSA-A23.1.

.4 Water to be potable in accordance with CAN/CSA-A23.1.

.5 Air entraining admixtures in accordance with CAN3-A266.1.

.6 Water reducing admixtures in accordance with CAN3-A266.2.

.7 Superplasticizing admixtures in accordance with CAN3-A266.6.

.8 Chlorides either as a raw material or as a constituent in admixtures shall not be used.

.9 Liquid membrane curing compounds shall not be permitted.

2.2 PRE-PACKAGED CONCRETE REPAIR PRODUCTS - GENERAL

.1 For pre-bagged products, each bag of product delivered to the site is to be clearly identified with the supplier and product name and date of manufacture. Technical literature detailing mixing, placing and curing requirements to be supplied to the site with the repair material.

.2 Submit specified Concrete Repair Systems to the Consultant for review 7 days prior to concrete placement.

.3 Consultant’s written approval of Concrete Repair Systems is required before initiation of repairs.

.4 All pre-bagged repair materials shall meet ASTM C-666 Test Method for Resistance of Concrete to Rapid Freezing and Thawing - minimum durability factor of 90%.

.5 All pre-bagged repair materials shall have a minimum 28 day compressive strength of 40 MPa.

.6 Pre-bagged materials shall not be used later than 6 months from the date of manufacture.

2.3 BONDING SLURRY

.1 Bonding slurry for concrete repairs shall be in accordance with CSA A23.1 and shall consist of:

   a) Type GU Portland cement: 1 part by volume

   b) Clean sharp, masonry sand: 1 part by volume

   c) Water to give a thick creamy consistency.

.2 Addition of polymer bonding agent in the bonding slurry or direct application of polymer bonding agent is not required for readi-mix or pre-bagged concrete repairs.

.3 Do not use Portland cement bonding slurry for pre-packaged rapid setting concrete or mortar. Strictly follow the manufacturers’ instructions for rapid set concrete or mortar installation.
2.4 **READI-MIX CONCRETE FOR GRADE SLABS, CURBS, SIDEWALKS, CONCRETE TOPPINGS OR STRUCTURAL CONCRETE:**

.1 Readi-mix concrete shall be supplied in accordance with CSA-A23.1, Alternative 1. It shall be ready-mix supplied Portland cement concrete meeting all the requirements of CSA-A23.1 with the following properties and constraints:

- Maximum water/cementing materials ratio of 0.40
- Minimum 28 day compressive strength of 40 MPa
- Maximum coarse aggregate size of 20 mm
- Slump of 80 ± 20 mm (prior to superplasticizer addition)
- Air Content of 6 ± 1%

Note: The use of 10 mm maximum size coarse aggregate is also permitted. The air content shall be 7 ± 1% for 10 mm maximum coarse aggregate.

Alternatively, pre-bagged dry-mix concrete may be used. Target 6000 psi Concrete Mix is a pre-approved product.

.2 Cementitious content may include up to 20% Type F or Type C fly ash by mass of cement. The use of silica fume in the concrete mixture is not considered necessary.

.3 Submit proposed concrete mix design proportions to the Consultant for review and written approval seven (7) days prior supplying to the Project.

.4 Superplasticizer may be used to increase the workability of readi-mix concrete. Use superplasticizers that do not significantly alter the air content after addition.

.5 All superplasticizer shall be added on site, not at the batch plant unless otherwise approved by the Consultant. The fresh concrete shall be adjusted to 80 ± 20 mm on site prior to superplasticizer addition. The slump after superplasticizer addition shall be 110 mm ± 30 mm.

.6 Tests for slump and air content shall be conducted on every truck load of concrete. Concrete slump and air content shall be measured before and after superplasticizer addition. Tests for slump and air content shall be conducted before any concrete is placed. Cast specimens for compressive strength testing at 7 and 28 days (1 specimen tested at 7 days and the average of 2 specimens at 28 days) shall be taken in accordance with CSA-A23.2. Cast two field cure specimens to confirm field compressive strength prior to shoring removal.

.7 Concrete testing shall be arranged for by the Consultant and paid for by the Owner.

2.5 **RAPID HARDENING PRE-PACKAGED CONCRETE FOR GRADE SLAB, CURBS, SIDEWALKS, CONCRETE TOPPING OR STRUCTURAL DECK SURFACE REPAIRS:**

.1 Pre-bagged rapid hardening concrete for slab surface repairs shall be weight batched, air entrained, freeze/thaw resistant, low shrinkage concrete with 3/8" (10 mm) maximum aggregate size. Pre-approved products include:

- Target Traffic Patch Fine (neat or extended up to 30% by weight with 3/8" (10 mm) coarse aggregate).
- Rapid Set DOT Repair Mix (neat or extended up to 30% by weight with 3/8" (10 mm) coarse aggregate).
2.6 **MORTAR OR CONCRETE FOR DECK SLAB SURFACE/SOFFIT, WALL OR COLUMN REPAIRS:**

.1 Mortar for minor concrete deck surface/soffit, wall or column repairs less than 2” (50 mm) in thickness shall be pre-bagged weight batched, air entrained, freeze-thaw resistant, low shrinkage mortar. Pre-approved products include:
   - Planitop XS by Mapei
   - Target VO Patching Mortar
   - Thoro Thorite 100

.2 Concrete for exterior concrete repairs greater than 2” (50 mm) in thickness shall be pre-bagged weight batched, air entrained, freeze-thaw resistant, flowable, low shrinkage concrete with 3/8” (10 mm) maximum aggregate size. Pre-approved products include:
   - Target 6000 psi concrete.
   - Target Flowcrete.

.3 Polymer additive to be used with pre-bagged mortar or concrete as mixing liquid and in bonding slurry only if required by the manufacturer in accordance with the manufacturer’s instructions.

2.7 **CONCRETE REINFORCEMENT:**

.1 Reinforcing bars where required shall be billet steel, grade 400, deformed bars to CSA G30.12 unless indicated otherwise.

.2 Welded wire mesh where required shall conform to CSA G30.5, “Welded Steel Wire Fabric for Concrete Reinforcement”.

.3 Chairs, bolsters, bar supports, spacers adequate for strength and support of reinforcing construction conditions.

.4 Reinforcing steel accessories shall be non-corrosive and commercially manufactured.

.5 Fabricate reinforcing to above reference standards.

.6 Fabrication tolerances for reinforcing steel ACI Standard 315.

.7 Ship bundles of bar reinforcement, clearly identified in accordance with bar list.

2.8 **SEALANTS:**

.1 Primers: Primer shall be used and shall be type recommended by sealant manufacturer.

.2 Backer Rod: Closed cellular foam backer rod, Sika Backer Rod or approved equal.

.3 Bond Breaker: pressure sensitive plastic tape, which will not bond to sealants.

.4 Sealants for joints shall be single component polyurethane non-hardening sealant suitable for exterior use and shall be compatible with and adhere to the substrate to which it is applied. Select appropriate grade of sealant for application on sloped and horizontal surfaces. Sealants shall conform to the current edition of the following standard:

Pre-approved sealants are as follows:
   - Sikaflex 1a Traffic Grade
- Tremco Dymonic FC

Color to be concrete grey.

.5 Joint Cleaner: xylol, methylethylketone or non-corrosive type recommended by sealant manufacturer and compatible with joint forming materials.

2.9 JOINT FILLER

.1 Sidewalk curb and slab/wall isolation joint filler to be ½" thick asphalt impregnated fibreboard.

3.0 EQUIPMENT:

3.1 SAND BLAST CLEANING EQUIPMENT

.1 Sandblasting equipment to be minimum 50 kg capacity pot, fitted with appropriate oil separators to ensure that only oil-free air is mixed with sand. Wet sand blasting equipment may also be used to minimize dust.

3.2 CONCRETE MIXING EQUIPMENT

.1 Concrete shall be delivered to site in transit mix trucks from a commercial batch plant which conforms to the requirements of CSA-A23.1.

.2 Pre-bagged concrete or mortar shall be mixed in suitable mechanical mixers. Hand mixing of pre-bagged concrete or mortar is not permitted.

3.3 CONCRETE PLACING AND FINISHING EQUIPMENT

.1 Concrete placing and finishing shall be in accordance with CSA-A23.1.

3.4 CONCRETE CURING EQUIPMENT

.1 Sufficient clean burlap and water sprinklers are to be provided to ensure that concrete can be moist cured as specified.

.2 Moist curing shall be in accordance with CSA-A23.1.

.3 Concrete curing compounds are not allowed on surfaces that require a membrane.

3.5 EQUIPMENT APPROVAL AND SUBSTITUTIONS

.1 Consultant may require the replacement of any unsatisfactory equipment during the Work to ensure that the project specification is met.

4.0 EXECUTION

4.1 DEMOLITION

4.1.1 EXTERIOR CONCRETE GRADE SLABS, CURBS, SIDEWALKS

.1 Where required, remove and dispose off site all concrete grade slabs, curb, sidewalks and asphalt in designated areas shown on the Drawings.

.2 Provide a minimum 2" deep saw cut at the transition between asphalt or concrete to be removed and disposed off site and concrete to be left in place. Saw cut the existing curb full depth at each end of the repair area to provide a clean joint for the new curb.

.3 Cut back and dispose off site existing vegetation where required. Remove and dispose of existing top soil to provide room to install concrete forms.
4.1.2 **CONCRETE REPAIRS**

.1 Provide a saw cut around the perimeter of the repair area a minimum of 1" deep (2" deep saw cut for grade slabs and concrete toppings). Avoid cutting reinforcing steel.

.2 Remove a minimum of 1" up to 2" concrete depth in the designated repair area. Concrete removal to be conducted using chipping hammers not exceeding 7 kg class.

.3 Where delaminated concrete or corroded reinforcing steel is encountered, remove delaminated concrete and expose corroded reinforcing. Contact the Consultant for review prior to continuing with repairs.

.4 Provide a minimum of 3/4" clearance around exposed reinforcing where more than 1/3 the diameter of the bar is exposed.

.5 Dispose all excavated concrete off site.

4.2 **SURFACE PREPARATION**

4.2.1 **EXTERIOR CONCRETE GRADE SLABS, CURBS AND SIDEWALKS**

.1 The Consultant shall review the sub-base condition prior to grading for new concrete slabs, curbs or sidewalks. Remove and replacement substandard sub-base materials as required by the Consultant.

.2 Compact sub-base to a Standard Proctor Density of 100% in accordance with Master Municipal Construction Document (MMCD) standards.

.3 Obtain Consultant’s approval of compacted sub-base before concrete placement.

4.2.2 **CONCRETE REPAIRS**

.1 Sandblast clean all prepared concrete surfaces to remove all loose and micro-fractured concrete particles, dust and contamination deleterious to bond.

.2 Sandblast clean the exposed existing reinforcing steel to remove loosely adhered concrete and residual corrosion products.

.3 Use air wands (dry, oil-free air) and/or vacuum cleaning equipment to remove blasting grit, slurry and debris from form work and concrete surfaces.

.4 Provide adequate protection and screens during demolition and blast cleaning operations to ensure the safety of pedestrian and vehicle traffic.

.5 When bonding fresh concrete to existing concrete, thoroughly saturate the existing concrete 16 to 24 hours before placing concrete. Use oil free compressed air to remove water from low areas and from exposed reinforcing steel.

4.2 **LINES AND GRADES**

.1 The Contractor is responsible for survey control of all Work. Periodic checks by the Consultant do not relieve the Contractor of any responsibility herein stated.

.2 Minimum concrete grade slab thickness for pedestrians shall be 4". Minimum concrete grade slab thickness for vehicle traffic shall be 6". Contractor shall confirm loading requirements and grade slab thickness with the Consultant prior to installing concrete forms.

.3 The Contractor shall provide a system such as screed rails or other approved methods to provide the specified concrete cover to reinforcing steel (where required) and to ensure strict adherence
to the drainage slopes. Concrete shall be sloped so no water ponds form on the finished concrete surface.

.4 Forming is not required for concrete repairs less than 2" thick. Concrete repairs greater than 2" thick must be formed and poured.

4.3 REINFORCING STEEL

.1 Install reinforcing steel or wire mesh as shown on the drawings.

.2 Where required, reinforcing steel of wire mesh to be installed at the midpoint of the slab depth using chairs or similar method.

.2 Minimum cover to reinforcing steel shall be 2" at all locations.

.3 At control joint locations, cut a 3" section from every second reinforcing bar or mesh wire for crack control.

4.4 CONCRETE PLACEMENT FOR GRADE SLABS, CURBS, SIDEWALKS AND CONCRETE TOPPING REPAIRS

.1 Inform Consultant at least 24 hours before placing concrete. No concrete to be placed until Consultant has inspected and approved in writing all preparation of concrete and reinforcing steel, and installation of forms. Adjustment of elevations at any unsatisfactory areas, and retesting, will be required before approval of preparation work by Consultant.

.2 When concreting starts, carry on as a continuous operation until the placing of the section is complete. When shown on Drawings, place concrete in the sections indicated and according to the sequence given.

.3 Place freshly mixed concrete in accordance with CSA-A23.1.

For concrete supplied by readi-mix transit trucks, all concrete must be placed and consolidated within 120 minutes of initial mix water addition. Site addition of water to maintain workability shall conform strictly to CSA-A23.1. No water shall be used to re-temper the concrete mix after the addition of superplasticizer.

For pre-bagged concrete, add dry concrete to water with continuous power mixing to achieve the required consistency. Use the minimum amount of water to achieve the required slump. Water to be weighed or volume batched to maintain consistency between batches. Mix for a minimum period of 5 minutes. All concrete must be placed and consolidated within 20 minutes of initial mixing. Subsequent addition of water or superplasticizer to maintain workability shall not be permitted.

For rapid hardening pre-bagged concrete, the mixing equipment and shall have sufficient capacity to ensure continuous concrete batching without interruption. The Contractor shall provide a sufficiently large work force to maintain continuous rapid hardening concrete batching, placement and finishing and ensure the final concrete placement meets the requirements of the project specifications.

.4 Deposit concrete as close as practical to its final position. Provide delivery equipment which will not exceed the safe loading capacity of the structure.

.5 Vibrators shall be adequately powered and sufficiently intense to compact the concrete readily into place. Systematically apply vibrators at such intervals that the zones of influence of the vibrator overlap. Insert the vibrator vertically into the concrete long enough to ensure that the concrete is
properly compacted. Employ a sufficient number of vibrators so that the required rate of placement vibration throughout the entire volume of each layer of concrete compaction is secured. Keep one spare vibrator at site for emergency use.

.6 Finished concrete surface is to be within 1/4" (5 mm) of the design elevation, but not uniformly low.

.7 Finish concrete in accordance with CSA-A23.1. Provide a smooth steel trowel float finish to horizontal suspended slab surfaces. Grade slab perimeters to have a 1/4" rounded edge.

.8 As soon as the concrete surface has been finished and can bear weight without marking, carefully cover with burlap. Place burlap sections to overlap each other by 6 inches or more and to overlap concrete slab by 1 ft (300 mm) or more at each side.

Thoroughly wet the burlap with water before placing it on the concrete and keep saturated during curing period with a water spray sufficiently fine to avoid damaging the concrete surface.

Cover burlap with polyethylene sheeting to maintain saturation of concrete during curing periods. For readi-mix concrete, the Contractor shall ensure that the burlap is kept wet at all times for 7 days after placing concrete. For rapid setting cement concrete, the curing period is a minimum of 4 hours or until the heat generated by the repair concrete has fully dissipated (whichever is the greater time).

.9 Grind any fins or protrusions within the repair area, and patch minor voiding.

4.5 MORTAR OR CONCRETE FOR CONCRETE REPAIRS

.1 A Portland cement/masonry sand bonding slurry (Section 2.3) shall be used when bonding fresh concrete to existing concrete or as directed in the product manufacturer’s literature, whichever is more stringent.

.2 Allow concrete to come to a saturated surface dry condition (SSD) before applying bonding slurry or concrete. Prepare a bonding slurry mixed with sufficient water to give a creamy consistency. Mix only enough slurry in each batch to ensure that the application of slurry is placed no longer than 20 minutes ahead of concrete placement. Discard any slurry that is not applied within 20 minutes of mixing.

.3 Apply bonding slurry by scrubbing on to the surface with a stiff bristle brush.

.4 For rapid set concrete and mortars, brush the mortar paste into the SSD concrete surface with a stiff bristle brush.

.5 Prepare mortar in accordance with the manufacturer’s recommendations using the manufacturer’s recommended latex as the mixing liquid. Add bagged product to latex with continuous power mixing to achieve the required consistency. Use the minimum amount of mixing liquid consistent with the placement method.

.6 Pre-soak concrete substrate and allow concrete to come to a saturated surface dry condition before applying bonding slurry or concrete. If required, use the manufacturer’s recommended latex as the mixing liquid for the cement/sand slurry. Scrub bonding slurry onto the prepared surface with a stiff brush.

.7 Place and consolidate material as soon as practical after mixing and before bonding slurry has dried out.

.8 Provide a key by scribing the surface of the mortar when the repair is completed in several lifts.
4.6 JOINTS

.1 Concrete control joints and isolation joints must be installed as part of the Work. Refer to project drawings for joint location and spacing, or this specification, whichever is more stringent.

.2 Install joints in concrete repairs to match the existing joints. Joint width to match existing. Install sealant and backer rod or asphalt impregnated board to match existing.

.3 For new concrete grade slabs, provide 1/2" wide, full depth isolation joints around the slab perimeter to isolate the slab from adjacent concrete work. For concrete curbs, install a full depth 1/2" wide joint every 8 feet. Install asphalt impregnated board in 1/2" joints.

.4 Provide sawcut control joints in the concrete grade slabs unless otherwise specified. Concrete control joints must be sawcut after the concrete has sufficiently hardened. Saw cutting must be conducted as soon as the concrete can be cut without ravelling and in no case later than 18 hours after the start of the pour.

.5 Control joint sawcut spacing to be equal to the width of the grade slab or maximum 8 feet for 4" thick slabs and 12 feet for 6" thick slabs. Sawcut depth to be 1/3 of the slab thickness (1-3/8" deep saw cut for a 4" thick slab and 2" deep saw cut for a 6" thick slab).

.6 For street sidewalks, provided tooled joints located at spacing equal to the sidewalk width. Joints to be 1/3 the depth of the sidewalk slab. Provide a 1/2" wide joint every 16 feet. Install asphalt impregnated board in 1/2" joints.

4.7 FINAL FINISHING

.1 For architectural grade slabs and walkways, steel trowel finish grade slab surfaces to receive a light sandblast after the 7 day curing period. Sandblast finish to be CSP 1 to 2 without exposing coarse aggregate particles. Contractor to conduct a mockup section for review and approval by the Consultant and Owner prior to continuing with the work.

.2 For street sidewalks, provide a medium broom finish.

4.8 SEALANTS

.1 For joint sealant, where required, install joint sealant in strict accordance with the manufacturer’s instructions or as detailed in this specification, whichever is more stringent.

.2 Prepare joint faces by abrasive cleaning or grinding. Ensure that all substrate surfaces are smooth, dry and firm. Immediately prior to sealant application, remove all dust using oil free compressed air.

.3 Prime joint faces with manufacturer’s primer.

.4 Install closed cell foam backer rod or bond breaker tape. Sealant profile ratio to be 1 wide by 1/2 to 1 deep. Install sealant to uniform cross-sectional shapes with depths relative to joint widths that allow optimum sealant movement capability as recommended by sealant manufacturer.

.5 Install sealant to fill joints completely from the back, without voids or entrapped air, using proven techniques, proper nozzles and sufficient force that results in sealants directly contacting and fully wetting the primed joint surface. Superficial pointing with a skin bead is not acceptable.

.6 Protect adjacent surfaces from sealants and install sealants with a clean neat transition to the edges of the joint surface. Remove any sealant from adjacent surfaces immediately. Remove any masking tape after sealant installation.
4.9 **DEFECTIVE CONCRETE AND PATCHING**

.1 Concrete surfaces to be free from open texturing, voids, and projections.

.2 For repair of defective concrete Work:
   a) Repair defective areas while concrete is still plastic, otherwise wait until curing is completed. Use repair methods approved by Consultant.
   b) Grind off high surface variations where directed and re-texture surface to match adjoining concrete as closely as possible.

.3 Remove and replace defective concrete where directed. Removal and replacement procedures will be detailed by the Consultant.

.4 Repair of defective concrete Work and/or removal and replacement of defective concrete prior to final acceptance of the deck to be carried out at Contractor's expense.

.5 Immediately after the removal of forms, all bolts, ties, nails or other metal not specifically required for construction purposes shall be removed or cut back to a depth of 25 mm (1") from the surface of the concrete.

4.10 **PROTECTION**

.1 All freshly placed and consolidated concrete shall be suitably protected during the curing period against damage from adverse weather conditions. Protection of the concrete from adverse weather conditions is the sole responsibility of the Contractor and shall be conducted in strict accordance with CSA-A23.1.

4.11 **TOLERANCES**

.1 Tolerances shall conform to CSA-A23.1 (current edition) or the requirements of these specifications, whichever are more rigorous.

*** END OF SECTION***
1.0 **GENERAL**

1.1 **Related Technical Requirements**

.1 Section 03 00 00 Concrete
.2 Section 07 00 10 Building Envelope – General Requirements
.3 Section 07 40 00 Cladding
.4 Section 07 62 00 Sheet Metal Flashing and Trim

1.2 **Co-ordination Requirements**

.1 Building Envelope Consultant.

1.3 **Performance Standards**

.1 Reinforcing and other steel requiring corrosion protection shall be embedded so that the minimum depth of concrete cover is in all cases greater than 40 mm.

.2 Stainless steel is to be used where reinforcement or other embedded metal has less cover than 40 mm.

.3 The concrete mix and placement and curing procedures are to be designed to provide the required quality of surface appearance and texture.

.4 Concrete structure that penetrates through the building enclosure constitutes a large thermal bridge and requires 2D or 3D heat transfer modeling. Refer to Building Envelope Thermal Bridging Guide latest edition for further details.

1.4 **Quality Control and Assurance**

.1 Submittals
  .1 Construct mock-ups of all assemblies to check contractor’s procedures as best practice.
  .2 Contractor to submit mix designs and placement procedures for architectural panels.

2.0 **MATERIALS**

2.1 **Performance Requirements**

.1 Maintenance
  .1 No maintenance for 100 years, except for cleaning.

2.2 **Prescriptive Requirements**

.1 Materials
  .1 Components
    .1 Concrete components to be certified compliant to CSA A23.1 for alkali aggregate reactivity.
.2 Finishes

.1 Architectural concrete surfaces are important to SFU and all architectural concrete finishes should be reviewed by SFU Facilities during design stage.

.2 In selecting concrete finishes for any project, cleaning requirements of materials should be considered. All cleaning equipment/processes/materials must be submitted to SFU Facilities for approval.

.3 Surfaces of exterior concrete to be treated with opaque paint coatings or a clear silane/siloxane type sealer after final cleaning.

.4 Consideration must be given for surfaces of exterior concrete near grade to be treated with a sealant and/or clear anti-graffiti type coating. Anti-graffiti coating systems with a wax top coat are preferred.

***END OF SECTION***
1.1 **GENERAL**

1.2 Related Technical Requirements

.1 Section 07 00 10 Building Envelope – General Requirements
.2 Section 07 40 00 Roofing and Siding Panels
.3 Section 07 62 00 Sheet Metal Flashing and Trim

1.3 Coordination Requirements

.1 Coordinate system design with Building Envelope Consultant.
.2 Coordinate system design with design of drainage, venting, and insulation of enclosure assemblies.
.3 Coordinate system design with Structural Engineer.

1.4 Performance Standards

.1 Reinforcing and other steel requiring corrosion protection shall be embedded so that the minimum depth of mortar, grout, or concrete cover is in all cases greater than 40 mm.

.2 Stainless steel is to be used where reinforcement or other embedded metal has less cover than 40 mm.

.3 Masonry, associated components, (and all materials in the wall assembly behind masonry) shall have a design service life of at least 100 years.

.4 Masonry shall be structurally supported to resist maximum wind loads, 30 year return.

.5 The support of masonry veneer shall be designed to resist cyclic deformations imposed by earthquake loading of the building.

.6 The structural back up wall for masonry veneer shall resist 1 in 30 year return design wind loading with a maximum deflection of L/360.

.7 Identify tie type in specifications.

.8 Provide details showing ties, masonry interfaces and support in drawings.

1.5 Quality Control and Assurance

.1 Submittals
   .1 Shop drawings for masonry ties, masonry support.
   .2 Construct mock-ups of all assemblies to check contractor’s procedures.

2.1 **MATERIALS**

2.2 Performance Requirements

.1 Maintenance
   .1 No maintenance for 100 years, except for cleaning.

.2 All masonry accessories to have design service lives compatible with masonry.
2.3 Prescriptive Requirements

.1 Materials

.1 Components
.1 All masonry ties to be stainless steel two-part ties.

.2 Structural steel employed in the support of masonry and in the wall cavity shall be hot dip galvanized or stainless.

.3 Where a galvanized steel or aluminum surface will be in contact with mortar or masonry, the metal shall be over coated with a layer of bituminous or other equivalent barrier material bonded over 100% of its surface area.

.4 All flashings and other waterproofing accessories in the wall cavity shall be designed for a service life of 100 years. Materials considered capable of this service interval are:
.1 Neoprene rubber sheet.
.2 Thermo fusible SBS modified asphalt roofing membrane, fully reinforced, and fully bonded to substrate.
.3 Asphalt modified urethane coating, fully reinforced, fully bonded to substrate.

.2 Finishes
.1 Surfaces of exterior masonry to be treated with a clear silane/siloxane type sealer after final cleaning.

.2 Consideration must be given for treating surfaces of exterior masonry near grade with a sealant and/or clear anti-graffiti type coating. Anti-graffiti coating systems with a wax top coat are preferred.

***END OF SECTION***
1.1 GENERAL

1.2 Steel Construction – Structural Requirements

.1 Design building structures and their structural components for a 100 year service life.

.2 Structural design to conform to BC Building Code.

.3 Drawings to include a summary of the structural systems and to provide supplementary information as required.

.4 Sustainable design principles have been considered for the project. LEED requirements selected by SFU have been satisfied.

.5 Live loads for specific occupancies as per the BC Building Code.

.6 Ensure that the design and field review of non-structural components is covered in the contract documents (drawings and/or specifications).

.7 Ensure that the independent structural concept review has been completed. Concept reviewer to submit a sealed letter to SFU Facilities confirming completion of the review.

1.3 Materials

.1 Ensure that the contract documents require all structural steel to be shop primed except for the appropriate exclusions.

.2 Exterior ledger angles and related components are to be galvanized for corrosion protection.

.3 Where decking is specified, use only galvanized steel decking as suitable for the exposure of the decking (interior or exterior).

.4 Finishes and cleaning of metals must be considered when selecting materials. SFU Facilities must be consulted during selection.

***END OF SECTION***
1.1 **GENERAL**

1.2 **Related Technical Requirements**

1.2.1 *Section 05 00 00 Metals*

1.3 **Co-ordination Requirements**

1.3.1 All trades.

1.4 **Description**

1.4.1 Miscellaneous metal fabrications including:

1.4.1.1 Handrails, guards and balustrades (handrails & guardrails attached to or inside buildings are considered to be structural items requiring certified welding).

1.4.1.2 Non-structural steel angles, plates, brackets and closures.

1.4.1.3 Metal stairs and ladders.

1.4.1.4 Loose steel lintels.

1.4.1.5 Rough hardware and fasteners.

1.4.1.6 Burglar bars.

1.5 **Performance Standards**

1.5.1 Determine applicable CSA, ASTM, and similar standards.

1.6 **Quality Control and Assurance**

1.6.1 **Submittals**

1.6.1.1 Shop drawings sealed and signed by Design Engineer.

1.6.2 **Quality Assurance**

1.6.2.1 A Professional Engineer Registered in BC and engaged by the fabricator to engineer components including connections where listed and/or required by BCBC, seal and sign shop drawings, and provide related Letters of Assurance for Professional Design, Field Review and Building Code Compliance. Costs to be included in the Contract Price.

2.1 **MATERIALS**

2.2 **Performance Requirements**

2.2.1 None.

2.3 **Prescriptive Requirements**

2.3.1 **Materials**

2.3.1.1 All metals must be galvanized at a minimum.

2.3.1.2 Exterior metal works are preferred to be stainless for high visibility areas.

2.3.1.3 Exterior metal works in lower visibility areas are preferred to be powder coated painted.

2.3.1.4 Galvanized metals are accepted on non-visible utility locations.

2.3.1.5 All visible joints to be fillet welded and ground to finish according to industry standards.

***END OF SECTION***
1.1 GENERAL

1.2 Related Technical Requirements

.1 Section 06 10 00 Rough Carpentry

1.3 Coordination Requirements

.1 Section 27 05 00 Common Work Results, and Section 27 11 00 Telecommunications Room Fittings, the general contractor must install plywood for the back-boards of all Communications Rooms in a professional manner. Fire rated plywood must be used and must be painted prior to mounting any equipment (fire resistant label must be visible throughout). Preference is to have boards furred out of walls. SFU IT must review all communication rooms design prior approval/construction.

.2 All trades.

1.4 Wood Construction – Structural Requirements

.1 Design building structures and their components for a 100 year service life.

.2 Structural design to conform to the BC Building Code.

.3 Drawings to include a summary of the structural systems and to provide supplementary information as required.

.4 Sustainable design principles have been considered for the project. LEED requirements selected by SFU have been satisfied.

.5 Ensure that the design and field review of non-structural components is covered in the contract documents (drawings and/or specifications).

.6 Ensure that the independent structural concept review has been completed. Concept reviewer to submit a sealed letter to SFU Facilities confirming completion of the review.

1.5 Materials

.1 Materials and design should ideally exceed BC Building Code requirements.

.2 Materials should be provided within local code and environmental requirements.
1.6 Lateral Load-Resisting Systems

.1 Use only plywood shear walls (or other acceptable engineered systems complying with Part 4 of the BC Building Code) to provide the lateral load resistance of wood frame structures.

.2 Do not use gypsum wallboard in contributing to the lateral load resistance of wood frame structures.

.3 Do not use oriented strand board for sheathing of wood frame shear walls.

.4 Continuity of the plywood floor diaphragm must be maintained on all floors. Do not cut or stop the plywood at party-wall locations.

***END OF SECTION***
1.1 **GENERAL**

1.2 Related Technical Requirements

1.3 Coordination Requirements

1.4 Design

1.5 Quality Control and Assurance

2.1 **MATERIALS**

2.2 Prescriptive Requirements

***END OF SECTION***
1.1 GENERAL

1.2 Related SFU Technical Requirements

1.1 12 35 53 Laboratory Casework
1.2 08 14 00 Wood Doors
1.3 11 53 33 Emergency Safety Appliances
1.4 10 20 00 Interior Specialties

1.3 Coordination Requirements

1.1 Coordinate with SFU Facilities
1.2 Coordinate with Hardware Consultant.

1.4 Description

1.1 Architectural Woodwork, defined as all clear, kiln dried, dressed or re-sawn material exposed to view in a finished building interior or exterior, including casework, frames, paneling, trim and other wood-related products and including cabinet hardware. Architectural Woodwork does not include Economy Grade.

1.5 Performance Standards

1.1 Architectural Woodwork Manufacturers Association of Canada (AWMAC)
1.1 AWMAC Quality Standards current edition at time of tender.
http://awmac.com/aws

1.6 Quality Control and Assurance

1.1 Submittals

1.1 Before Start of Work
1.1 List of all proposed materials for review and color samples for selection plus for final approval.
1.2 Shop drawings should consider conforming to AWMAC Quality Standards requirements that include details of construction, profiles, jointing, fastening and other related details.
1.3 Sample mock-up.

1.2 Work should consider to be in accordance with Grade or Grades specified in the AWMAC Quality Standards (AQS) current edition at time of tender.

1.3 All architectural woodwork material must be reviewed and approved by SFU Facilities prior to final installation.

1.4 Exterior wood is discouraged on building. Consideration will be given on a project basis in consultation with SFU Facilities.

1.5 Woodwork Manufacturer Qualifications:

1.1 Minimum 5 years of production experience similar to this project, whose qualifications indicate ability to comply with requirements of this Section.

1.2 Minimum one project in past 5 years where value of woodwork within 20 percent of cost of woodwork for this Project.

1.4 At Completion
1.1 Maintenance data shall itemize list C/W each finish type, color formulation.
1.2 Maintenance material shall be determined.
2.1 MATERIALS

2.2 Performance Requirements

.1 All Architectural Woodwork shall conform to Architectural Woodwork Standards.

.2 Laboratories
   .1 Wet-lab countertops would require marine grade plywood substrate at a minimum. Solid state may be considered.
   .2 Wood is allowed within laboratories, including casework, trim, wood doors and frames, etc., but only on approval of SFU Facilities.

.3 Seismic Anchorage is required on all cabinets and shelving over 1200 mm high or where units are likely to be a hazard from overturning. Refer also to Structural Section for engineering requirements.

2.3 General

.1 AWMAC Quality Standards (AQS) current edition at time of tender.

.2 Typical
   .1 Casework Grade - Custom.
   .2 Casework Style: Flush Overlay

.3 Typical Veneer when using Wood Veneer Ply
   .1 White Birch.

.4 Security Problem Areas (to assist in preventing doors and drawers from being pried open)
   .1 Casework Style: Flush Overlay

.5 Sealer Products are preferred for use on glu-lam wood products for exposed wood remediation.
   .1 Follow detailed manufacturer’s instructions for Clear Finish Broda Clarity Wood Stone (Wood Brightener/Iron Shield)
2.4 Environmental

.1 Source

.1 Sourcing requirements will be advised on a project basis.

.2 Manufacture

.1 Adhesives, preservatives, hardeners, synthesizing agents and finish coatings shall be compliant.

.2 MDF to be CARB2 compliant, no added formaldehyde and recycle certified.

.3 Plywood shall be Exterior Grade (i.e. manufactured with no added formaldehyde).

.3 Performance

.1 Energy

.1 Determine.

.2 Durability

.1 Select plastic laminate type and thickness suitable for intended use; avoid high gloss.

.3 Life Cycle Costing

.1 15-year.

.4 Provide modular components to facilitate reuse whenever possible.

.5 Maintenance

.1 Determine.

.6 Disposal

.1 Minimize use of packing materials such as cardboard for shipping case goods, millwork and furniture and if used, recycle. Use blanket wraps for shipping whenever feasible.

2.5 Prescriptive Requirements

.1 Materials

.1 Components

.1 MDF will only be used in correct applications on a project basis, and upon approval from SFU Facilities.
.2 Plywood Cores at the following locations:
  .1 Core for countertops with plumbing cut-outs.
  .2 High humidity areas.
  .3 All food service areas.

.3 When plastic laminate or melamine surfacing is used, provide same finish (backer sheet when concealed) on all surfaces of the core.

.4 Cabinets
  .1 Sustainable and certified woods to be used wherever possible.
  .2 No rainforest products.
  .3 Maximized recycled content.
  .4 Avoid use of adhesives, use re-usable mechanical fasteners where possible.
  .5 Do not specify fir ply, specify birch ply.
  .6 Standard cabinet construction to be 3/4”.

.7 Cabinet Hardware Requirements
  .1 Ensure commercial availability for maintenance.
  .2 Hardware to suit use/duty for institutional use.
  .3 Heavy Duty hinges throughout.

.2 Execution

  .1 Conform to Architectural Woodwork Standards Manual including the recommendations additional to the work as described.

***END OF SECTION***
1.1 **GENERAL**

.1 Vapour barriers are required in all SFU buildings and they shall be located on the warm side of insulation.

.2 All heated occupied buildings on campus shall have a competent air barrier system, which requires integration into the plane of air tightness early in the design development process.

.3 Involvement from a Building Envelope Professional (BEP) as required by BECx Standards (NIBS guideline 3).

1.2 **Exterior Metal Fabrications**

.1 Canopies, railings, safety anchors, signage and art work to be designed to resist damage from exterior exposure by being made of corrosion resistant materials, adequately coated, or sheltered from wetting.

.2 Glass used as guards or canopies to be tempered and laminated.

.3 All structural penetrations to support exterior metal fabrications to be designed to integrate with air and vapour barrier systems, cladding systems, and be protected from corrosion where exposed in the wall cavity.

.4 All roof furniture to be mounted on curbs at least 100mm above scupper level.

.5 All steel exposed outdoors is to be hot dip galvanized. Paint, if applied should consist of a marine/industrial grade coating system (a typical system would consist of an epoxy barrier coat and aliphatic urethane topcoat).

.6 All inserts set into masonry or concrete, used to affix exterior metal fabrication, to be stainless steel.

1.3 **Roof Parapets and Canopies**

.1 1,067 mm (3’6”) high insulated or thermally broken minimum parapets designed as guards are recommended for new buildings and considered on a project basis. This creates safer and more efficient working conditions and reduces the need for roof anchors.

.2 It is preferred to provide canopies (overhead protection) over every exterior door to reduce the risk of water ingress into the building and provide protection of the public against the elements. The viability of such design will be considered on a project basis.

*The overhead ratio is defined as the length of the overhang (distance from jamb outwards and to the side) to the height of the overhang above threshold of the door. The extent of the overhang recommended depends on the door type:*

.1 If the doors meet the required water ingress rating (using the Canadian Supplement to NAFS or based on the recommendations of the enclosure consultant for the project), the overhead ratio = 1:4

.2 If the door does not meet the required water ingress rating but exceeds 100Pa and is an outswing door, then the overhead ratio = 1:2

.3 If the doors cannot pass a water ingress test at 100 PA or is an inswing door, then the overhead ratio = 1:1
1.4 Roof leak detection Systems

.1 Roof Leak Detection Systems may be required in some locations see Section 07 50 00 Membrane Roofing.

1.5 Roof Usage Policy - OVERVIEW

.3 All roofs that are maintained by SFU Facilities are also controlled by SFU. This is not only to protect the assets and to limit the exposure of liability to SFU, but also to protect the public from hazards. This roof usage policy governs all roofs maintained by SFU Facilities.

.4 Roof tops which are accessible by the general public, (non-maintenance personnel), require protection for roof-mounted assets and for people to safely access the roof.

.1 Roof-mounted assets requiring design considerations by the architects and engineers of record, may include any of the following:

.1 Exposed roof membrane
.2 Air handling units
.3 Condensers
.4 Fans
.5 Vents and air intakes
.6 Fire fighting hose reel cabinets
.7 Additional dead loads on the structure, such as the possibly of water tanks for green roof irrigation

.2 Hazards for staff and public may include any of the following:

.1 Climbability of perimeter guards, especially where containers may facilitate climbing
.2 Fumes from laboratories
.3 Slippery surfaces
.4 Roof-top equipment vital to the function of the building or vital to research
.5 Allergens for building occupants; (location of building air-intake louvres))
.6 Roof anchors and cables as tripping hazards
.7 Increased fire risk from dry grasses, compost etc.
.8 Strong winds; either natural or from exhaust air louvres

1.6 Roof Usage Policy - POLICY

.1 Requirements:

.1 Where public access is anticipated on any roof maintained by SFU Facilities, this policy may require that architects and engineers minimize SFU’s exposure to liability by including any or all of the following in their roof design:
.1 Flexible and safe methods of restricting and controlling public access at the perimeter.

.2 Un-climbable guard rails around the perimeter to prevent falls from the roof, and which conform to the latest BC Building Code.

.3 Robust protection of all roof membranes and flashings, drainage planes, roof barrier membranes and roof drains.

.4 The provision for extending one nearby passenger elevator to roof level to provide full accessibility for handicapped visitors and staff.

.5 The provision of a dedicated freight elevator solely servicing all the uses taking place on the roof.

.6 Adequate lighting and signage for life-safety and exiting in case of a fire.

.7 A calculation of the number of staff and visitors, affecting dedicated exit widths and routes off the roof and into the building’s exit routes.

.8 The provision of at least one dedicated nearby exit stair shaft for the safe exiting of able-bodied people from off the roof.

.9 Additional structural strength to support additional dead loads such as assembly occupancy.

.10 A leak detection system of flat-wire grids.

.2 Early discussion, at the Planning stage, is required with SFU Facilities.

***END OF SECTION***
1.1 **GENERAL**

1.2 **Related SFU Technical Requirements**

1.2.1 *Section 07 00 10 Building Envelope – General Requirements*

1.3 **Coordination Requirements**

1.3.1 Coordinate design with BEP.
1.3.2 Coordinate design with Structural Engineer.
1.3.3 Coordinate design with Mechanical Consultant.

1.4 **Performance Requirements**

1.4.1 Dampproofing and waterproofing must prevent leakage on new roofs.
1.4.2 Plants and green roofs must have adequate dedicated service and maintenance access. Common problems with leakage and cleaning should also be considered.

1.5 **Quality Control and Assurance**

1.5.1 Quality Assurance

1.5.1.1 Initial testing of permeability, bond strength, material thickness, and flood testing will be carried out by the Owner at his expense. Subsequent test (hard and soft costs) will be borne by contractor.

1.5.1.2 *Applicator to provide material submittal and drawings showing any deviation from RCABC Waterproofing Standards.*

1.5.2 Quality Control

1.5.2.1 Contractor to test moisture content of concrete substrate to verify that substrate moisture content does not exceed manufacturer’s specifications.
1.5.2.2 Submit results to consultant prior to application of membrane.
1.5.2.3 Flood testing and EFVM scans are to be performed prior to installation of overburden.

1.5.3 Warranties

*The following warranties and guarantees are required:*

1.5.3.1 First two years - Guarantee, secured by Performance Bond, commencing on the Final Holdback release due date.

1.5.3.2 Third year to fifth year - Extended Guarantee, unsecured by Bond, commencing on the expiration of the Performance Bond. Joint and Sealant guarantee by Coating applicator and Manufacturer.

1.5.3.3 20 year warranty (Tremco) is currently in place on most roofing systems at SFU and is the preferred choice – alternative products will be considered but should have equivalent parts and labor warranty.

1.5.3.4 Submit signed certificates to Consultant.

1.5.4 Commissioning

1.5.4.1 Contractor to repair any defects found in membrane as a result of flood testing or *Electric Field Vector Mapping (EFVM)* scan.
2.1 MATERIALS

.1 Provide sub-grade waterproofing system for horizontal surfaces.

.2 Provide sub-grade waterproofing system for vertical surfaces.

.3 Drain bodies to have clamping ring to receive membrane.

3.1 EXECUTION

.1 All substrate cracks in concrete substrates to be pretreated by sawing out crack, installing bridging sealant, and reinforcing waterproofing system over the crack.

.2 Concrete bonding surfaces to be cleaned and prepared by shot-blasting, sand blasting, or water blasting.

***END OF SECTION***
1.1 **GENERAL**

1.2 Related Technical Requirements

.1 Section 07 00 10 Building Envelope – General Requirements

1.3 Performance Standards

.1 Performance must meet latest editions of ASHRAE 90.1 as well as BCBC.

.2 Thermal bridging should be coordinated with Building Envelope Professional.

1.4 Quality Control and Assurance

.1 Quality Control

.1 During construction, confirm performance standards are met.

2.1 MATERIALS

2.2 Performance Requirements

.1 None

2.3 Prescriptive Requirements

.1 Materials

.1 For plastic foam insulations, AN/ULC-S770 Standard shall apply for establishing the required "R" value (known as LTTR "Long Term Thermal Resistance" value in this standard).

.2 Expanded polystyrene insulation may not be used where in contact with ground, below-ground or wet locations.

.3 Provide spray-in-place polyurethane insulation at intersecting building assemblies (refer BCBC 5.3.1.3).

.4 Materials considered to have sufficient service life include:

.1 For rainscreen walls: semi rigid rock wool and fiberglass.

.2 For roofs: refer to RCABC’s list of approved products.

.3 Foams should only be used when protected by concrete or masonry such as in a precast or cast in place sandwich application.

.5 Fasteners (attachment of cladding, sub-girts, flashings, etc.) located in the exterior wall cavities shall be of stainless steel or PVC.

***END OF SECTION***
1.1 GENERAL

1.2 Related SFU Technical Requirements

.1 Section 07 00 10 Building Envelope – General Requirements

1.3 Coordination Requirements

.1 Coordinate design with BEP.

.2 Identify air / vapour / moisture barrier systems location and all materials on drawings.

.3 Provide details showing the continuity of the air / vapour / moisture barrier systems at all joints and junctions between enclosure assemblies (windows, doors, walls, roofs, penetrations, foundations, etc.) in the building.

.4 Coordinate details of drainage, venting, insulation, and cladding of enclosure assemblies.

1.4 Performance Standards

.1 All heated occupied buildings on campus to have an air barrier system.

.2 The air barrier must be located at a thermally protected location in the assembly and must be continuous across all parts of the building above grade.

.3 Penetrations by structural elements, electrical, mechanical services through the building enclosure, and interfaces at windows and doors are the most common sources of service life and performance related problems with air, vapour and moisture barrier systems.

.4 Production of a durable air barrier requires selection of durable materials and location of the air barrier within the building enclosure where it will not be rapidly deteriorated by the elements.

.5 The air barrier is to be integrated with all components of the building enclosure such as walls, windows and door frames, roof, foundation, and service penetrations.

.6 The air barrier shall have a service life equal to cladding or be maintainable from inside the building. SFU will not accept air barrier assemblies that are not visible and require maintenance in the expected service period.

.7 Air and moisture barrier leakage rates should be prescribed/ clarified by the design team and BEP.

.8 The air and vapour barriers are to be located close together in the assembly, or be of one material if possible. Any materials located between separate air and vapour barriers must be immune to moisture damage (100% inorganic).
.9 The air barrier is to be structurally supported to resist maximum wind loads, 30 year return. This is particularly important at movement joints where fatigue caused by excessive movement cycles of an unsupported membrane may fail the seal.

.10 The air barrier shall resist cyclic deformations caused by structural or other movement at all joints.

.11 Air barrier system shall be tested and rated in advance of construction and/or by testing in the field during construction and commissioning to check compliance with air tightness requirements.

.12 The vapour barrier is to be located on the warm side of insulation.

.13 The moisture barrier must be continuous and flashed to the exterior to prevent entry of water.

1.5 Quality Control and Assurance

.1 Submittals
   .1 Certification for Air barrier assembly (CCMC or equivalent).

.2 Quality Assurance
   .1 Construct mock-up of assemblies to check contractor’s procedures.
   .2 Test mock-ups to verify air tightness and resistance to structural loading.

.3 Quality Control
   .1 Test sections of assembly to verify air tightness on a project by project basis.
   .2 Testing for conformance to leakage rates will be conducted as part of the project.

.4 Commissioning
   .1 Carry out fan depressurization test with smoke to verify air tightness of completed building. Air tightness testing to also include positive and negative thermographic scans of building completed on a project by project basis.
   .2 Air barrier components or assemblies that are not visible or accessible and require maintenance in the expected service period of the exterior wall are not acceptable.

2.1 MATERIALS

2.2 Prescriptive Requirements

.1 Identify all air seal materials that form the air barrier assembly.

.2 Show location and continuity of all critical barriers on detail drawings and sections.

.3 Air barrier materials vulnerable to moisture damage, or heat and UV aging, must be located in the assembly so as to be protected from damaging levels of wetting and radiation over the service life.

.4 All materials must be suitably fastened to resist applied wind loads while remaining airtight.
.5 Air and Vapour barriers:

.1 Exterior insulated rainscreen walls: self-adhesive SBS modified asphalt sheet acting as both air and vapour barriers.

.2 Interior insulated rainscreen walls: smart vapor retarder such as Membrane by CertainTeed or equivalent.

.3 Hybrid insulated (insulation inside and outside of stud wall) rainscreen walls: Self-adhesive waterproof membrane which are vapour permeable.

.4 All other walls: properties and location of the vapour barrier in the assembly must comply with: ASHRAE 160 provide model results showing where the dew point will be located.

***END OF SECTION***
1.1 **GENERAL**

1.2 Related SFU Technical Requirements

.1 *Section 07 00 10 Building Envelope – General Requirements*
.2 *Section 08 00 10 Openings - General Requirements*

1.3 **Coordination Requirements**

.1 Coordinate design with BEP.
.2 Integrate design with design of windows, doors, flashing and other penetrations.
.3 Identify all materials that form the cladding assembly and required support system.
.4 *Coordinate the* Air tightness, drainage, venting, and insulation of enclosure assemblies.

1.4 **Performance Standards**

.1 Cladding shall be designed to be weather tight under sustained conditions of combined wetting and wind pressure.
.2 Cladding shall be designed to resist return wind loading.
.3 Cladding shall be designed to resist lateral and vertical deformations of the primary structure without loss of attachment to the building.
.4 The cladding is to be integrated with all components of the building enclosure such as window and door frames, roof, foundation, and service penetrations to provide a weather tight system.
.5 Exterior wood cladding is not preferred.
.6 Design service life of claddings to be 75-Years.
.7 All masonry accessories to have design service lives compatible with masonry.
.8 Window and door installations should be designed to allow replacement of the units without dismantling masonry *wall*.
.9 Cavities built behind the cladding shall be drained and ventilated to the exterior.
.10 Cavities built behind the cladding shall be compartmentalized as required at least every second floor level, beneath the parapet, and at the outside corners of the building.

1.5 **Quality Control and Assurance**

.1 Submittals

.1 Shop drawings of cladding system and associated support structure *showing all critical barriers (water shedding surface, moisture barrier, vapour barrier, thermal and air barrier)*. Shop drawings are to be sealed by a P. Eng. registered to practice in BC. Model Schedule S-B and S-C and copies of site visit reports are to be provided by the engineer responsible for the shop drawings.
.2 Quality Assurance
   .1 Construct mock-ups of all assemblies to check contractor’s procedures.
   .2 Test mock-ups as required to verify water tightness and resistance to structural loading.

.3 Maintenance
   .1 Windows have a shorter design service life than cladding. Make provision for replacement of windows and other penetrations before renewal of cladding is due.

2.1 MATERIALS
   .1 All materials must be reviewed and approved by SFU Facilities.

   .2 Identify all materials that form the cladding assembly and closures to adjacent systems.

   .3 Cladding materials considered to have sufficient design service life include:

      .1 Masonry
      .2 Concrete, precast
      .3 Anodized aluminum composite panels, class I or thicker anodizing
      .4 Stainless steel
      .5 Terne coated stainless steel
      .6 Zinc
      .7 Exterior tile, glazed/unglazed
      .8 Slate or clay tile
      .9 Fiber cement boards

***END OF SECTION***
1.1 **GENERAL**

1.2 **Related SFU Technical Requirements**
   .1 *Section 07 00 10 Building Envelope – General Requirements*

1.3 **Coordination Requirements**
   .1 Coordinate design with BEP.

1.4 **Description**
   .1 Roofing system complete with all related assembly components, fasteners, adhesives, cover boards, underlays, insulation, membranes and all roof related hardware and flashings as appropriate to the building and as specified.
   .1 In addition to the above, and in the case of re-roofing, the assembly shall include wood blocking additions and/or modifications as required to meet the requirements of the new roofing assembly.

1.5 **Design Requirements**
   .1 Roofing is to be designed to meet Guarantee Standards of the Roofing Contractors Association of British Columbia Guarantee Corp. (*RoofStar Guarantee*) as published in the "RGC Roofing Practices Manual" ("RPM") and requires a minimum 5 (five) year RoofStar Guarantee.
   .2 Roofing is to be designed to *CSA 123.21 Wind Uplift Standards*.
   .3 New and re-roof assemblies shall have a minimum of 2% slope “to drain”. This can be achieved by structural slope, sloped insulation, cricket and back slopes or any combination of these.
   .1 Deviation from this requirement must be obtained from SFU Facilities in writing prior to design. Consideration will only be given where existing building conditions will not allow for excessive tapered insulation elevations, for example, low window sills, low door thresholds or poor drain locations.
   .4 The design service life of low-sloped roofs is to be a minimum of 25-Years.
   .5 *Low Slope Roofs: exposed 2 ply SBS is the minimum requirement. A variance is required for the use of an inverted roof. (See 1.4.16 below)*
   .6 At inverted roofs, a *RoofStar Guarantee* approved leak detection system must be included in the assembly. See 2.2 Prescriptive Requirements, .4 Leak Detection Systems for further details.
   .7 *Monitored leak detection is required in the following situations:*
     .1 All heavy wood roofs, conventional and inverted
     .2 All green roofs over conventional
     .3 All conventional roofs with occupied spaces above (decking, landscaping etc.)
     .4 Anything hardscaped
   .8 *Initial EFVM scan and leak locate system only is required in the following situations:*
     .1 All green roofs over inverted -fully bonded to sloped concrete deck.
.9 Monitored leak detection is NOT Required in the following situations:

.1 Conventional roofing over steel deck or vented wood space.
.2 Conventional roofing over concrete deck.

.10 Performance Standards for roof insulation to be those set out in Section 07 21 00 Thermal Insulation.

.11 The installation of concrete or asphalt topping over 2 ply membrane roofing is not permitted without prior approval and written confirmation from SFU Facilities. (refer to 2.1.2 in Section 07 10 00)

.12 For use of hot rubber type membrane refer to Section 07 10 00.

.13 Vapour retarders are to be included in all assemblies and shall be fully adhered to the substrate. Products shall be appropriate to the building envelope configuration and be installed so as to wrap and envelop the insulation, compatible for connection to the building envelope air barrier, and be sealed at all penetrations. Laminate Kraft paper and adhesive is not an acceptable vapour retarder.

.14 In conventional roof assembly, insulation is to be adhered with two part urethane adhesive. In the case of conventional roof assembly over wood frame decking, screw fasten the first layer and adhere the upper layers (reduces thermal bridging and eliminates washer heads at fasteners from showing through the roofing membrane).

.15 Insulation overlay board is to be installed over the insulation and under the roof membrane in all cases despite manufacturers’ minimum standards that do not require it. This requirement would also apply with mineral fiber insulation board which have an integral facer to receive the membrane.

.16 Roofing membranes are to be fully adhered, or torched applied 2 ply SBS modified bitumen membrane. Alternative membranes are not permitted without prior approval and written confirmation from SFU Facilities.

.17 Drains

.1 For new construction all drains shall be cast iron and include all appropriate hardware.

.2 Cast iron drains shall be re-used when re-roofing, and complete with drilled and tapped stud holes and new hardware as required to function as originally designed and installed.

.3 At all cast drains, tie-in is to be done with the application of reinforced PMMA stripped into the drain.

.4 All drain baskets, strainers or screens shall be cast iron or aluminum, plastic will not be permitted.

.5 The use of drain inserts will only be considered when dictated by building configurations or circumstance. Written permission is required from SFU Facilities prior to design.

.6 If drain inserts must be used a “U-Flow” or Menzies “Blue Seal” connection seal shall be utilized when a hard plumbing connection is not possible. O-rings are not acceptable.
.7 All drains are to be sumped with sumps turned 45º degree to direction of roofing plies.

.18 Membrane plies are to extend over the top of all parapets and 50 mm down past blocking and lapped over the outside surface of the wall finish. Where nail-able substrates exist the membrane shall be mechanically secured (nailed) on the outside face.

.19 Where the top edges of the stripping plies terminate on higher walls the stripping plies are to terminate in such a way as to obtain two seals on the vertical wall face (cap stripping to extend up past base sheet and obtain a separate seal to the substrate.

.1 All stripping plies shall be mechanically terminated to the substrate at least 200 mm above the roof surface.

.2 Top edges of membranes are to be protected by counter flashings.

.3 In new construction, reglets will be installed to allow for the installation of membrane plies and or flashings. Gumlip flashings will not be permitted.

.4 In re-roofing, where reglets cannot be re-used or are not present and gum lip flashings must be used, installation shall be “double gum lip” as per RCABC Guarantee standards RPM detail.

.20 For all landscaping over membranes see requirements for Sub-grade waterproofing system – Section 07 10 00.

.21 See sections on Wall Cladding Systems for other detailing requirements of air/vapour barrier and insulation systems.

1.6 Quality Control and Assurance

.1 Quality Assurance

.1 Meet or exceed the RoofStar Guarantee 5-Year guarantee standards All roofing system products to conform to the RoofStar Guarantee Standards and to the appropriate CSA, CGSB, ULC, CULC, and ASTM Standards for the materials used in the roofing system; products to be listed in the RGC Accepted Materials List of the RoofStar Guarantee Roofing Practices Manual, and to be in conformance with the manufacturers’ published product and performance data.

.2 Quality Control

.1 An Independent Inspection Agency acceptable to RoofStar Guarantee, and assigned by RoofStar Guarantee on acceptance by the Consultant and the SFU Facilities, to conduct field review inspections as per the minimum protocols as set forth by the RoofStar Guarantee for their 5 Guarantee Program. It is understood that in addition to these responsibilities the independent inspection agency will provide re-inspection services at the 2 year anniversary – in the case of the 5 year warranty.

.1 Cost for the warranty and inspections are to be included in the contract sum.

.2 SFU Facilities reserves the right to increase the field review inspection frequency to FULL TIME site inspections while the work is in progress. Extra costs for this to be borne by SFU.
.3 Added inspections just prior to the expiration of the warranty, if required, will be arranged and the costs borne by SFU.

.4 A manufacturer’s representative to also inspect the work as required for the purposes of providing the manufacturer’s labour, material and workmanship warranty upon completion.

1.7 Submittals

.1 Manufacturer Product Data, including MSDS data, for each product proposed.
.2 Samples of membrane, flashings, cladding and/or pavers as required for color selection.
.3 Sloped insulation, cricket and/or back slope plan.
.4 Sheet metal flashing shop drawings.
.5 Manufacturer’s leakproof warranty.
.6 Worksafe BC clearance letter.
.7 Manufacturer’s confirmation of training.
.8 Fastening patterns and sheet layout for mechanically attached membrane assemblies.

1.8 Warranties

.1 Provide the RoofStar Guarantee Roofing System Record, to include the RoofStar Guarantee standard 5-Year Guarantee, copies of Inspection Reports, listing and literature of all products used, and Roof Maintenance Guide.

.2 Provide a written and signed Membrane Manufacturer’s Warranty in the name of the Owner. The warranty to include for removal and replacement of the defective membrane including labour, for a non-prorated ten-year period. The membrane warranty to not be limited by other components that are only available or manufactured by the membrane manufacturer. Letters modifying the manufacturer’s standard warranty are not acceptable.

.3 Provide the manufacturer’s labour, material and workmanship warranty leakproof warranty for a period of 10 years.

.4 Where adhesive is used in the assembly, include and provide the adhesive manufacturer’s warranty.

.5 All warranties to commence at Date of Substantial Performance.

2.1 MATERIALS

2.2 Performance Requirements

.1 Life Cycle Expectation
   .1 Minimum 25-Year service life expectancy
2.3 Prescriptive Requirements

.1 Preferred System at Low-Slope Roofs

.1 2-Ply SBS Bituminous Modified Flexible Membrane Roofing System, exposed, insulated, adhered, generally torch-applied. Refer to RoofStar Guarantee Manual TAB 5.0.2 Section 07535, Outline Specification for this system, from which the following are preferred options.

.2 Thermal barrier/underlay at steel deck to be provided where required by code: shall be minimum 1/2 inch gypsum board.

.3 Vapour retarder is required on all roofing assemblies and shall be SBS modified bitumen sheet.

.1 Steel or wood decks shall receive primer as prescribed by the membrane manufacturer. Membrane shall be peel and stick, self-adhered or adhered appropriate to the membrane manufacturer and the specified roofing assembly. Kraft vapor retarders are not acceptable.

.2 Concrete decks shall receive primer as prescribed by the membrane manufacturer. Preferred membrane application shall be fully adhered and torch applied.

.4 Insulation overlay shall be ¼” inch or ½” inch “Dens Deck” and be adhered or mechanically attached through to the substrate as determined by the substrate and the requirements of the assembly.

.1 Note that 2 (two) layers of insulation overlay are required when installed over heat sensitive insulations.

.5 Insulation shall achieve a minimum value of $R=25$ for both new and re-roof assemblies. The effective $R$ value is to be measured at 0°C.

.1 Insulation for use in conventional assemblies, the preferred roofing configuration, is polyisocyanurate or mineral fibre.

.2 Type I and II EPS (expanded polystyrene) insulations are permitted however are intended to be used to provide slope to drain in combination with polyisocyanurate insulation.

.3 Type IV XPS (extruded polystyrene) is intended for use only in inverted roofing assemblies and is to be considered only when inverted roofing is unavoidable.

.4 Insulation installed in conventional assemblies shall be installed in two layers with a minimum 12 inch offset and stagger between layers (for example 2 layers of 2 inch as opposed to 1 layer of 4 inch).

.5 Insulations installed in adhered assemblies are to be maximum 4’ X 4’ in size. Insulation installed in mechanically attached assemblies to be a maximum of 4’ X 8’ in size.
.6 Attachment

.1 Fasteners: minimum number of fasteners and stress plates for installation on wood or steel decks to be as specified by the RoofStar Guarantee Manual for 5/10 Year Guarantee standards and/or as required to FM (Factory Mutual) 1-90 whichever is greater.

.2 Adhesives: adhesive application rates when used in adhering insulations and coverboards on concrete decks shall meet or exceed the requirements of the RGC, the manufacturer and FM requirements for 1-90.

.1 The preferred adhesive for all assemblies is a two component polyurethane such as Insta-Stik by Dow Chemical or similar.

.2 Materials

.1 Insulation: refer to Section 07 21 00 Thermal Insulation.

.3 Components

.1 Install walkway pads at all access door and hatches, around all rooftop mechanical and other equipment requiring maintenance, and from there leading to the main roof access stairs, ladders, or roof hatch.

.1 Walkways to be either a reinforced walkway, cap sheet manufactured by the same manufacturer as the roof membrane, or 2''x2''x2'' precast plain finish concrete paver slabs on pedestals (no substitutes such as duckboards or poured-in-place concrete).

.2 Install approx. 2'' inch apart and away from cants and flashings, in a regular and uniform pattern.

.2 Provide overflow scuppers in accordance with the British Columbia Plumbing Code 2012, section 2.4.10.4. Hydraulic Loads from Roofs or Paved Surfaces.

.3 All penetration hardware to have only on line or cable per flashing installation and shall incorporate a gooseneck hood, heat shrink or uncured EPDM membrane wrap c/w stainless hose clamps. Tape, putty or caulking are not acceptable.

.1 Multiple lines or cables installed in only one penetration flashing is only acceptable when a purpose made hood or gooseneck is installed and that said lines or cables are slack enough to allow for a significant downward belly in the lines/cables.

.4 Leak Detection Systems

.1 The leak detection system must meet RoofStar Guarantee requirements as laid out in the RCABC Roofing Practices Manual.

.2 The leak detection system must have the capability of issuing email alerts complete with a graphic of the roof indicating the location of the leak and must also be capable of issuing alarms to the BMS system.

.3 The leak detection system can be hard wired or connected via BACnet to the SFU BAS.
3.1 **EXECUTION**

.1 All materials to be protected from the weather and elements with purpose made tarps and elevated from the ground or deck. Factory wrappings are not acceptable protection from the elements.

.2 Install roofing only when weather conditions permit. Materials that become wet due to inclement weather shall be replaced with no expense to the Owner.

.3 Install only as much material as can be rendered completely watertight by days end include for night seal and tie-ins as required to maintain the integrity of installed components.

.4 In the case of reroofing the replacement roofing and building shall be sealed and rendered watertight by day’s end.

.5 In the case of reroofing all debris is to be disposed of with purpose made chutes. Debris is not to be thrown from the roof at any height.

.6 All areas installed shall be completed to the base sheet and base sheet stripped daily.

.7 Field cap sheet stripping shall follow base sheet installation within 48 hours weather permitting or soon thereafter.

.8 Run roofing membrane up and over the top of the parapet and 2” down the wall. Cover membrane flashing with a metal parapet cap terminating in a 3” downturn and a ¾” drip on both sides of the parapet. This should be mandatory for all roofs, and wall flashings.

.9 Avoid the use of gum pans.

.10 **HVAC equipment installation:**

   .1 Where house keepings pads are provided: HVAC equipment can be bolted down into concrete pad, and pad is to be installed over a 3ply roofing system

   .2 Where large HVAC equipment has proprietary frame: starter curb complete with roofing membrane are to be provided and liquid membrane flashing (PMMA) is to then be applied and extend from waterproofed curb to top of HVAC frame. The underside of the HVAC is to receive 3 ply SBS.

***END OF SECTION***
1.1 DESIGN REQUIREMENTS


.2 Projects with green roof systems and/or landscaping on slab require close and early coordination among the Landscape Architect, Architect, Structural Engineer and SFU Facilities to ensure that the landscape design objectives are integrated into the structural design.

.3 Design should take into account the need for routine horticultural maintenance. Even extensive green roof plantings may require periodic maintenance to remove weeds and volunteer species, rejuvenate grass-scapes, renew plantings or service irrigation components. Consideration should also be given to access and removal of gardening debris and fall protection appropriate for landscape staff.

.4 Consideration should be given to the pollen production of plant cover in relation to air intakes.

.5 For grade level green roofs, consideration should be given for the structural loading and access for large equipment such as elevated work platforms (boomlifts, scissor lifts, etc.) to facilitate maintenance of adjacent building facades.

***END OF SECTION***
1.1 General

1.2 Design Requirements

.1 Roofing is to be designed to meet Guarantee Standards of the Roofing Contractors Association of British Columbia Guarantee Corp. (RGC) as published in the "RGC Roofing Practices Manual" for a 5-Year guarantee.

.2 Roof covering to conform to CAN/ULC-S107-M "Standard Methods of Fire Tests of Roof Coverings" for a Class A, B or C classification.

.3 Roofing is to be designed to minimum Factory Mutual wind uplift standards, Class I90 windstorm.

.4 Sheet metal roofing systems are to be concealed fastener type.

.5 The design service life of sheet metal roofs is 30 years to first major maintenance/replacement.

.6 The air barrier system in a sheet metal roofing systems is to function as a secondary drainage plane. All fastener penetrations are to be sealed and clamped, and the air barrier plane is to be water tight over the design service life of the roofing.

.7 All sheet metal roofs must be designed to consider potential snow slumping hazards. Snow retention stops must be incorporated into roof slopes where there is the potential for public injury from sliding snow.

1.3 Materials

.1 Insulation to be rockwool or polyisocyanurate types.

.2 Sheet metal accessories for low slope roofs are to be a minimum 0.71 mm thick (24 ga), Z275 (G90) galvanized. Prefinished metal work to have Dofasco Series 5000 paint finish over galvanizing or equivalent.

.3 Sheet metal roofing is to be a minimum 0.71 mm thick (24 ga.), Z275 (G90) galvanized. Prefinished metal work to have Dofasco Series 5000 paint finish or equivalent applied over galvanizing.

.4 Other sheet metal roofing systems to be approved by Technical Services (Phone: 604-822-9510). If approved, other sheet metal roofing systems to be selected with design service life and maintenance considerations foremost.

.5 Metal work concealed in the roof assembly is to be at a minimum 18 gauge Z275 (G90) galvanized sheet metal, protected with a bituminous coating where in contact with damp materials.

.6 Metal work is to be provided with electrolytic isolation between dissimilar metals including fasteners.
.7 Air barrier/roof underlay membrane systems considered to have adequate design service lives for use under sheet steel roofing systems are:

.1 Single ply polyester-reinforced torch applied SBS modified bitumen roofing membrane; fully reinforced 180 g felt weight.

.2 Some high melting point, adhesively applied bitumen membranes, fully reinforced 180 g weight.

***END OF SECTION***
1.1 **GENERAL**

1.2 Related SFU Technical Requirements
   
   .1 Section 07 00 10 Building Envelope – General Requirements
   .2 Section 07 50 00 Membrane Roofing

1.3 Co-ordination Requirements
   
   .1 Coordinate design with Building Envelope Professional.

1.4 Performance Standards
   
   
   .2 Fabricate to SMACNA *(Sheet Metal and Air Conditioning Contractor’s National Association)* – *Architectural Sheet Metal Manual Standards*.

1.5 Quality Control and Assurance
   
   .1 Quality Assurance
      
      .1 Refer Section 07 50 00 Membrane Roofing.
      .2 Follow all recommendations of the "RGC Roofing Practices Manual", as a minimum.
   
   .2 Quality Control
      
      .1 Refer Section 07 50 00 Membrane Roofing.

1.6 Submittals
   
   .1 Provide samples for colour selection.

2.1 **MATERIALS**

   .1 Base metal for sheet metal accessories and for sheet metal flashing and trim to be:
      
      .1 Zinc coated (Rheinzink) sheet steel conforming to the requirements of ASTM A653 (or A653M as applicable) with a minimum zinc coating of G90 (Z275), or
      
      .2 Alternate - Subject to SFU approval only: Aluminium-zinc coated (Galvalume) steel sheet conforming to the requirements of ASTM A792 (or A792M) with a minimum coating of AZ50 (AZM150).
      
      .3 Alternate - Subject to SFU approval only: Aluminum sheet conforming to CSA HA Series1975, plain:
         
         .1 Generally minimum 0.81 mm (20 gauge), 1.02 mm (18 gauge) at parapets and flashings 200mm (8") width or wider
         
         .4 Minimum 24 gauge thickness.
   
   .2 Exposed Coil-Coated Finish metal used for fabrication of flashings to be:
      
      .1 Two-Coat Fluoropolymer: AAMA 621.
.2  Three-Coat Fluoropolymer: AAMA 621.
.3  Mica Fluoropolymer: AAMA 621.
.4  Metallic Fluoropolymer: AAMA 621.
.5  FEVE Fluoropolymer: AAMA 621.
.6  Siliconized Polyester: Epoxy primer and silicone-modified, polyester-enamel topcoat; with dry film thickness of not less than 0.2 mil (0.005 mm) for primer and 0.8 mil (0.02 mm) for topcoat: Cascadia Metals SMP Series.

.3 Provide continuous clip-type fasteners at all parapet flashings, of same material as flashing.

.4 Provide overflow scuppers whenever perimeter walls exceed 100 mm (4") in height, to BC Building Code requirements. Refer to SMACNA Appendix A-7, Scupper Sizing.

.5 Fabrication shall be standing seams only at inside and outside corners, S-Lock at all other locations.

3.1 EXECUTION

.1 Apply isolating coating to all metal surfaces in contact with cementitious materials.

.2 Avoid the use of reglets as roofing membrane terminations.

.3 Avoid surface fasteners.

.4 Provide 10% slope towards roof at all parapets, min. 2% elsewhere.

***END OF SECTION***
1.1 **GENERAL**

1.2 Access to roof is required for the purpose of maintenance and for servicing mechanical equipment where applicable.

1.3 Performance Requirements

   .1 General

      .1 All roofs to be provided with access from interior of building, as follows:

         .1 Preferred access is by stairwells. Ship’s ladder and roof hatch are less desirable.

         .2 Minimum size for roof hatch must be 3’, and access must be 2m from a roof edge or else guard rails at the access point must be provided. Hatch to have, integral curb and flashing, insulated, externally mounted safety grab handle, NRP hinges, and provision for padlock.

1.4 Prescriptive Requirements

   .1 Safety Note

      .1 Where maintenance personnel would need to work close to parapets less than 1,070 mm (3’ 6”) high, guard rails are to be provided. Alternatively, Fall Protection may be required; (refer to Section 11 81 29 Facility Fall Protection).

***END OF SECTION***
1.1 **GENERAL**

1.2 **Co-ordination Requirements**

.1 Coordinate with Firestopping requirements in *Divisions 21, 26 and 27.*

1.3 **Description**

.1 Firestopping systems designed to act as a firestop and smoke seal within fire-resistive wall and floor assemblies for any through penetrating items such as cables, cable trays, conduits, ducts, pipes and any poke-through termination devices, such as electrical boxes along with their means of support through the wall or floor opening.

.2 Firestopping materials at fire-resistive wall and floor assemblies such as joints at intersections of dissimilar construction.

1.4 **Performance Standards**

.1 Firestopping shall achieve a fire rating of not less than the surrounding assembly.

.2 CAN/ULC S115-11, "Standard Method of Fire Tests Of Firestop Systems".

.3 ULC List of Equipment and Materials:


.2 ULC or cUL listed *firestop assemblies* for intended application.

1.5 **Quality Control and Assurance**

.1 Quality Assurance

.1 Contractor to have a quality control program for firestopping installation.

.2 All trades to attend a QC start-up meeting prior to working on site.

.3 Pre-Installation Conference

.1 Convene a meeting between related sections following award of contract to discuss Firestopping requirements.

.2 Ensure that other sections are aware of the maximum and minimum clearance requirements to the penetration stipulated by the Underwriter's design listing.

.2 Quality Control

.1 Installer to be certified by product manufacturers for installation of products, including for safety and so as to ensure warranties are not affected.

.2 Do not mix *products in the system from* differing manufacturers.

.3 Use the same product for all like applications.
.3 Commissioning

.1 At the time of building commissioning, provide a comprehensive seminar to SFU Facilities on the purpose and nature of the firestop systems used. Include a "hands-on" session on re-entry, re-sealing and all safety aspects of the firestops.

.4 Maintenance

.1 Tag service penetrations and every 3.0 meters of joint seal with printed tags indicating name and phone number of subcontractor and the following statement: "CAUTION! FIRESTOP: DO NOT RE-ENTER, PUNCTURE OR DESTROY UNLESS PREPARED TO RE-SEAL IMMEDIATELY WITH PROPER, SFU-APPROVED METHOD!"

2.1 MATERIALS

.1 Product preference:

.1 General fire stopping, products manufactured by Hilti (Canada) Limited.
.2 Zone pathways for Division 27 – specifically use Hilti CFS-SL GP system.

.2 Use low VOC products.

3.0 EXECUTION

.1 Use primers whenever recommended by manufacturer.

***END OF SECTION***
1.1 **GENERAL**

1.2 Co-ordination Requirements

.1 Coordinate design with Building Envelope Professional.

1.3 Description

.1 Sealants (caulking) at all project locations.

1.4 Performance Standards

.1 SFU observes that:

   .1 The University experiences continual failures in exterior caulking on door and window frames, louver frames, cladding joints and other areas of non-movement. Consequently, joint sealants are not to be used as a primary method of waterproofing or shedding water. Appropriate counter flashings and cladding details to be provided.

   .2 Only high performance elastomeric sealants are to be used. Sealants must be capable of withstanding dynamically moving joints in exterior applications for long periods of time (typically 20+ years).

   .3 All joints to receive sealant shall be designed to accommodate anticipated movement. This should include movement due to thermal expansion and contraction as well as structural movement. This is of particular importance at window and door perimeters.

   .4 The consultant is therefore to develop details, select sealants, and involve manufacturers so as to obtain high performance, durability, and low-maintenance, incorporating quality assurance programs in the contract documents particular to the project and developed in concert with manufacturers and specialist companies of this trade, and the envelope consultant.

1.5 Quality Control and Assurance

.1 Submittals

   .1 Before Start of Work

      .1 List of all proposed sealant materials and installation instructions for review, and colour samples for selection by Consultant.

      .2 MSDS Material Data Sheets for review and posting at jobsite.

      .3 Certification reports of VOC content.

   .2 At Completion

      .1 Maintenance data shall be an itemized list:

         .1 C/V manufacturer / distributor name / sealant type / color formulation / warranties.
.2 Quality Assurance

.1 Trade contractor who specializes in the application of sealant systems.

.3 Warranties

.1 Extended warranties for each product as offered by sealant manufacturers to apply.

2.1 MATERIALS

.1 Materials

.1 All sealants must not contain hazardous materials such as asbestos. Note that many existing applications at SFU contain asbestos-based caulking.

.2 Exterior weather seal sealants shall be high performance neutral cure silicone such as: Dow Corning 991, 790 and 795 or GE SILPRUF and GE SILPRUF NB.

.3 Use non-staining sealants for sensitive substrates such as stone unless testing has been done to ensure compatibility with regular sealants.

***END OF SECTION***
1.1 GENERAL

1.2 General Note

.1 Involvement from Building Envelope Professional (BEP) required as required by BECx Standards (NIBS Guideline 3).

.2 Production of a competent air barrier requires integration of the line of air tightness into early design decisions.

1.3 Performance Standards (latest edition)

.1 CAN/CSA-A440.2-09/A440.3-09 - Fenestration energy performance/User guide to CSA A440.2-09, Fenestration energy performance.

.2 NFRC 100, Procedure for Determining Fenestration Product U-factors.

.3 NFRC 200, Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence.

.4 CAN/CSA-A440.4 “Window and Door Installation”.

1.4 Windows – General

This Section applies to all Glass and Glazing included in Sections: 08 41 13 Aluminum-Framed Entrances and Storefronts, 08 50 00 Windows, 08 80 00 Glazing, and 08 44 13 Glazed Aluminum Curtain Walls.

.1 Systems to utilize exterior rain screen deterrents, interior air seal barriers, and cavities pressure equalized to the exterior to minimize water infiltration into the internal areas of the system, assembled and installed to provide control and drainage to the exterior of any water which enters the pressure equalized cavities.

.2 All seals between frame and glazing to be made with compressed gaskets.

.3 Frames to be glazed with internal removable stops or using tamper proof fasteners where security is required.

.4 Window installations need to accommodate building movements including inter-storey drift during seismic loading.

.5 Air infiltration/exfiltration level:

.1 A3 level for operable products (0.5 l/sm2) and Fixed level for non-operable products (0.2 l/sm2) all measured at 75Pa.

.6 Water tightness rating for windows to be selected based upon exposure to elements related to location on the façade and site conditions.

.7 Sound attenuation ratings for windows to be selected based upon interior requirements.

.8 Thermal transmission and shading coefficient for windows and doors to be selected in coordination with mechanical consultant.

.1 Buildings designed to ASHRAE 90.1 (latest edition): Provide overall U-values and SHGC that are lower than prescriptive values for Zone 4 buildings.

.1 Non-metal framing $U_{SI} \leq 2.3 \text{ W/m}^2\text{K}$.

.2 Metal curtainwall / window wall $U_{SI} \leq 2.8$.

.3 Metal windows, operable for fixed, and non-entrance doors: $U_{SI} \leq 3.1$.

.4 Overall SHGC $\leq 0.40$. 
.2 Buildings designed to BCBC.

.9 Operable windows to be included for ventilation and occupant comfort where noise and mechanical ventilation concerns do not preclude this.

.10 Operable windows are not to be installed in laboratories or spaces where pressure differentials need to be maintained in order to allow negative pressures to be maintained relative to adjacent spaces and to prevent draft conditions.

.11 Make provision for window washing and other maintenance access to both sides of glazing units, including in atrium spaces. Access by man lift is preferred.

.12 Hardware and seals of operable units should be designed so that hardware can be adjusted and seals maintained or replaced over the life of the window to maintain air and weather tightness.

.13 Frames need to be supplied with receiving surfaces for sealing to air and vapour barrier materials, insulation, and cladding in the wall assembly.

.14 Exterior sills and flashings to be installed with a definite outward slope (15° degrees or more)

.15 Designers should consider industry standard bird friendly design guidelines, as well as designing to prevent birds from nesting or becoming a nuisance.

1.5 Windows - Materials

This Section applies to all Glass and glazing included in Sections: 08 41 13 Aluminum-Framed Entrances and Storefronts, 08 50 00 Windows, 08 80 00 Glazing, and 08 44 13 Glazed Aluminum Curtain Walls.

.1 Glazing units to have a 10-Year warranty.

.2 Frame materials to be selected for a minimum 30-Year service life.

.3 Suitable frame materials include thermally broken aluminum.

.4 Where permitted by code fiberglass windows may be specified provided they meet a minimum performance class and grade of CW 45 in accordance with NAFS.

.5 In a non-academic building of less than 3 stories in height, and where permitted by building code, AAMA 303 certified PVC compounds windows may be considered provided they meet a minimum performance class and grade of CW 45 in accordance with NAFS. PVC windows to be white or light colours only.

.6 Frame coating: Aluminum AAMA 2603 for interior coatings, AAMA 2604 for exterior coatings in high traffic areas (entrances) for greater abrasion resistance, AAMA 2605 for exterior exposed coated surfaces. Anodized finishes to conform to AAMA 611 or AAMA 612 (clear coated anodized finish).

.7 All materials should be shop fabricated and finished with no field cutting of materials allowed.
.8 Non-metal and non-wood windows to meet a minimum performance class of NAFS CW class.

.9 Sill accessories and flashing material shall be connected with waterproof joints or shall be underlain with continuous secondary waterproofing. Joints shall remain waterproof while accommodating thermal movement for the life of the installation.

.10 All windows to be installed over a waterproofed sub sill pan that covers the entire underside of the window up to the air seal line.

1.6 Doors – General

This Section applies to all Doors included in Sections: 08 11 00 Metal Doors and Frames, 08 41 13 Aluminum-Framed Entrances and Storefronts, 08 50 00 Windows, 08 80 00 Glazing, and 08 44 13 Glazed Aluminum Curtain Walls.

.1 Doors not designed to be weathertight should be protected from inclement weather by canopies or by other means.

.2 Water tightness rating for exposed doors to be selected based upon exposure to elements related to location on the façade and site conditions.

.3 Frames to be glazed with internal removable stops or using tamper proof fasteners where security is required.

.4 Fire doors must not have manual hold-open devices and must not be painted such that tags remain visible.

.5 Doors must conform to SFU colours.

.6 Door sub sill pans need to be integrated with terminations of roofing membranes.

.7 Check scuppers for height relative to door sills.

.8 Frames need to be sealed to air and vapour barrier materials, insulation, and cladding in the wall assembly.

.9 Wherever required for fire rating, use hollow metal thermally broken doors. At all other locations use thermally broken aluminum door or fiberglass.

.10 Wide stile glazed thermally broken aluminum doors in aluminum frames or fiberglass doors in pressed metal frames are preferable.

.11 Wood doors with a mineral core are acceptable under some circumstances but not recommended for maintenance.

.12 For security purposes doors should be single. All exterior exit doors (with panic hardware or "pass out" locksets) must be singles within their own frames. Where wider openings are required for movement of equipment, supplies, etc., provide removable center mullions.

.13 The University requires that all doors with glazed assemblies (floor to door height, or ceiling) be tempered glass.

.14 Where vision glass is located in a required fire separation use Firelite and not wired glass.

.15 Provide minimum 150 mm (6") high base to all sidelights to provide adequate protection to glazing from floor washers, polishers and vacuum machines.

.16 Use of floor checks, pivots, concealed closers and/or concealed panic devices is not
.17 Door stiles of glazed doors must be 127 mm (5") x 45 mm (1 3/4") minimum in order to accept surface mounted panic hardware and mortise locksets. Glass doors are not recommended.

.18 Doors to swing out for all Service Rooms and provide an acoustic seal.

.19 Any exterior or vestibule doors that swing over walk off mats must have sufficient clearance underneath to accommodate the mats without having to make special provisions in the mats such as cutaways.

1.7 Doors - Materials

This Section applies to all Doors included in Sections: 08 11 00 Metal Doors and Frames, 08 41 13 Aluminum-Framed Entrances and Storefronts, 08 50 00 Windows, 08 80 00 Glazing, and 08 44 13 Glazed Aluminum Curtain Walls.

.1 Materials to be selected for a 30-Year service life.

.2 Corrosion protection considered suitable for steel materials consists of Z275 galvanizing and painting.

.3 Aluminum frame coating: AAMA 2604 for exterior coatings in high traffic areas (entrances) for greater abrasion resistance, AAMA 2605 for exterior exposed coated surfaces. Anodized finishes to conform to AAMA 611 or AAMA 612 (clear coated anodized finish).

.4 All materials should be shop fabricated and finished, with no field cutting of materials allowed.

.5 PVC doors to have a minimum exterior wall thickness of 2 mm, and to have internal steel reinforcing in every member.

.6 Sill accessories and flashing material shall be connected with waterproof joints or shall be underlaid with continuous secondary waterproofing. Joints shall remain waterproof while accommodating thermal movement for the life of the installation.

***END OF SECTION***
1.1 **GENERAL**

1.2 Related SFU Technical Requirements

1.3 Co-ordination Requirements

1.4 Description

1.5 Performance Standards

1.6 Submittals

2.1 **MATERIALS**

2.2 Prescriptive Requirements
.2 Components
   .1 Design aspects
      .1 Standard and minimum door size shall be 915 mm x 2,134 mm x 44 mm (3'-0" x 7'-0" x 1 3/4").
      .2 Maximum door height: 2,134 mm (7'-0").
      .3 Glazed doors shall provide stile width 152 mm (6") typical, 127 mm (5") minimum.
      .4 Avoid double doors whenever possible where security is a requirement; provide lockable removable mullions at double doors where extra width is required such as for moving equipment, supplies, etc.
      .5 At glazed screens and sidelights shall provide 152 mm (6") high base to protect against damage from floor cleaning equipment, etc.
      .6 Interior doors should have a doorlite or sidelite for personal security.
      .7 Provide electrical pathways to mid hinge, strike and header of frames for future electrification of openings. Must include pull string to each pathway.
      .8 Glazed doors must have styles and rails. No glazed doors with only top and bottom rails or patch hardware.
      .9 Doors must have mid-rails if equipped with exit devices.

   .2 Provide back boxes.

   .3 Finishes
      .1 Finish paint coat must be applied before final hardware install.

   .4 Fabrication
      .1 Frames to be fully-welded (knock-down frames are acceptable only by special SFU Facilities approval).

   .5 Coordination
      .1 For security reasons from within a building, EXIT alarms may be required on certain Exit-Only doors.

***END OF SECTION***
1.1 GENERAL

1.2 Related SFU Technical Requirements

.1 Section 06 40 00 Architectural Woodwork
.2 Section 07 00 10 Building Envelope – General Requirements
.3 Section 08 00 10 Openings – General Requirements
.4 Division 27

1.3 Co-ordination Requirements

.1 Coordinate Exterior Door Design with BEP
.2 Coordinate design with Division 16 - Electrical Consultant.
.3 Coordinate design with SFU IT
.4 Coordinate design with SFU Facilities

1.4 Performance Requirements

.2 CAN/CSA-0132.2 Wood Doors.
.3 CAN 3-0188.1 Particle Cores.
.4 Hollow core doors are unacceptable.
.5 In buildings of 3 stories or less, exterior wood doors to be installed under the cover of an overhang with a minimum 1:2 overhang ratio.
.6 In the case that Site built exterior wood doors are required, they must be field tested for water infiltration to ASTM E1105 at 300 Pa without water infiltration and have the following:
   .1 Drip flashing at head
   .2 Open out
   .3 Interior perimeter air seal rubber gasket at head, jamb and sill
   .4 Step threshold with integral bulb gasket at sill
   .5 Weather resistant astragal to be provided at meeting rails of a pair of door leafs
   .6 Exterior door sweep gasket at sill
   .7 Hardware – corrosion resistance, multi-point for doors over 80”

1.5 Quality Control and Assurance

.1 Submittals
   .1 Provide a list of all proposed materials for review, and color samples for selection plus for final approval.
   .2 Submit shop drawings.
   .3 Provide manufacturer installation instructions and test data, for fire rated doors.
   .4 Submit 8”x12” top corner sample of each type of door proposed for acceptance of construction and veneer.
.2 Quality Assurance
   .1 Follow AWMAC Quality Assurance Program. All doors to have an AWMAC guarantee and follow the AWMAC Inspection and Guarantee Program.

.3 Quality Control
   .1 Trade contractor shall be a member of AWMAC – BC.
   .2 All work to be inspected both at the plant and on site by an AWMAC approved/appointed Inspection Agency, acceptable to the Consultant and AWMAC, and paid by the Trade Contractor.
   .3 An AWMAC appointed inspector to review and approve all shop drawings and inspect all work at both the plant and the site.

.4 Warranties
   .1 2-Year AWMAC Guarantee Certificate to include replacing and refinishing due to defects or faulty workmanship.
   .2 3-Year manufacturer warranty against deformation (bow, twist, cup, twist) and against core, stile, and rail show-through (telegraphing, as determined by AWMAC Standards Manual.

2.1 MATERIALS

2.2 Performance Requirements
   .1 Environmental – Source
      .1 Endangered wood species must not be used in the manufacturing of wood doors. Recommended species:
      .1 Veneer shall be Birch, Oak, or Maple.
      .2 Trim shall be Birch, Oak or Maple.

   .2 Manufacture
      .1 Avoid adhesives, preservatives, hardeners, and synthesizing agents and finish coatings that contain formaldehyde and high V.O.C. content.

2.3 Prescriptive Requirements
   .1 Materials
      .1 Wood doors with a mineral core are not recommended for maintenance reasons but are acceptable under some circumstance.

   .2 Components
      .1 Standard and minimum door size: 915 mm x 2,134 mm x 44 mm (3'-0" x 7'-0" x 1 ¾").
      .2 Maximum door height: 2,438 mm (8'-0").
      .3 Glazed doors shall have stile width of 152 mm (6") typical, 127 mm (5") minimum.

   .3 Provide solid wood backing for all hardware installation.

   .4 Fabrication
      .1 All doors to be solid core.

   .5 Execution
      .1 Seal hinge gains, top and bottom of doors before installation.

***END OF SECTION***
1.1 GENERAL

1.2 Related SFU Technical Requirements

.1 Section 07 00 10 Building Envelope – General Requirements
.2 Section 08 00 10 Openings – General Requirements

1.3 Co-ordination Requirements

.1 Coordinate design with Building Envelope Consultant.
.2 Coordinate design with Division 26 Electrical Consultant.
.3 Coordinate design with Divisions 27 and 28 SFU IT Services

1.4 Description

.1 Exterior aluminum type framing systems: Only use storefront in protected areas under overhangs or canopies. In all other locations curtain wall is required.

1.5 Performance Standards

.1 ASTM E283, “test method for rate of air leakage through exterior windows, curtain walls and doors.”
.2 ASTM E330, “structural performance of exterior windows, curtain walls and doors by uniform static air pressure difference.”
.3 ASTM E331, “test method for water penetration of exterior windows, curtain walls and doors by uniform static air pressure differential.”

1.6 Performance Requirements

.1 It is strongly recommended that storefront glazing only be designed for walls having overhangs that will keep the walls dry under normal light-breeze weather conditions. It is requested that self-draining curtain wall systems be selected for installation on exposed walls with no overhangs.

.2 In addition to any other applicable Codes, Standards and Project Requirements, exterior systems to meet or exceed the following minimum requirements.

.3 Environmental Separation

.1 Water Tightness rating for windows to be selected based upon exposure to elements related to location on the façade and site conditions. Use the NAFS Canadian supplement.
.2 Air Infiltration to be determined in accordance with the requirements in ASHRAE 90.1 latest version.

.4 Framing systems to be thermally broken.

.5 Engineering Design

.1 Wind Loads: assemblies, reinforced where required, capable of withstanding local positive and negative wind pressures.
1. Minimum 25 psf (1.2 kPa) inward and 25 psf (1.2 kPa) outward acting normal to the plane of the wall.
2. As required to meet Project Structural Design Criteria.
3. As required to meet the requirement of BC Building Code.
4. Based on CAN3-S157 and allowable deflection of 1/175.

2. Seismic design to meet all of the requirements for:

3. System to provide for expansion and contraction within system components caused by a cycling temperature range of 100 degrees C over a 12 hour period without causing detrimental effect to system components.

4. The system capable of withstanding a metal surface temperature range of 180° F (100° C) without buckling, failure of joint seals, undue stress on structural elements, damaging loads on fasteners, reduction of performance, stress on glass, or other detrimental effects.

5. Assemblies to support design loads and accommodate structural deflection and long term creep movements and drift as shown on the Structural Drawings without stress on glass, buckling, failure of joint seals, undue stress on structural elements, damaging loads on fasteners, reduction of performance, or other detrimental effects caused by structural movement.

6. The connection of the storefront framing to the structure of the building to be detailed in such a way that only horizontal and vertical forces are transmitted. No bending moments to be applied by the storefront to the structure or structural support.

7. Operable windows which are within 3.6 m (12') from grade to meet ASTM F 588 Grade 20 minimum for forced entry resistance.

8. Fasteners
   1. Exposed fasteners and anchors: aluminum, 300 series stainless steel, or nickel-plated brass.
   2. Concealed fasteners and anchors: aluminum, cadmium plated steel, zinc plated steel, or stainless steel.
   3. Concealed anchors: aluminum, or carbon steel painted after fabrication with zinc chromate or other primers not containing lead.

6. Environmental

7. Coordination
   1. For security reasons from within a building, EXIT alarms may be required on certain Exit-Only doors.

1.7 Quality Control and Assurance

1. Submittals
   1. Shop drawings (including all enclosure interface details) sealed and signed by Engineer.
   2. Manufacturer to submit performance test data to confirm performance criteria.
.3 Submit Hardware Schedule; refer to Section 08 71 00 Door Hardware.
.4 Submit samples, including finishes for selection.
.5 Submit Maintenance Data
   .1 As-installed hardware schedule and installation instructions.
   .2 Source for replacement parts.
   .3 Maintenance instructions.

.2 Quality Assurance

.1 All structural performance requirements of this section including anchorage and fasteners to be designed and certified by a professional engineer registered in the Province of British Columbia, to also carry out periodic site reviews during construction and at completion, and submit reports and letters of assurances for professional design, field review and building code and project criteria compliance.
.2 Costs to be included in the contract price.

.3 Quality Control

.1 SFU Facilities will appoint and pay for an independent inspection agency to conduct field testing for water penetration, air leakage and pressure equalization.
.2 Initial field test at any given location shall be paid by SFU. Cost of re-testing to verify corrected work shall be paid by Contractor
.3 Contractor is responsible to provide test chambers and ensure adequate power and water supply.
.4 Water testing to ASTM E.1105 and air leakage testing at NAFS test pressure.

.4 Warranties

.1 5-Year

2.1 MATERIALS

2.2 Prescriptive Requirements

.1 Materials

.1 Preferred Systems:
   .1 Framing shall be Kawneer 1600 curtain wall or equivalent
   .2 Kawneer 451T storefront section or approved equivalent is acceptable in protected locations only.
   .3 Doors: Kawneer 500 wide stile (or equivalent), maximum height 2,134 mm (7'-0"), maximum width 1,220 mm (4'-0").

.2 Use of floor checks, pivots, concealed closers, in-floor power operators and/or concealed exit devices is not permitted.
.3 Install overhead stops, wall stops, or floor stops where required to prevent damage from door contacting wall, another door, and provide controlled swing/stop.

.2 Finishes

.1 Finishing products:
   .1 Thermosetting enamel coating meeting the requirements of AAMA 603.8:
   .2 Thermosetting fluopolymer two coat meeting the requirements of AAMA 605.2:
.3 Clear anodized coating to conform to AAMA Class II.
.4 Champagne, bronze or black coloured anodized coating to conform to AAMA Class I.

.3 Execution

.1 Before Installation

.1 At exterior locations, ensure that a waterproofed sill pan membrane (or equivalent) is installed to drain to exterior, over the entire perimeter of the opening over which the framing system is to be installed.

***END OF SECTION***
1.1 **GENERAL**

1.2 Related SFU Technical Requirements

1.3 Co-ordination Requirements

1.4 Description

1.5 Performance Standards

1.6 System Selection

1.7 Performance Requirements

1.1 **GENERAL**

1.2 Related SFU Technical Requirements

1.3 Co-ordination Requirements

1.4 Description

1.5 Performance Standards

1.6 System Selection

1.7 Performance Requirements

1.1 **GENERAL**

1.2 Related SFU Technical Requirements

1.3 Co-ordination Requirements

1.4 Description

1.5 Performance Standards

1.6 System Selection

1.7 Performance Requirements

1.1 **GENERAL**

1.2 Related SFU Technical Requirements

1.3 Co-ordination Requirements

1.4 Description

1.5 Performance Standards

1.6 System Selection

1.7 Performance Requirements

1.1 **GENERAL**

1.2 Related SFU Technical Requirements

1.3 Co-ordination Requirements

1.4 Description

1.5 Performance Standards

1.6 System Selection

1.7 Performance Requirements
.1 Water Tightness: see 1.6.1.1.1 above.
.2 Air Infiltration: see 1.6.1.1.2 above.
.3 Wind Load Resistance shall meet ASTM E330
.4 Resistance to Forced Entry shall be F20 (windows reachable from grade).
.5 Hardware to include multi-point locking with centre locking handle

.3 Systems to utilize exterior rain screen deterrents, interior air seal barriers, and cavities pressure equalized to the exterior to minimize water infiltration into the internal areas of the system, assembled and installed to provide control and drainage to the exterior of any water which enters the pressure equalized cavities.

.4 Exterior systems to incorporate a thermal break.

.5 Engineering Design

.1 Wind Loads: Assemblies shall be reinforced where required, capable of withstanding local positive and negative wind pressures.
  .1 Minimum 25 psf (1.2 kPa) inward and 25 psf (1.2 kPa) outward acting normal to the plane of the wall.
  .2 As required to meet Project Structural Design Criteria.
  .3 As required to meet the requirement of BC Building Code.
  .4 Based on CAN3-S157 and allowable deflection of 1/175.

.2 Seismic Design to meet all of the requirements for:
  .1 BC Building Code, latest edition

.3 System to provide for expansion and contraction within system components caused by a cycling temperature range of 100 degrees C over a 12 hour period without causing detrimental effect to system components.

.4 The system capable of withstanding a metal surface temperature range of 180° F (100° C) without buckling, failure of joint seals, undue stress on structural elements, damaging loads on fasteners, reduction of performance, stress on glass, or other detrimental effects.

.5 Assemblies to support design loads and accommodate structural deflection and long term creep movements and drift as shown on the Structural Drawings without stress on glass, buckling, failure of joint seals, undue stress on structural elements, damaging loads on fasteners, reduction of performance, or other detrimental effects caused by structural movement.

.6 The connection of the curtain wall to the structure of the building to be detailed in such a way that only horizontal and vertical forces are transmitted. No bending moments to be applied by the curtain wall to the structure or structural support.

.7 Operable windows which are within 3.6 m (12') from grade to meet ASTM F 588 Grade 20 minimum for forced entry resistance.

.8 Fasteners:
  .1 Exposed fasteners and anchors: aluminum, 300 series stainless steel, or nickel-plated brass.
  .2 Concealed fasteners and anchors: aluminum, cadmium plated steel, zinc plated steel, or stainless steel.
.3 Concealed anchors: aluminum, or carbon steel painted after fabrication with zinc chromate or other primers not containing lead.

.6 Environmental

.1 Service Life Expectancy: 50-Year for exterior, 25-Year for interiors

.7 Coordination

.1 For security reasons from within a building, EXIT alarms may be required on certain Exit-Only doors.

.2 Skylights and Glass Roofs Over Occupied Space

.1 The glazing trade’s engineer will take responsibility of ensuring skylight assemblies (including glass portion) are designed and technically tested to meet code requirements and will sign off on final assembly.

.2 Use SSG system with no cap on purlins.

.3 Rain screen rafters and purlin gutter system.

.4 Minimum slope 20 degrees, maximum slope 45 degrees.

.5 Integral purlin to rafter condensation gutter with water tight evaporation tray along skylight sill.

.6 Glazing to be double glazed heat strengthened glass. Inboard pane to be laminated glass with a minimum PVB film thickness of 1.5 mm.

.7 Basis of design: Kawneer 2000 series or approved alternative.

.8 T-bar skylight – not allowed over habitable space, however can be used as canopy over exterior space.

1.8 Quality Control and Assurance

.1 Submittals

.1 Shop drawings sealed and signed by Engineer

.2 Shop drawings to be submitted to SFU Building & Infrastructure Records.

.3 Manufacturer performance test data to confirm performance criteria.

.4 Samples, including finishes for selection.

.2 Quality Assurance

.1 All structural performance requirements of this section including anchorage and fasteners to be designed and certified by a professional engineer registered in the Province of British Columbia, to also carry out periodic site reviews during construction and at completion, and submit reports and letters of assurances for professional design, field review and building code and project criteria compliance. Costs to be included in the contract price.

.2 Laboratory testing: Curtain wall manufacturer to provide as a minimum a certified copy of test report verifying compliance with the project specifications.
.3 Quality Control

.1 SFU Facilities will appoint and pay for an independent inspection agency to conduct field testing for water penetration, air leakage and pressure equalization.

.2 Initial field test at any given location shall be paid by SFU. Cost of re-testing to verify corrected work shall be paid by Contractor.

.3 Contractor is responsible to provide test chambers and ensure adequate power and water supply.

.4 Mock-up test procedures

.1 On major project, curtain wall subcontractor is required to arrange for a representative mock-up to be tested in an accredited lab. Test procedures to include the following:

.1 Preload, static pressure air infiltration, static pressure water infiltration, dynamic pressure water infiltration, structural service loads, inter-story drift test, inter-story vertical movement, condensation Resistance / thermal cycling, structural ultimate loads.

.5 Warranties

.1 5-Year.

2.0 MATERIALS

2.1 Prescriptive Requirements

.1 Components

.1 Preferred framing type shall be Kawneer 1600 UT (or approved equal).

.2 Door

.1 Refer to Section 08 41 13 Aluminum-Framed Entrance and Storefronts.

.3 Finishes

.1 Finishing products:

.1 Thermosetting enamel coating meeting the requirements of AAMA 603.8;

.2 Thermosetting fluropolymer two coat meeting the requirements of AAMA 605.2;

.3 Clear anodized coating, AAMA Class II.

.4 Execution

.1 Before installation

.1 At exterior locations, ensure that a peel and stick air barrier membrane (or equivalent) is installed to drain to exterior, over the entire perimeter of the opening over which the framing system is to be installed.

***END OF SECTION***
1.1 **GENERAL**

1.2 **Related SFU Technical Requirements**

   .1 Section 07 00 10 Building Envelope – General Requirements
   .2 Section 08 00 10 Openings – General Requirements

1.3 **Co-ordination Requirements**

   .1 Coordinate design with BEP

1.4 **Description**

   .1 Exterior Aluminum fixed and operable window framing system.

1.5 **Performance Standards**

   .1 BC Building Code, including accessibility requirements.
   .2 AAMA/WDMA/CSA 101/I.S.2/A440-08, NAFS—North American Fenestration Standard/Specification for windows, doors and skylights (NAFS-08)

1.6 **Performance Requirements**

   .1 In addition to any other applicable codes, standards and project requirements, exterior systems to meet or exceed the following minimum requirements.

   .2 Environmental Separation

      .1 Products shall conform to Performance Class CW PG40 on the basis of prior testing. Required Water Penetration Test Pressure to be determined using CSA A440S1 methods and rounded up to nearest NAFS water penetration resistance test pressure, and specified in Pascals separately from Performance Grade. Air infiltration/exfiltration levels to be A3 for operable products and Fixed for non-operable products.

      .2 Windows reachable from grade to have a forced entry resistance of ASTM F 588 Grade 20. This is greater than the minimum NAFS requirement of Grade 10.

      .3 Window systems to incorporate a thermal break.

   .3 Engineering Design

      .1 Wind Loads: *design assemblies to withstand* local positive and negative wind pressures.

         .1 Minimum 25 psf (1.2 kPa) inward and 25 psf (1.2 kPa) outward acting normal to the plane of the wall.
         .2 As required to meet project structural design criteria.
         .3 As required to meet the requirement of BC Building Code.
         .4 Based on CAN3-S157 and allowable deflection of 1/175.

      .2 Seismic design to meet all of the requirements for:

         .1 BC building code latest edition.
.3 System to provide for expansion and contraction within system components caused by a cycling temperature range of 100 degrees C over a 12 hour period without causing detrimental effect to system components.

.4 The system capable of withstanding a metal surface temperature range of 180° F (100° C) without buckling, failure of joint seals, undue stress on structural elements, damaging loads on fasteners, reduction of performance, stress on glass, or other detrimental effects.

.5 Assemblies to support design loads and accommodate structural deflection and long term creep movements and drift as shown on the Structural Drawings without stress on glass, buckling, failure of joint seals, undue stress on structural elements, damaging loads on fasteners, reduction of performance, or other detrimental effects caused by structural movement.

.6 The connection of the window framing to the structure of the building to be detailed in such a way that only horizontal and vertical forces are transmitted. No bending moments to be applied by the window to the structure or structural support.

.7 The glazing trade’s engineer will take responsibility of ensuring skylight assemblies (including glass portion) are designed to meet code requirements and will sign off on final assembly.

.8 Fasteners
  .1 Exposed fasteners and anchors: aluminum, 300 series stainless steel, or nickel-plated brass.
  .2 Concealed fasteners and anchors: aluminum, cadmium plated steel, zinc plated steel, or stainless steel.
  .3 Concealed anchors: aluminum, or carbon steel painted after fabrication with zinc chromate or other primers not containing lead.

.4 Environmental
  .1 Service Life Expectancy: 50-Year for exterior, 25-Year for interiors

1.7 Quality Control and Assurance

.1 Submittals
  .1 Shop drawings (including all enclosure interface details) sealed and signed by Engineer see 1.6.2.1.
  .2 Manufacturer performance test data to confirm performance criteria.
  .3 Samples, including finishes for selection.

.4 Maintenance Data
  .1 As-installed hardware.
  .2 Source for replacement parts.
  .3 Maintenance instructions.

.2 Quality Assurance

.1 All structural performance requirements of this section including anchorage and fasteners to be designed and certified by a professional engineer registered in the province of British Columbia, to also carry out periodic site reviews during construction and at completion, and submit reports and letters of assurances for professional
design, field review and building code and project criteria compliance. Costs to be included in the contract price.

.3 Quality Control

.1 SFU Facilities will appoint and pay for an independent inspection agency to conduct field testing for water penetration, air leakage and pressure equalization.

.2 Initial field test at any given location shall be paid by SFU. Cost of re-testing to verify corrected work shall be paid by Contractor.

.3 Contractor is responsible to provide test chambers and ensure adequate power and water supply.

.4 Water testing to ASTM E.1105 and air leakage testing at NAFS test pressure.

2.1 MATERIALS

2.2 Prescriptive Requirements

.1 Windows in Laboratory spaces to be open-able only with a controlled tool, for use only in the event of Mechanical System shut-down/failure.

.2 Components

.1 Preference shall be Kawneer "Isoport 516" or approved equals.

.2 Where permitted by code fiberglass windows are permitted

.3 Windows manufactured of PVC are not acceptable for academic uses.

.3 Finishes

.1 Finishing products (aluminum):

.1 Thermosetting enamel coating meeting the requirements of AAMA 603.8:

.2 Thermosetting fluropolymer two coat meeting the requirements of AAMA 605.2:

.3 Clear anodized coating, AAMA Class II.

.4 Execution

.1 Before installation ensure that a waterproofed sill pan membrane (or equivalent) is installed to drain to exterior, over the entire perimeter of the opening over which the framing system is to be installed.

***END OF SECTION***
1.1 **GENERAL**

1.2 **Related SFU Technical Requirements**

   .1 Division 26
   .2 Division 28
   .3 Section 08 00 10 Openings – General Requirements
   .4 Section 28 05 00 Common Work Results for Electronic Safety and Security
   .5 Section 28 13 00 Access Control

1.3 **Coordination Requirements**

   .1 Electrical Consultant
   .2 Architectural Hardware Consultant
   .3 SFU IT Services
   .4 SFU Facilities Services
   .5 Architectural Consultant

1.4 **Description**

   .1 The supply only of all mechanical finish hardware.

   .2 The supply, installation, termination, testing and verification of all electrified hardware, automatic operators and door control system to form a complete operating system including the installation of all non-electrified finish hardware on all portals with electrified hardware. The supply, installation and termination of all local cable for electrified hardware specified within this section (see scope of work diagram). Local cable is defined as cable between div. 8 devices and the power transfer device (between door and frame). Tenders for supply only of hardware will be rejected outright.

1.5 **Performance Standards**

   .1 Hardware shall comply with the current issue of codes and standards as listed herein.

   ANSI American National Standards
   BHMA Builders Hardware Manufacturers Assoc.
   CSA Canadian Standards Association
   ULC Underwriters Laboratories Canada
   NFPA National Fire Protection Association
   DHI Door and Hardware Institute
   NFPA 80 Fire Doors and Windows
   BHMA Standards Materials and Finishes
   DHI - Document Installation Guide for Doors and Hardware
1.6 Design and Coordination Requirements

.1 All electrified hardware applications and products specified herein have been selected to allow for all available options and therefore the exact operation is deemed to be a site configurable variable. It will be the responsibility of this contractor to determine the exact functionality and operational requirement for all electrified hardware as well as the exact requirements for interface to related systems prior to commencing work.

.2 Convene a design review meeting within forty (40) days of Contract award. Coordinate functional review of design documents and resolve any conflicts between Contract Documents and actual requirements.

.3 Coordinate final conduit system design, device locations, and electrical service allocations and requirements. The Division 26 contractor shall be responsible for the supply and installation of all industry standard conduit, back boxes, junction boxes, device boxes, and terminal panels to provide a complete conduit system. Provide all manufactured system specific enclosures to Division 26 contractor for installation as part of the conduit system. Substantial corrosion resistant pull strings to be installed in all conduit runs.

.4 Confer with various sections of work and refer to detail drawings prior to ordering hardware to ensure that they will conform to and fit actual conditions on site. Refer to door schedule for correct sizing of all hardware. Refer to architectural details for exact location of all devices.

.5 Check all architectural details and confirm special frame rebate details and applications. Provide special lip strikes, or any special peripheral components suitable for the application as detailed. Refer to door schedule and architectural details to confirm glazing sizes and applications. Provide hardware sized or templated to accommodate glazed openings.

.6 Coordinate hardware components with door and frame manufacturers to ensure correct door and frame preparation. Inform manufacturers where conduit may be required within their respective assemblies and provide all required templates for door and frame preparation. Ensure that frames have been prepared correctly and that appropriate back boxes for conduit termination have been provided at correct locations prior to frame installation. Ensure that doors have been prepared correctly for all devices and that doors contain flexible conduit where required.

.7 Coordinate with aluminum door trade to ensure the proper preparation and fabrication of aluminum doors and frames. Coordinate where holes and grommets are required in framing system to accommodate cabling. Provide physical samples rather than paper templates if requested. If any devices are required to be installed in door or frame assemblies in the shop or during assembly or fabrication, provide such items direct to manufacturers in ample time to allow for work to be completed in accordance with construction schedule. Coordinate and template concealed closer holder devices to the required degree of opening to obtain hold open points without door or hardware contacting other surfaces.
1.7 Quality Control and Assurance

.1 Submittals

.1 Submit six (6) copies of the detailed hardware schedule for review prior to ordering hardware. Schedules shall be standard vertical format. Headings shall include room designations, door numbers, door size and material, frame material, handing, fire resistance rating, degree of opening, and original hardware group. A schedule of mounting heights shall be included with shop drawings. Each opening shall have its own item number and only door and hardware assemblies which are identical in every detail, may be grouped together on one heading. Product description shall be complete in every detail as recommended by the manufacturer under ordering procedures including sizes and fasteners.

.2 Submit six (6) copies of engineering drawings including: system block diagrams indicating all components, interconnection and cabling; complete detailed system point to point circuit and riser diagrams, conduit and cable allocations, enclosure and back box types; and all required information to provide a detailed review of functional criteria and equipment assessment. Provide conduit and cabling drawings specific to each application for coordination with Div. 26 and/or Div. 29 work. Conduit drawings shall show detail for cable hole and grommet locations within curtain wall framing systems where required.

.3 Submit one sample of each device if requested by Consultant.

.4 Submit installation, operating and maintenance manuals:

• (1) Copy of as installed hardware schedule incorporating all changes
• (1) Copy of as install systems wiring diagram including changes
• (1) Copy of all installation instructions
• (1) Copy of parts and maintenance data
• (1) Binder for above

.2 Quality Control

.1 Subcontractors shall have a minimum of five (5) years documented experience supplying and installing electrified hardware and shall be registered in the Province of British Columbia with adequate equipment, maintenance, and advisory facilities in the location of the project to fulfill contract obligations.

.2 Project management personnel directly responsible for supervision of this Work, shall be an accredited (A.H.C.) Architectural Hardware Consultant with a minimum of five (5) years of documented experience in the management of electrified hardware installation.

.3 Provide a written statement within (30) thirty days of Contract award outlining supervisors’ experience, projects, and contact references. Any changes to the approved supervisory crew shall require written approval of the Consultant.
2.1 MATERIALS

2.2 General

.1 Specified products have been selected to establish a minimum requirement for design, finish, operation and functionality and have been proven to be compatible with systems or products specified in other sections. Approval for alternate products or systems may be granted provided that quality and functional criteria has been retained, and submissions are executed in accordance with General Conditions. These submissions must be reviewed by the SFU locksmiths and the Hardware Consultant prior to approval. Be responsible for costs incurred by other trades where an alternate product or system is not compatible with products or systems specified in other sections.

.2 All like products shall be of one manufacture.

2.3 Specified Manufacturers

.1 The manufacturers listed herein have been approved for use in the preparation of this document.

.2 Butts
Stanley  CB199/CB179
McKinney  T4A3386/TA2714
Ives  5BB1HW/5BB1

.3 Mortise Locksets
Sargent  8200 series with LNJ lever
Schlage  L9000 series with 03B lever

.4 Cylinders
Abloy  (No Sub)

.5 Exit Devices
Von Duprin  98/99 series, 33A/35A series
Sargent  8000 series

.6 Door Closers
LCN  LCN 4040XP series
Sargent  350 series

.7 Stops and Flatware
Trimco
Gallery
Ives

.8 Thresholds and Seals
Pemko
Draftseal
Crowder

.9 Power Supplies
Von Duprin  PS900 series
Securitron  BPS series

.10 Door Position Indicators
Sentrol  1076W
### 2.4 Material Requirements

1. Furnish hardware with all necessary fasteners, mounting brackets and special tools required for the proper installation as recommended by the manufacturer. Fastening devices shall be of the same Material and finish as the item to which it is fastened. Any hardware items not installed with fasteners supplied by the manufacturer will be required to be removed and reinstalled with fasteners supplied by the manufacturer.

2. Provide 114mm x 101mm butts for doors up to 950mm and 127mm x 101mm butts for doors over 950mm wide. Provide 3 butts per leaf for doors up to 2150 in height and one additional butt for each additional 600mm in door height. Exterior out swinging doors shall have non-removable pins. Refer to frame details and dimensions for conditions requiring wide throw hinges or specially swaged hinges.

3. All locksets shall be provided with 03B/LNJ lever design. Where lever trim is specified on exit devices, trim shall match lever design on locks. Provide wrought boxes with all strikes. Refer to door and frame details and dimensions for conditions requiring special length or flat strike lips. Privacy locks for "unisex washrooms" must be equipped with key exterior, indicator bolt, and large HC thumb turn interior.

4. Door Closers shall be used only as required by fire ratings and where required to complete the desired function of a door (Security, Energy Loss, Sound Containment, Push/Pull doors). Door closers must be mounted on the inside of a building and on the inside of a room for aesthetics. Doors that swing into a building or room must be installed in "regular arm" application. Doors that swing out of a building or room must be installed in a "parallel arm" or "top jamb" application as is required by the door and frame condition. All parallel arm type closers must be “EDA/P10” heavy duty. All handicap washrooms must be equipped with delayed action, and reduced opening force spring door closers to meet the required accessibility code.

5. All floor and wall stops shall be cast brass or bronze base material. Provide wall stops wherever possible. Where wall stops are not suitable due to Site conditions, provide suitable floor stops. Provide machine screws and lead shields for all concrete applied floor or wall stops.

6. All flatware and door protection shall be .050" Type 304 satin stainless steel and fastened with self-tapping sheet metal screws or wood screws. Kickplates and armorplates on push side shall be 50mm less than door width on single doors and shall be 25mm less than door width on double doors. Mopplates on pull side shall be 25mm less than door width on single doors and 25mm less than door width on double doors. Coordinate exact plate sizes to ensure that edges butt directly to edge guards where specified. Kickplate height shall be sized as per schedule except where restricted by glazing or door grilles. Refer to door schedule for detail drawings for grille locations and other requirements. Kickplates are to be applied on doors with door closers only.
.7 All openings with a fire resistance rating and combustible floor materials shall be provided with non-combustible sills as per NFPA80. Thresholds shall be notched for frame stop and shall be drilled and countersunk for flush mounted flat head screws. Provide flat head stainless steel screws and concrete anchors. Install and level thresholds flush with adjacent vinyl floor finish. Thresholds shall be used sparingly (ie exteriors doors, fire rated doors, and acoustic doors). Refer to door schedule for threshold locations and types.

.8 Proper acoustic seals shall be provided for theatres, interview rooms, etc. as required by end users and specified herein.

.9 Conform to Underwriters Laboratories ULC or cUL applicable listings for labelled hardware in rated openings.

2.5 Finishes

.1 Finishes shall be as listed herein except where noted otherwise.

.2 Butts   BHMA 626   Satin Chromium Plated
.3 Locksets   BHMA 630   Satin Stainless Steel
.4 Exit Devices & Strikes BHMA 630   Satin Stainless Steel
.5 Door Closers BHMA 689   Satin Aluminum Painted
.6 Stops, Holders BHMA 626   Satin Chromium Plated
.7 Flatware, Pulls BHMA 630   Satin Stainless Steel

2.6 Keying System

.1 All permanent cylinders are to be Abloy, supplied by the owner. Abloy products listed are for the benefit of the end user for order entry purposes. Keyed alike temporary cylinders are to be provided by the hardware supplier, for use during construction. Temporary cylinders remain the property of the hardware supplier. Permanent cylinders installed by SFU Locksmiths.

2.7 Wire and Cable

.1 All local wiring for the system shall be supplied, installed, and terminated by this section. All wiring shall meet the standards of the latest edition of the Canadian Electrical Code CSA-22.1. Cable design shall be as required by Contractors’ engineering and the system when complete, must perform to the complete satisfaction of the Consultant and must be free from all interference from cross-talk, hum, switch, and relay noise

.2 All wiring shall be stranded PVC insulated multi-conductor jacketed cable and shall be installed in conduit. Each end of each cable shall be clearly labeled with Panduit # LJSL4-Y3 labeling system. All wiring shall be terminated in terminal strips or blocks and neatly installed, laced tagged where required. Connections to terminal blocks shall be made with solder less connectors with a separate terminal for each conductor.

.3 All wire from hardware power supply to locking devices for power circuits for high inrush latch retraction exit devices shall be #14 AWG for runs up to 50 feet and #12 AWG for runs up to 100 feet. All wire from hardware power supply to locking devices for power circuits for electric locks shall be #18 AWG for runs up to 150 feet and #16 AWG for runs up to 250 feet. All wire for request to exit and monitoring circuits shall be #22 AWG.
2.8 Warranty Requirements

.1 All products shall be guaranteed against defects in design, workmanship, materials, and finishes. Any defects shall be made good at no additional cost to the Owner. Warranty periods shall commence from date of Total Performance of the Work.

| Finish Hardware | (12) Months |
| Door Closers | (120) Months |
| Electrified Hardware | (18) Months |
| Butt Hinges | Life of Building |
| Power Operators | (12) Months |

3.1 EXECUTION

3.2 General

.1 Coordinate with electrical, door hardware, door and frame suppliers, and any other trades who may have field devices operating to the demands of the system.

3.3 Inspection

.1 Inspect surfaces and conditions on site prior to commencing work. Verify that all door and frame assemblies have been prepared correctly prior to commencing work. Commencement of work assumes acceptance of site conditions.

.2 Verify that all conduit, back boxes, junction boxes, device boxes, and terminal panels have been installed where required prior to commencing work.

.3 Prior to final inspection verify that all hardware has been installed according to the approved hardware schedule and manufacturer’s instructions and ensure correct operation.

3.4 Installation

.1 Install hardware in accordance with approved hardware schedule, manufacturers installation instructions, and DHI document "Installation Guide for Doors and Hardware". Install hardware to the degree of opening as listed in the approved hardware schedule.

.2 Template and install O/H stops and holders to the required degree of opening to protect exposed trim from contacting other surfaces.

.3 Install adhesive fastened materials on a clean dry surface. Ensure that gasketing does not interfere with closing or latching of door assemblies.

.4 Install wall stops to contact levers or pulls where they protrude from the door. Where push plates and pulls are mounted back to back, through bolts for pulls shall be countersunk and plates shall cover bolt heads.

.5 Size all universal closers to suit site conditions and in accordance with barrier free accessibility code.

.6 If shimming is necessary use only approved corrosive resistant metal shims. Organic materials are not acceptable.
.7 All electrified hardware shall be supplied, installed and terminated by this section except where indicated to be by others in the hardware schedule. All local wire and cable for electrified hardware shall be supplied, installed, and terminated by this section. Local cable is defined as cable between div. 8 devices and the power transfer device (between door and frame).

.8 Request to exit inputs shall be terminated at access panels by Security Contractor. Termination of access panel outputs to hardware power supply inputs coordinated between Div. 8 & Security Contractor.

.9 Door position switches for man doors shall be supplied by this section to allow for door and frame preparation. All door position switches shall be installed by this section and terminated at access panels by Security Contractor.

.10 Power supplies for electrified hardware shall be supplied by Div. 8 and installed connected to conduit, power and fire systems Div. 26. Hardware power supplies shall be provided with control modules that completely isolate hardware power from security access panels. Control modules shall allow a dry trigger input from the access panel outputs to control power to the hardware device and shall provide individual fused outputs for each device.

.11 Where automatic operators are specified on access-controlled openings, provide relay modules which allow push buttons operations to be interfaced with the access control system. Un-secure side push buttons shall be supplied with DPDT switches and shall provide direct activation to the operator and request to exit input to the access system. Secure side push buttons shall provide direct activation of the operator and shall be enabled or disabled by the access control system. Where required, card reader shall provide direct activation of operator.

3.5 Testing and Commissioning

.1 Prior to final inspection verify that all hardware has been installed according to the approved hardware schedule and manufacturer’s instructions. Test all electrical hardware and monitoring devices to ensure that hardware is fully operational in stand-alone mode.

3.6 Protection and Maintenance

.1 Be responsible for protective treatment and other precautions required to ensure that hardware components will be without damage until completion of the Work. Replace any item that is scratched, marred, or damaged. Instruct the Owner on the proper operation, care and maintenance of hardware and door systems.

3.7 Hardware Groups

.1 Manufacturers are listed to provide quality and function information; alternates of the same quality and function are acceptable for use.

***END OF SECTION***
1.1 **GENERAL**

1.2 Related SFU Technical Requirements

.1 Section 07 00 10 Building Envelope – General Requirements
.2 Section 08 00 10 Openings – General Requirements

1.3 Co-ordination Requirements

.1 Coordinate design with BEP.

1.4 Description

.1 Glass and Glazing.

1.5 Performance Standards

.1 MNECB Model National Energy Code for Buildings, typically using values for "Natural Gas".
.2 ANSI/ASHRAE 90.1.
.3 CAN/CGSB-12 Series Standards: glass types; performance.
.4 CAN/CGSB-12.20: Structural Design for Buildings.
.5 IGMAC Insulating Glass Manufacturers of Canada guidelines.
.8 British Columbia Energy Efficiency Act.

1.6 Quality Control and Assurance

.1 Submittals

.1 Shop drawings sealed and signed by Engineer
.2 Samples if other than clear glass.
.3 Performance data.
.4 Maintenance and cleaning procedures.

.2 Quality Assurance

.1 Work shall be performed by a qualified glazing contractor with minimum five (5) years experience, with adequate facilities and skilled personnel suitable for this work.

.3 Quality Control

.1 Drawings indicate minimum thicknesses and requirements.

.2 Final thickness, safety glazing, heat strengthening, and other performance requirements to meet Code and Standards, Project Criteria, and required structural performance are the responsibility of the Contractor based on location and intended use.

.3 Structural performance requirements of exterior glazing, as well as that for exterior and interior Structural Glazing including anchorage and fasteners, to be designed and certified by a Professional Engineer registered in the Province of British Columbia, who is to also carry out periodic site reviews during construction and at completion, and submit reports and Letters of Assurances for Professional Design, Field Review and Building Code and Project Criteria Compliance.
.4 Costs to be included in the contract price.

.4 Warranties
   .1 10-Year for sealed units.

2.1 **MATERIALS**

2.2 Materials

   .1 Locally produced materials should be used whenever possible.

   .2 *Manufacturer of IGU, must be IGMA certified.*

   .3 *Glass spacer type: thermally improved as required to meet specified energy performance requirements. Non-thermally broken aluminum spacers shall not be used.*

   .4 *Installation of glazing to conform with IGMA TM-3000-90, TB-3001 and TM-1300*

   .5 List allowable glass types with applications (no tempered glass on buildings except where required to be safety glass in doors and sidelights):

      .1 *Exterior glazing, simple building form and small units – Annealed or Heat Strengthened Glass.*

      .2 *Exterior glazing, complex building or solar shades or reflective glass or large units - Heat Strengthened Glass to reduce risk of breakage due to thermal stress.*

      .3 *Exterior glazing, all buildings- low e on surface 2*

      .4 *Exterior glazing- appropriate bird friendly design including glass fritting or film application*

      .5 *Spandrel glass - Heat Strengthened Glass*

      .6 *Handrail, skylight, canopy and overhead glass – Heat strengthened laminated (minimum PVB interlayer 1.5mm)*

      .7 *Safety glass in doors and sidelights: tempered*

      .8 *Safety glass in fire rated doors and sidelights: non-wired fire rated glass*

      .9 *Clearestory vertical glazing over occupied space: heat strengthened laminated glass with a minimum 11.5mm PVB interlayer*

2.3 Components

   .1 Exterior glazing minimum shall be insulated sealed double glazing units. Component design to maximize energy performance as established by the Project Criteria, including orientation and expected functional use of space in which glazing occurs.

   .2 Use wired glass only where required for fire rating.

2.4 Finishes

   .1 Any staining of glass or other surfaces by alkaline materials is cause for rejection.

2.5 Replacement Glass

   .1 Consideration to be given to the availability of replacement glass.
2.6 Glass Cleaning Access

.1 Consideration to be given to access for glass cleaning including the structural capacity of floors to support appropriate man-lifts and/or the use of monorail systems.

.2 Consideration to be given to access and use of anchor system as applicable.

***END OF SECTION***
1.1 **GENERAL**

1.2 **Coordination Requirements**

.1 SFU Facilities

1.3 **General Requirements**

.1 SFU Facilities must be consulted before any finishes are specified.

.2 A finish-board or sample-board showing all architectural finishes should be provided for review and approval by SFU facilities on all projects.

.3 Green housekeeping and cleaning are a consideration when selecting finishes.

1.4 **Acoustic Requirements**

.1 Design consultant will carry acoustic specialists when achievable for all educational facilities.

.2 Acoustics and privacy must be considered for all projects.

.3 Ensure acoustic compatibility of all systems and materials.

.4 Classrooms and labs to comply with latest sound reflectance and absorption criteria.

1.5 **Environmental Requirements**

.1 Always consider the use of recyclable, recycled, non-toxic, low maintenance and durable finishes.

.2 Wherever possible utilize water-based, low or non-Volatile Organic Compound (VOC) type adhesives.

1.6 **Guards**

.1 In the design of large volume spaces such as atriums and elevated walkways, the use of 1500 mm (5'-0") high guards is to be considered rather than the BCBC minimum guard height of 1068 mm (3'-6").

2.1 **FLOORS**

2.2 **Mat Wells**

.1 Mat wells of any design shall not be used. Walk-off mats shall be used.

.2 Institutional Grade Entry Mats are required in all entries to reduce cleaning, and to provide sufficient non-slip flooring at entrances.

.3 Any exterior or vestibule doors that swing over walk off mats must have sufficient clearance underneath to accommodate the mats without having to make special provisions in the mats such as cutaways.

2.3 **Flooring Materials and Design Requirements**
.1 Subfloors shall be such that no inconsistencies can be transmitted to the floor finish.

.2 Seal Mechanical and Service Room Floors with urethane elastomeric membrane flooring per Section 09 67 00 Fluid Applied Flooring.

.3 Linoleum to be excluded from washrooms, baths, showers and labs.

.4 Epoxy coatings to be excluded from showers, use non-slip finish tiles (non-glazed finish).

.5 Wherever possible use low toxicity and/or sustainable materials.

.6 Hardwood Floors - refer to Section 09 64 00 Wood Flooring for finishing standards.

.7 Ceramic or Commercial Resilient Flooring: to be used in high traffic areas such as building entrances, corridors, hallways, laboratories, classrooms, coffee areas and lunch rooms.

Ceramic tiles are to be used in washrooms. This requirement applies to both new and replacement installations. Only slip resistant materials should be used in wet areas, especially building entrances.

.8 Exposed concrete in stairs and floors to have a stain resistant sealer.

.9 Carpet, (preferably carpet tile), is to be specified for enclosed administration offices, open administration areas, staff conference and meeting rooms.

.10 Carpet, (preferably carpet tile), may be used in lounge areas where food is not available; otherwise use linoleum wherever possible.

.11 For ease of cleaning, linoleum is preferred in undergraduate areas.

.12 In large lecture theatres or other areas where fixed seating occurs, use resilient flooring for ease of maintenance. Consideration must be given to acoustic treatment other than carpet as a floor finish.


3.1 SEISMIC RESTRAINT

.1 Design for the seismic restraint of shelves, cabinets, fixtures and vending machines, according to BC Building Code Part 4 and CSA S832-06 ‘Seismic Risk Reduction of Operational and Functional Components (OFCs) of Buildings’.

.2 Lobby Areas to suit future seismic restraint for vending machines

4.1 WALLS

4.2 Materials

.1 Ensure lower 3’ of walls in high traffic areas are abuse resistant (i.e. chair rails or wall bumpers and corner guards)
.2 Behind showers or tubs use cement board clad with plastic tub surrounds.

.3 Standard Public Spaces:
   .1 Regarding interior colours, so as to minimize SFU Facilities storage, costs and wastage, it is recommended that colour selections for public space wall areas be made in consultation with SFU Facilities.
   .2 Where wood finishes that clad walls require fire retardant, use only pressure-treated fire retardant, not surface-applied.
   .3 Where drapery is required to be fire retardant, use only inherently permanent fire retardant fabrics.

.4 Vinyl should not be applied directly drywall to as it damages the drywall when removed and does not allow for maintenance on walls when they require patching/painting.

.5 Vinyl is not successful as a whiteboard medium and therefore should not be used

5.1 CEILINGS

5.2 Material
   .1 Concealed-spline ceilings are not acceptable.
   .2 Minimize use of ceiling material - expose where possible.
   .3 Use only ceilings that are easily accessible and that can be removed and replaced by the service trades without damage and without requiring other tradesmen or special equipment. It should be noted that drop-down tiles with reveal edges are weaker than standard tiles.
   .4 Architectural ceiling panels must be fully accessible.
   .5 Fire resistant ceilings that require the use of hold down clips must not be used.
   .6 Coordinate noise reduction coefficient and sound reduction coefficient with an Acoustic Consultant.

6.1 ARTWORK
   .1 Seismic restraint of Artwork is required.
   .2 Coordinate structural attachment and seismic restraint of artwork with Structural Engineer.
   .3 All artwork is managed and coordinated with SFU Art Gallery.

***END OF SECTION***
1.1 **GENERAL**

1.2 **Related SFU Technical Requirements**

.1 *Section 01 35 43.13 Environmental Procedures for Hazardous Materials*

.2 *Section 02 41 00 Demolition*

.3 *Section 09 00 10 Finishes – General Requirements*

1.3 **Performance Standards**

.1 Association of Wall and Ceiling Contractors of British Columbia (AWCC) Specifications Standards Manual.

2.1 **MATERIALS**

2.2 **Performance Requirements**

.1 Environmental

.1 Consider utilizing board with a high percentage of recycled gypsum.

.2 Prefer low volatile organic compound (VOC) emitting joint compounds.

.3 Consider the use of paper joint tape instead of fiberglass. (Use only where recommended by the board manufacturer.)

.4 Use water resistant board and other specialty boards only where absolutely necessary as these products are not easily recycled.

.5 Manufacture

.1 Gypsum board shall be with a high percentage of recycled gypsum.

.2 Joint compound shall be low VOC.

.3 Joint tape shall be paper, fiberglass only where recommended by the board or surface treatment manufacturer.

2.3 **Prescriptive Requirements**

.1 Materials

.1 The use of exterior "gypsum board" is not permitted in any long term installation except at much protected locations. Instead utilize reinforced cement board or gypsum sheathing with a silicone treated gypsum core bonded to inorganic fiberglass matt both sides or, where possible, consider the use of plywood.

.2 In wet areas use re-enforced cement boards or boards with a silicone treated gypsum core bonded to in-organic fiberglass mat on both sides.

.2 Components

.1 Gypsum Wallboard, standards per AWCC Manual, and as follows:

.1 Type shall be regular for vertical surfaces.

.2 Typical preferred thickness shall be 5/8".

.3 Type shall be 'X' type where required for fire-resistance-rated assemblies, or 'C' where this type is noted at ULC Designs.

.4 Type shall be sag-resistant type for ceiling surfaces.

.5 Edges shall be tapered.

.2 Acoustical sealant for exposed Joints shall be manufacturer's standard non-sag, paintable, non-staining latex sealant to ASTM C 834.
.3 Finishes

.1 Refer to GA-214 Manual for description of level of gypsum wallboard finishing.

.4 Execution

.1 Use finishing techniques that reduce the amount of sanding required (i.e. finishing with a wet sponge).

.2 Heat and ventilate area when curing to quickly remove VOC’s, avoid propane heaters due to high moisture generation.

.3 To avoid the absorption of VOC’s from other material; store gypsum in a well ventilated area and apply paint or other surface treatment as soon as possible after installation.

.1 Use finishing techniques that reduce the amount of sanding required (i.e. finishing with a wet sponge).

.4 Install gypsum panels with face side out, except where gypsum panel is the substrate for ceramic tile work where backside shall face out.

***END OF SECTION***
1.1 GENERAL

1.2 Related SFU Technical Requirements

.1 Section 09 00 10 Finishes – General Requirements

1.3 Performance Standards

.2 Meet all of the requirements stipulated by BC Building Code.

1.4 Design

.1 Metal studs are preferred over wood studs.

1.5 Quality Control and Assurance

.1 Submittals
.1 Shop drawing: for all seismic restrained engineered studwork, bracing, and suspension systems, including where such systems act as support for work requiring seismic restraints (i.e. Laboratory and other cabinets, fume hoods, vending machines, etc.).

.2 Quality Assurance
.1 All seismic restraint work including anchoring devices to be designed and certified by a professional engineer registered in BC, who is to also carry out periodic site reviews of the work of this section during construction and completion, and submit reports and letters of assurances in the forms established by BC Building Code. Costs to be included in contract.

2.1 MATERIALS

.1 Life Cycle Costing.
.1 25-Year

2.2 Prescriptive Requirements

.1 Materials
.1 Products
.1 Metal channel carriers and stiffeners: thick cold rolled steel, galvanized.
.2 Acoustical Sealant: meeting CGSB 19-GP-21M.
.3 Apply a double bead of acoustic sealant 3/8" (10 mm) from each edge, to all partition tracks prior to securing.

.2 Minimum Metal Stud Gauge
.1 0.46 mm (25 gauge) except as otherwise required.
.2 0.88 mm (light duty 20 gauge) at the following locations:
.1 Studs exceeding allowable heights for L/240 as given in Tables in Manual.
.2 Studs (double) on either side of door frames and header.
.3 Studs supporting ceramic tile finishes.
.4 Ceiling deflection track.
.2 Execution
  .1 Maximum stud spacing: 16” oc.
  .2 Provide allowance for deflection of structure minimum 1” for studwork.

***END OF SECTION***
1.1 **GENERAL**

1.2 **Related SFU Technical Requirements**

.1 *Section 09 00 10 Finishes – General Requirements*

1.3 **Description**

.1 Ceramic and Other Tile.

1.4 **Performance Standards**

.1 Do tile work in accordance with Tile Installation Manual latest edition produced by the Terrazzo Tile and Marble Association of Canada (TTMAC).

1.5 **Quality Control and Assurance**

.1 **Submittals**

.1.1 **Before Start of Work**

.1.1 All tiling (materials/color samples etc.) to be reviewed and approved by SFU Facilities.

.1.2 MSDS Material Data Sheets for review and posting at jobsite.

.2 **At Completion**

.2.1 Maintenance data shall be itemized list c/w manufacturer/distributor name for all products used.

.2.2 Extended warranties.

.2.3 Provide for the Owners future maintenance 2% of the tile used, in original unopened packaging.

.3 **Quality Assurance**

.3.1 Whenever possible, obtain manufacturer extended warranties (Five-Year plus), generally available for larger tiled areas when manufacturer of tile-setting materials and accessories supplies all such materials and carries out inspections of the tile work installation.

.2 **Quality Control**

.2.1 Tile installation shall be in strict accordance with the written instructions and recommendations of the tile manufacturer and related product manufacturers.

2.1 **MATERIALS**

2.2 **Requirements**

.1 **General**

.1.1 Fibreglass backed rated (WonderBoard or HardieBacker, ULC Compliant) products must be used.

.2 All non-mosaic type tiles used in wet areas or entry areas to be non-slip with a static coefficient of friction of .60 or higher in accordance with ASTM C1028.

.3 Ceramic tile must conform to the standards for stain resistance, crazing and thermal shock requirements when tested in accordance with CAN2-75.1-M77.

.2 **Environmental**

.2.1 Epoxy grouts introduce environmental risks and their use should be limited to areas that require the extra durability and ease of maintenance that these products offer.

.2.2 Due to the toxic fungicide additives in mildew resistant sealant, its use should be limited to areas of constant moisture.
.3 Products are to use non-toxic and non-specialized cleaning materials.

***END OF SECTION***
1.1 **GENERAL**

1.2 **Related SFU Technical Requirements**

.1 *Section 09 00 10 Finishes – General Requirements*

1.3 **Description**

.1 Metal T- Bar Suspension Systems and Infill Tiles, or alternative ceiling type with ease of access

1.4 **Performance Standards**


.2 Suspension components shall be in accordance with ASTM-C635, "Intermediate Duty" for typical ceiling lighter weight panels such as mineral fiber panels.

.3 “Heavy Duty” for heavier panels such as composed of gypsum board.

.4 Installation shall be in accordance with ASTM-C636.

.5 Seismic design, components, and installation: in accordance with ASTM-E580, Clause 4 "Areas Subject to Moderate to Severe Seismic Disturbance" and subsequent Clauses, and meeting all of the following requirements:

   .1 BC Building Code.
   .2 Coordination with seismic requirements of other trades, such as for *Divisions 20 to 25 and 26*, affecting the work of this section.

.6 Use only ceilings that are easily accessible and that can be removed and replaced by the service trades without damage and without requiring other tradesmen or special equipment.

.7 Only materials that carry some assurance of a future supply of patterns and colors should be specified.

.8 Fire resistant ceilings that require the use of hold down clips, and concealed spline systems must not be used at SFU.

.9 Wetlabs have specific ceiling requirements and should be reviewed on a case-by-case basis with SFU Facilities.

1.5 **Quality Control and Assurance**

.1 **Submittals**

   .1 Samples.

.2 **Quality Assurance**

   .1 All seismic restraint work including anchoring devices shall be designed and certified by a Professional Engineer registered in BC, who shall carry out periodic site reviews of the work of this Section during construction and at completion, and submit reports and Letters of Assurances in the Forms established by BC Building Code. Costs to be included in Contract.
2.1 MATERIALS

2.2 Performance Requirements

.1 General
   .1 T-bar ceilings are required to be seismically reinforced in all new constructions.
   .2 Typical, to equal or exceed: published performance data for "preferred" Armstrong components noted below, or as recommended by Project Acoustical Consultant.
   .3 Flame Spread Rating of 0-25 required for all Educational Facilities.

.2 Environmental
   .1 Source
      .1 ISO 1400 Series Certified.
   .2 Life Cycle Costing
      .1 25-year for suspension system.
      .2 High recyclable material content.
      .3 Maintenance.
         .1 Provide for the Owners future maintenance 5% of the tile used, original unopened packaging. The requirement for extra materials is reduced to 2% if the standard materials are utilized.

.3 Disposal
   .1 Recyclable.

2.3 Prescriptive Requirements

.1 Materials

   .1 Products should generally be imperial (2x2 or 2x4)

.2 Components

   .1 The following preferred standard panel products are used and stocked for maintenance at SFU; if used, the requirement for extra materials will be reduced:
      .1 Imperial 2x2
      .2 Imperial 2x4

   .2 For other systems proposed, criteria for selection: ease of accessibility, durability, high light reflectance, environmental responsibility, recommended for use by Project Acoustical Consultant.

.3 Execution

   .1 Connect T-Bar to edge molding using pop rivets, matching color of suspension system, as set out for seismic restraint by ASTM Standards.

***END OF SECTION***
1.1 GENERAL

1.2 Description

.1 Wood Flooring and Related Accessories.
.2 Finishing of Wood Sports Floors.

1.3 Performance Standards

.1 NFCA National Floor Covering Association
   .1 Floor Covering Specification Manual

.2 Sports Floor Systems (Resilient Systems)
   .1 Performance criteria standards and requirements to be determined with Sports
     Associations and users for each particular sport, and specialist sports floor system
     manufacturers.

1.4 Quality Control and Assurance

.1 Submittals
   .1 Confirm with SFU that gym floor markings are to current regulations and meet
     requirements.

.2 Quality Assurance
   .1 Trade to have recognized specialized experience and have successfully completed 5
     similar wood floor and/or Sports Floor System installations, including sanding and
     finishing, for 5 preceding years minimum.

.3 Building Acclimation
   .1 Ensure wood flooring is given proper time for acclimation to the building
     environment.
   .2 Ensure building environment conditions are stable with acceptable temperature and
     humidity levels, together with operational HVAC system, before starting acclimation
     process.

2.1 MATERIALS

2.2 Performance Requirements

.1 General
   .1 Longest life finishes to be used. SFU recognizes that this will likely involve products
     with high VOC content. Ensure coordination in job scheduling. Sufficient ventilation to
     be provided, including to prevent absorption by other materials.

2.3 Prescriptive Requirements

.1 Components
   .1 New wood floors (other than Sport Floors) to be factory pre-finished, c/w acrylic
     impregnation of the wood cells to improve indentation and wear resistance, and finish
     coat of extra-hard mineral crystals suspended in multiple coats of ultra-violet cured
     urethane with stain injected throughout the wear layer, all to minimize maintenance.

.2 Finishes
   .1 Sports Floors
     .1 Sealer shall be 2 coats water based or moisture cured urethanes - Basic
       Coating Hydro line, Reichhold MC330 or equal.
     .2 Line marking paint to be compatible with sealer and top coat.
     .3 Top Coat shall be water based or moisture cured urethane - Basic Coat Street
       Shoe, Reichhold MC330 or equal.
.3 Execution
   .1 Refinishing of Sports Floors
      .1 Sand off existing floor finishes with 16 or 24 grit paper.
      .2 Second Cut shall use 36 grit paper, if old finish is still present.
      .3 Follow rough sanding with 60 grit paper.
      .4 Skim fill entire floor with latex wood sealer.
      .5 Final sand with 100 grit paper.
      .6 Vacuum floor prior to first coat of finish.

***END OF SECTION***
1.1 **GENERAL**

1.2 **Co-ordination Requirements**
   
   .1 Coordinate with SFU Facilities.

1.3 **Description**
   
   .1 Resilient Flooring and Bases, typically used for wetlabs.

1.4 **Performance Standards**
   
   .1 National Floor Covering Association of Canada (NFCA) - Floor Covering Reference Manual.
   
   .2 Applicable product Standards including CSA, CGSB and ASTM.

1.5 **Quality Control and Assurance**
   
   .1 Submittals
      
      .1 Before Start of Work
         
         .1 List of each proposed materials for review, and color samples for selection plus for final approval.
         
         .2 MSDS Material Data Sheets for review and posting at jobsite.
         
         .3 Manufacturer requirements for bond and moisture tests, and reports of test results to indicate substrate conformance.
      
      .2 At Completion
         
         .1 Maintenance data shall be an itemized list c/w manufacturer/distributor name, product type and color.
         
         .2 Maintenance material shall be a minimum 5% of each product/color used (no cuttings), 2% if the standard materials listed below are utilized.
         
         .3 Include sufficient adhesive in unopened containers. Package and label, including Project Name and Number, and hand over to SFU Facilities.
         
         .4 Maintenance Manual shall be manufacturers’ recommended maintenance procedures and products.
   
   .2 Quality Assurance
      
      .1 For sheet material, installer to be a certified manufacturer-trained "Master Mechanic" (or similar term), completely familiar with the products, seam welding, and the manufacturer currently recommended methods and conditions of installation. Submit certificate of qualification. Similarly for other resilient flooring installers, when available.
      
      .2 Adhesives and auxiliary products to be as recommended in writing by each resilient flooring manufacturer.
   
   .3 Quality Control
      
      .1 Manufacturer preference shall be a registered ISO 9001 quality system.
      
      .2 The manufacturer’s representative shall inspect the work when required during the contract, and at completion prior to submitting the manufacturer's warranty.
      
      .3 Install resilient flooring only when moisture emission from concrete substrate is at or below the maximum permissible level of 3 lbs. of water per 1000 sq.ft, based on qualitative tests using calcium chloride test kits developed by the Resilient Flooring Institute, and to manufacturer's requirements.
.4 Warranties
   .1 In addition to a 2-Year subcontractor warranty, submit a 5-Year manufacturer limited warranty for sheet flooring work.

.5 Commissioning
   .1 Provide xx hours of instruction time to SFU Facilities on recommended maintenance procedures and products, by manufacturer representative in presence of trade contractor.

.6 Maintenance
   .1 Refer to Section 01 77 00 Closeout Procedures.

2.1 MATERIALS

2.2 Performance Requirements

   .1 General
      .1 Products to conform and perform to Manufacturer published literature.

   .2 Environmental
      .1 Source
         .1 Manufacturer preference for registered ISO 14001 Environmental Management System.

      .2 Manufacture
         .1 Select materials of lowest VOC content, including adhesives which preferably should be water-based.
         .2 Select products with highest natural material content: Use linoleum as much as is practical, as the preferred product.
         .3 Consider the use of linoleum which is produced from natural renewable ingredients.

      .3 Maintenance
         .1 Suggest cleaning agents of least impact on environment.

   .2 Disposal
      .1 Products containing PVC: do “NOT” incinerate.
      .2 Dispose for recycling wherever possible.

2.3 Prescriptive Requirements

   .1 General
      .1 All flooring types must have cleaning and maintenance requirements reviewed and approved by SFU Facilities prior to selection/ approval of floor types.

   .2 Rubber Flooring
      .1 Rubber flooring is preferred for public areas.
      .2 Rubber flooring is preferred in classrooms and theatres.

   .3 Sheet Vinyl
      .1 Use in areas of lower traffic and for labs.
      .2 Use non-slip vinyl with abrasive strip embedded for janitor rooms.

   .4 Epoxy Flooring
      .1 Use in washrooms.
      .2 Wet areas (as option to ceramic or similar tile), food service areas, and laboratories.
3.1 **OTHER**

.1 Cleaning
   .1 Refer Section 01 77 00 Closeout Procedures.

.2 Turn-Over Procedures
   .1 Contractors will conduct construction clean (dust, debris, etc.) prior to handover.
   .2 Upon handover and before occupancy, SFU Project Manager will initiate SFU Facilities ‘trade assist’ for a final clean prior to occupancy.

***END OF SECTION***
1.1 GENERAL

1.2 Related SFU Technical Requirements

1.3 Description

.1 Waterproof membrane flooring and base to be applied at all Mechanical Rooms (see 2.1.1.2), Penthouses, and similar locations where leaks in building systems may occur and cause water damage, such as to floors below. Fluid applied flooring may be applied in washrooms, pool changerooms, wetlabs, and kitchens as well.

.2 Waterproof traffic topping as corrosion protection for all concrete parking slabs. Chosen system to have been specifically designed for this purpose.

1.4 Quality Control and Assurance

.1 Submittals
   .1 MSDS data sheets; installation instructions.
   .2 Sample, to include base upturn; color samples for selection.
   .3 Maintenance data and instructions.

.2 Quality Assurance
   .1 Manufacturer licensed applicator.

.3 Quality Control
   .1 Strictly conform to Manufacturer written instructions, including preparation of substrates.

2.1 MATERIALS

2.2 Performance Requirements

.1 Membrane Flooring
   .1 Urethane elastomeric solvent-free liquid-applied seamless waterproof flexible flooring, extended up to a suitable uniform height. System typically consists of a primer, primary coating, and colored top coat. Min. 40 mil dry thickness is preferred.

.2 Traffic Topping
   .1 A waterproof traffic coating consisting of a flexible, liquid applied, elastomeric membrane topped with a liquid applied polyurethane wearing course containing hard aggregates and a urethane topcoat.

   .2 The system to be totally water-proof, flexible and thermally compatible with the concrete substrate under applicable service conditions.

   .3 Finished surfaces to be skid resistant, wet or dry.

2.3 Environmental

.1 Life Cycle Costing
   .1 25-Year.

***END OF SECTION***
1.1 **GENERAL**

1.2 Related SFU Technical Requirements

1.2.1 Section 01 77 00 Closeout Procedures

1.2.1 Section 09 00 10 Finishes – General Requirements

1.3 Description

1.3.1 Carpet Tile, (preferred), Direct Glue-Down Carpet, and Carpet Accessories.

1.4 Performance Standards

1.4.1 British Columbia Building Code.

1.4.2 NFCA National Floor Covering Association Floor Covering.

1.4.3 CAN/CGSB-4.129: Carpet for Commercial Use.

1.4.4 CAN/CGSB-4.155: Flammability of Soft Floor Coverings.

1.4.5 CGSB 4-GP-156: Direct Glue-Down Carpet, Guide to Selection and Installation.

1.4.6 CAN/ULC-S102.2: Standard Method of Test for Surface Burning.

1.4.7 WorkSafeBC Workers Compensation Board, Industrial Health and Safety Regulations.

1.4.8 WHMIS Workplace Hazardous Materials Information System.

1.5 Quality Control and Assurance

1.5.1 Submittals

1.5.1.1 Before Start of Work

1.5.1.1.1 Manufacturer's product data verifying compliance with specification requirements for carpet types and accessories specified.

1.5.1.1.2 Manufacturer's full range (large set) of carpet colors and patterns available for carpet types meeting specification requirements for review and selection.

1.5.1.1.3 Two 400 mm (16") square samples of each type and of each color of carpet to be used. For carpet with pattern repeat, submit a minimum of three repeats of the pattern.

1.5.1.1.4 Manufacturer's product data and material / color range of carpet accessories for review and selection.

1.5.1.1.5 Seaming Plan for all areas clearly indicating materials, patterns / colors, pile direction, joint (seam) locations (i.e. locations of length and cross seams and open edges) and other details including type and finish / color of trims and moldings used, required to clarify the work for review before commencing installation. Cross seams shall be avoided and will only be permitted where made unavoidable by carpet width or roll length. Avoid seams at doors and pivot points.

1.5.1.1.6 Certificate from carpet manufacturer stating that each roll of carpet furnished has been manufactured in accordance with specification requirements along with roll registration numbers.

1.5.1.2 At Project Completion

1.5.1.2.1 Manufacturer's maintenance data and cleaning instructions for each type of carpet installed.

1.5.1.2.2 Two percent (2%) of total carpeted area from same production run of each type,
color and/or pattern of carpet installed, in full roll width x length as required, and sufficient adhesive to install this carpet, in unopened containers.

.3 In addition to the above, turn over to the SFU Facilities all carpet pieces remaining at job completion. No carpet scraps shall be removed from the site without the SFU Facilities written approval.

.2 Quality Assurance
   .1 Conform to NFCA Specification Standards Manual requirements for all products and installation, and all manufacturers’ written instructions.

.3 Quality Control
   .1 Conduct hygrometer moisture tests on concrete shall not to exceed 65% per CCI Manual, or stricter manufacturer requirements.
   .2 Test new and suspect concrete floors for alkalinity and neutralize in accordance with NFCA/CCI recommendations. Carpet manufacturer’s representative to review carpet seaming and installation to ensure conformance with guarantee requirements and submit a written report to the Consultant and SFU Facilities.

2.1 MATERIALS

2.2 General Requirements
   .1 Preference is not to have carpet installed in public areas.
   .2 Carpet tiles should be used whenever possible.
   .3 Products with quick lead times should be specified.

2.3 Performance Requirements
   .1 Minimum Performance

     .1 Soil and stain protection shall be an integral life long stain proofing, i.e., inherent in or bonded to nylon fiber. Topical treatments are not acceptable.
     .2 Stain resistance (STR) shall be a minimum level of 8 in high traffic areas and 6 in low traffic areas based on AATCC 138 test for 5 washings to simulate removal of topical treatments by hot water extraction followed by AATCC 175 test.
     .3 Soil resistance (SR) with an average of 3 fluorine analyses to CRI TM-102, of a single composite sample shall be a minimum of 500 ppm fluorine by weight and a minimum of 400 ppm fluorine by weight after 2 AATCC 171 (Hot Water Extraction) cleanings.
     .4 Static control shall be a permanent anti-static filament, and without chemical treatment, with maximum static generation below 3.0 kV after hot water extraction under standard conditions of 21º C and 20% relative humidity.
     .5 Anti-microbial protection shall be permanent (not topical) treatment to prevent bacteria, fungi and bacteria growth lasting life of carpet.
     .6 Indoor air quality shall be to minimum Canadian Carpet Institute Indoor Air
Quality standards, with maximum 0.5 mg/cm²·hr total VOC emission in accordance with ASTM D5116-90.

.7 Flammability CAN/ULC-S102.2 shall be Flame Spread Rating of 300; Smoke Developed Classification of 500.

.8 Radiant panel test shall be class I (0.45 watts/m² or greater).

.9 Pill test shall pass.

.2 Environmental

.1 Carpet to be 14001 certified or equal, for recycled content or recyclables.

.2 Source

.1 ISO 9002 quality audit certified.

.3 Performance

.1 Indoor Air Quality

.1 All carpet is to comply with the requirements of The Carpet and Rug Institute’s Indoor Air Quality Program, as described in “Carpet Testing Program Procedures - Overview” and “The Carpet and Rug Institute Indoor Air Quality Carpet Testing Program.” Each product to hold an eight-digit identification number assigned to it by this program. PCH4 emitting carpets must be identified in submission with test data.

.4 Disposal

.1 Recycle-Ability of Carpet

.1 Carpet face must be 100% recyclable.

.2 Submit manufacturer’s recycling program with for each product.

.3 Provide percentage of recycled content contained in each product by color and recycle-ability of each product.

2.4 Prescriptive Requirements

.1 Carpet coloration shall be mottled, multi-colored, feathered look; preferably dark colour with lighter accent colours or mid to dark colours. Luster shall be dull.

.2 Carpet coloration must hide dirt and demonstrate to minimal maintenance and cleaning.

.3 Components

.1 General

.1 Carpet tiles are preferred for their ease of installation, their ease of changeability, and their comparable price to broadloom.

.2 Carpet provided shall be first quality commercial grade carpet for heavy traffic usage as manufactured by a nationally recognized manufacturer.

.2 Yarn

.1 100% first quality, type 6/6 or 6 bulk continuous filament (BCF) nylon.

.3 Carpet construction shall meet the following minimum requirements:

.1 Construction shall be level loop or textured level loop.

.2 Dye Method:

.1 Solution dyed or other method providing permanent stain resistance (i.e., inherent in or bonded to nylon fiber) with low luster colour(s).

.3 Plies shall be a minimum of 3.

.4 Pile height shall be 5.0 mm (0.197”) maximum; 4.0 mm (0.144”) minimum.

.5 Tuft Bind shall be a minimum 12 pounds, wet or dry.
.6 Gauge shall be minimum 39.4 col/10 cm (1/10") or better (a looser gauge may be allowed if Kilotex rating is sufficiently high).

.7 Stitch count shall be a minimum 40 / 10 cm (10 per inch).

.8 Yarn face weight shall be a minimum 950 gm/m2 (28 oz/sq.yd), or better (a lesser weight may be allowed with a Type 2 or 3 backing system).

.9 Pile density factor (ASTM D418) shall be a minimum 12 Kilotex/cm2.

.4 Adhesives

.1 Premium grade, low VOC (solvent-free), waterproof type for direct glue down carpet application as recommended by carpet manufacturer for backing system and substrate / grade level and usage conditions, complete with guarantee against adhesive bond failure. Spread rates stipulated by the manufacturer to be strictly adhered to.

3.1 OTHER

.1 Turn-Over Procedures

.1 Contractor to ensure that glued carpets are protected against damage from rolling loads for 48 hours after installation and protected by covering with plywood or hardboard where rolling traffic will occur (i.e. moving of equipment, etc.).

.2 Contractor to ensure that carpet is protected from traffic damage with suitable covering (un-dyed untreated paper) until floor has been turned over and accepted by SFU Facilities. Typically also provide two large sections of surplus carpet cuttings and place at entry doors so that they can be used as doormats by other trade personnel entering the carpeted area.

***END OF SECTION***
1.0 **GENERAL**

1.1 Related SFU Technical Requirements

.1 *Division 09 Finishes*

2.0 **MATERIALS AND DESIGN REQUIREMENTS**

2.1 Generally, access floors are discouraged, but will be reviewed on a project by project basis in coordination with SFU Facilities.

2.2 Consider access flooring for ease of renovations, particularly where ease of access and changes to services is required, and for re-use.

2.3 Include also the engineering and anchoring of all posts.

***END OF SECTION***
1.1 GENERAL

1.2 Related SFU Technical Requirements

.1 Section 09 00 10 Finishes – General Requirements
.2 Section 27 05 00 Common Work Results
.3 Section 27 11 00 Telecommunications Room Fittings

1.3 Co-ordination Requirements

.1 Coordinate with Consultants - Structural, Mechanical, Electrical and/or Landscape.
.2 Coordinate with SFU Facilities and SFU Project Manager
.3 Coordinate with the Architect
.4 For Mechanical Room Floor Coatings, refer to Section 09 67 00 Fluid Applied Flooring.
.5 SFU IT Services

1.4 Description

.1 Exterior and Interior Painting.

1.5 Performance Standards

.1 Master Painters Institute (MPI) published Manuals as follows:
   .2 Existing surfaces shall use MPI Maintenance Repainting Manual.

1.6 Quality Control and Assurance

.1 Submittals
   .1 Before Start of Work
      .1 List of all proposed paint materials for review; color samples for selection; color
         samples for final approval.
      .2 MSDS Material Data Sheets for review and posting at jobsite.
      .3 Certification reports for Eco-Logo and VOC content.
   .2 During Work
      .1 Use MPI Accredited Assurance Association (A.Q.A.) inspector reports, or
         preferably MPI inspector.
      .2 Manufacturer Inspectors' reports when required.
   .3 At Completion
      .1 Maintenance data: itemized list c/w manufacturer/distributor name, paint type,
         color formulation.
      .2 Maintenance material shall be minimum four (4) unopened 1 liter cans of each
         product/color, labeled including Project Name and Number, to be handed over
         to SFU Facilities at Project site, for storage within the Project site (i.e.
         designated Janitor Room).

.2 Quality Assurance

.1 Trade Contractor shall be a member of master painters and decorators association

.2 Follow MPI Quality Assurance Program including the MPDA Inspection and
   Guarantee Program.
3.3 Quality Control
   1. All work to be inspected by an MPI approved/appointed Inspection Agency, acceptable to the Consultant and the MPI Accredited Assurance Association (A.Q.A.), and paid by the Trade Contractor; MPI Inspection to be carried out irrespective of type of Guarantee.

   2. When "special" non-MPI products or systems are to be used, the manufacturer to also carry out inspections and certify the work, following the same procedures as set out in the MPI Manual, and paid by the Trade Contractor.

   3. Inspection to include inspection of surfaces prior to start of work, moisture tests, preparation for painting, primer, completed work, and during and at end of Warranty including expediting correction of defects.

4. Warranties
   1. 2-Year MPI Accredited Quality Assurance Association's 2-year guarantee, or a 100% 2-Year maintenance bond issued by a surety licensed in British Columbia warranting also that painting work has been performed to MPI Manual requirements. The A.Q.A. association's guarantee shall NOT exclude any of the work carried out under this section.

2.1 MATERIALS

2.2 Performance Requirements
   1. General
      1. Use products that are listed in MPI Manual Current Approved Product List.
      2. Material such as linseed oil, shellac, turpentine, etc. not specifically listed by brand name shall use highest quality product.
      3. All products for each paint system applied shall be from same manufacturer for compatibility.
      4. Primers on steelwork shall provide MPI approved primers suitable for paint systems noted, and suitable for subsequent work carried out by this Section. Coordinate with Section 05 00 00 Metals and Section 05 50 00 Metal Fabrications.
      5. All paint systems shall be MPI "premium grade" except as noted.
      6. Whiteboard paint must not be used on campus as it is toxic and is against SFU's sustainability policies.

   2. Environmental
      1. Source
         1. Preference shall be ISO 9001 2008 registered manufacturers.
            http://www.praxiom.com/iso-9001.htm
      2. Manufacture
         1. Select lowest range VOC products from each MPI product category number listed in the MPI Manual current approved product list, preferably "Three-Tree" and Eco-Logo certified.
      3. Performance
         1. Durability
            1. Minimize tinting to maintain durability.
      2. Life Cycle Costing
.1 Exterior expectancy shall be minimum 8 years using standard coatings. Expectancy for High Performance Coatings shall be a minimum 15 years, and whenever possible financially, contractors are to use high performance coatings. Approximately 60-year for silicate-based paints, especially on cementitious-finished heritage buildings.

.2 Interior expectancy is 5-10 years.

.3 Disposal
   .1 Refer Section 01 74 19 Construction Waste Management and Disposal.

2.3 Prescriptive Requirements

.1 Materials
   .1 Use MPI approved products except where noted.
   .2 Use paint with reduced volatile and preservative content formulated for minimum VOC emissions, especially where rooms are continuously occupied.
   .3 Paint shall not contain mercury, lead, hexavalent chromium, or cadmium compounds.
   .4 Use alkyd paints only at high impact areas, or with special approval. (See note .6 next).
   .5 Do not use water-soluble paints for handrails, or door frames where hand oils could cause paint breakdown.
   .6 Preference should be given to alkyd paints in renovation work and for painting handrails, doors, door frames and window frames because of durability and life cycle cost. Being more durable, less VOC’s are released over time than water based paints which must be renewed more often. Do not use water based paints on handrails etc. where hand oils will break down the paint.
   .7 Mechanical, Electrical, and similar Service Rooms or enclosed spaces, and concealed spaces: Services in these area, including equipment, piping, pipe insulation, coils, ductwork, conduit, electrical and control panels, access panels, etc. are NOT to be painted, except for pre-finishing carried out by manufacturers and any make-good work.
   .8 For Mechanical Room floors over occupied spaces see Section 09 67 00 Fluid Applied Flooring.

.2 Paint Systems, Components, Sheen, and Use

.1 Exterior New Work
   .1 EXT 5.1B / Inorganic Zinc Primer + High Performance Acrylic / Gloss / Exposed Structural Steel.
   .2 EXT 5.1D / Alkyd / Gloss / Miscellaneous Metal including railings, guardrails, bollards.
   .3 EXT 5.1G / Zinc Rich Primer + 2-Component Aliphatic Polyurethane / shop finished exposed structural steel; detailing of steelwork carefully coordinated to minimize fieldwork touch-up.
   .4 EXT 5.3B / Alkyd / Gloss / galvanised hollow metal doors and pressed steel
frames; roof-top ducting, vents and piping, exterior galvanized metal generally.

.5 Strong consideration should be given to using Potassium Silicate-based paints on cementitious surfaces. Contact the Architect, Technical Services; phone: 604-822-9510. Silicate-based paints must be completely unaffected by UV, static dirt-repelling, completely breathable, inorganic/sustainable, must bond chemically with the cementitious substrate and have a life-expectancy of more than 60 years.

.2 Exterior Renovation Work

.1 REX 5.1K or L / Water Based Light Industrial Coating / semi-gloss / painted doors and frames.

.2 Strong consideration should be given to using Potassium Silicate-based paints on cementitious surfaces. Contact the Architect, Technical Services; phone: 604-822-9510. Silicate-based paints must be completely unaffected by UV, static dirt-repelling, completely breathable, inorganic/sustainable, must bond chemically with the cementitious substrate and have a life-expectancy of more than 60 years.

.3 Interior New Work

.1 INT 3.1A / Latex / Custom / Eggshell / Mechanical, Electrical Rooms, and Service Rooms.

.2 INT 3.1C / High Performance Acrylic / Eggshell / typical concrete surfaces.

.3 INT 3.1D / Alkyd / semi-gloss / concrete in washroom, janitor, and similar rooms.

.4 INT 3.2H / Latex Zone & Traffic Markings / nosing at stairs, conforming to BC Building Code for the visually impaired; other safety markings required by BC Building Code, authorities having jurisdiction, Worksafe.

.5 INT 4.2A / Latex / Custom / Eggshell / Mechanical, Electrical rooms, and service rooms.

.6 INT 4.2K / High Performance Acrylic / Eggshell / typical concrete block surfaces.

.7 INT 4.2C / Alkyd / semi-gloss / concrete block in washroom, janitor and similar rooms.

.8 INT 5.1B / High Performance Acrylic / Gloss / Structural Steel.

.9 INT 5.1E / Alkyd / Gloss / Metal Fabrications at contact surfaces such as stairs, railings, trench gratings, trench covers and frames, access doors/panels, elevator doors and frames.

.10 INT 5.3C / Alkyd / Gloss / galvanized hollow metal doors, door and window frames; galvanized metal fabrications.

.11 INT 5.3F / Alkyd Dryfall / flat / steel deck.

.12 INT 6.4C / Alkyd / Gloss / wood trim.

.13 INT 9.2A / Latex / Custom Grade / Eggshell / gypsum board in Mechanical, Electrical Rooms, and service rooms.


.15 INT 9.2C / Alkyd / semi-gloss / gypsum board in washroom, janitor and similar rooms.
.4 Interior Renovation Work

.1 RIN 5.3B / Water Based Light Industrial Coating / semi-gloss / painted hollow metal doors and pressed steel frames.

.2 RIN 6.3P / Water Based Light Industrial Coating / semi-gloss / painted wood doors and frames.

.3 Colour Finishes

.1 Exterior New Work

.1 The colors should preferably adhere to SFU colours.

.2 Suggested interior corridor colours are as shown in a silver General Paints booklet titled “Neutral Colours”.

.4 Metal Fabrications at or near ground level.

.1 GP-3979A is mandatory for all exterior metal fabrications on campus, such as handrails, stairs, railings, and light standards and other similar fittings and components on the Site. General Paint has no problem mixing this color's older ref. number when specified:

.5 Electrical panels, fire hose cabinets, access panels: match color of adjoining surfaces except as otherwise required by Building and/or Fire Codes.

.6 Fabrication

.1 Conform to MPI Manuals.

2.4 Execution

.1 Conform to MPI Manuals, including preparation for work of this Section.

.2 Contract MPI inspectors for quality control.

.3 Allow each coat to dry before applying the next coat, sanding between coats.

.4 Any resultant damage or results emanating from preparation for painting, including pressure washing and similar procedures, are the responsibility of the Contractor.

3.1 OTHER

.1 Cleaning

.1 Remove paint spots from both existing and new surfaces regardless of who caused them.

.2 Communications cables must not be painted. They must be masked and protected from paint overspray or direct painting.

.3 Wall-mounted plywood back-boards inside all Communications Rooms must be painted. See Section 27 05 00 Common Work Results and Section 27 11 00 Telecommunications Room Fittings.

***END OF SECTION***
1.1 **GENERAL**

1.2 Related SFU Technical Requirements

.1 Division 27 Sections 27 41 16 AV Systems
.2 Division 27 41 16.1 AV Cable Labeling
.3 Division 27 Section 27 05 05 Communication Rooms Design Guidelines.

1.3 Coordination Requirements

.1 SFU Facilities
.2 Acoustic Consultant.
.3 SFU IT Services

1.4 Reference Standards:

.1 American Association of College Facilities Management.

1.5 Classrooms

.1 Demonstrate adaptability to technology changes.
.2 Refer to Audio Visual Services, SFU IT, for sound, video and control systems guidelines.
.3 Acoustic Consultant to be SFU approved.
.4 Demonstrate active acoustic strategy.
.5 Demonstrate passive acoustic strategy.

1.6 Washrooms

.1 “Airport style” washroom design without the use of doors is preferable and promotes the use of hand dryers over paper towels.
.2 Hardwiring is required in washrooms for hand dryers.
.3 Preferred hand dryers are Dyson Airblades AB14
.4 For floor drains, see Division 22 Section 22 05 00 Plumbing - General Requirements.
.5 For plumbing fixtures, see Division 22 Section 22 40 00 Plumbing Fixtures.

1.7 Electrical Rooms

.1 The preferred location for Electrical Rooms is on North or East exterior building wall (for cooling).

1.8 Communications Rooms

.1 A Communications Room is a service room designed to safely house telecommunications equipment. It is also used to mount and terminate voice, data, RF, and when approved by SFU IT Services – security cables security cables and their associated terminating and distribution systems.

.2 Communications room construction shall meet all applicable building, fire, electrical and safety codes and regulations as stated by SFU. Hub Rooms shall be constructed to meet a 1 hour fire separation. A smoke detector, connected to the fire alarm system, shall be installed in all communications rooms.
Each campus building will contain a Main Communications Room and possibly many Local Communications Rooms. The Main Communications Room may be used as a floor serving facility in addition to a Local Communications Room serving facility. No other building systems are to be installed in the Main Communications Room.

Local Communications Rooms or Closets are used as a floor serving facility for mounting and terminating approved communications cabling and hardware only. No other building systems are to be installed in the Local Communications Room.

Details of communications systems function and installation are handled by Division 27.

False ceilings are not permitted in communication rooms.

Communications Rooms and Closets have special requirements addressed in Division 27 of the Technical Guidelines, particularly Section 27 11 00 Telecommunications Room Fittings. They shall only contain approved equipment and systems as indicated in Division 27.

All Communications Rooms shall be designed and located in the building so that direct access is from a common or non-secure area. Communications Rooms are not to be located behind other rooms that might have specialized or secure locks installed; for example, a custodial room.

AV and Equipment Rooms

AV rooms used as theatre projection rooms have special requirements and SFU Facilities shall be consulted in these situations.

Mechanical Rooms

Floor to be concrete with 2 coat elastic membrane that will block concrete cracks when built over occupied space. For Mechanical Room floors over occupied spaces see Section 09 67 00 Fluid Applied Flooring.

Showers

Shower stalls shall be white durable plastic tub/shower surround and substrate shall be cementitious board, mineral fiber board or masonry. Floors to have waterproof membrane and slope to drain. Shower stall to have 100mm curb, except in accessible shower stalls. Where possible make single stalls accessible.

Custodial Rooms

Custodial rooms required for every building and adhere to following:

- Custodial rooms should not be designed as shared space.
- Minimum one closet for every 1400 m² of floor or a minimum of one closet per floor.
- Slop sink: 3'-0" large on the floor, concrete or a durable fiberglass material with one temperature control tap, a faucet, and a hose connection.
- Walls: Locate the slop sink in the corner with ceramic tile (or other completely water repellent material) on both walls out at least a foot past the edges of the slop sink. The backer board behind the ceramic tile is Hardy plank.
.5 Flooring: Non slip vinyl with an abrasive strip embedded to prevent slipping.

.6 Shelving: A minimum of five wall mounted shelves for storage of janitorial material and enough space on the floor to store both a janitors mop pail, a cleaners cart with cleaning supplies and a large garbage can.

.7 Shelving: A minimum of five wall mounted shelves for storage of janitorial material and enough space on the floor to store both a janitors mop pail, a cleaners cart with cleaning supplies and a large garbage can.

.8 Lighting: Lighting should be energy efficient and auto on/off with controlled off door position indicator switch

.9 Electrical: Duplex outlets, no more than 6m apart are required in the corridors and the classrooms for vacuuming/floor washing machines. Do not put janitorial outlets on any circuits that are used for classrooms, A/V, or data.

.2 Existing Buildings

.1 Many existing buildings have janitor/service spaces where there are shared spaces – the space usages should be separated as much as possible when encountered through renovations.

1.13 Energy Efficient Lab Design

.1 Lab designs should strive to adapt technologies listed in SFU Energy Efficient Lab Design.

1.14 Biohazard Labs

.1 Please contact SFU Facilities for design detail guidelines and planning.

.2 For floor drains, see *Division 22 Section 22 05 00 Plumbing - General Requirements*.

1.15 Radioisotope Labs

.1 Please contact SFU Facilities for design detail guidelines and planning.

.2 For floor drains, see *Division 22 Section 22 05 00 Plumbing - General Requirements*.

1.16 Animal Care Facilities

.1 Design and construction is to be completed in accordance with the latest CCAC guidelines.

1.17 Kitchen and Lounges

.1 Provide space between the countertop and over counter cabinets to mount paper towel dispenser and soap dispenser.

***END OF SECTION***
1.1 **GENERAL**

1.2 **Related SFU Technical Requirements**

   .1 SFU Floor and Room Numbering Instructions (latest edition)
   .2 SFU Door numbering and Labeling Requirements (latest edition)

1.3 **Coordination Requirements**

   .1 Coordinate with SFU Facilities

1.4 **Authority and Approvals**

   The task of room numbering is **coordinated through Records Management**. No additions to or changes in building names, floor or room numbers, or signage changes in the sign standards may be completed without approval from Facilities Services.

1.5 **Intent**

   The These standards provide a consistent identification system for building floor levels and room identification. Standardizing floor and room identification is critical for the University's administrative systems, campus way finding systems and supports university wide space management.

   These standards apply to SFU Burnaby campus, and recognize the interconnectedness of the terraced buildings and the interrelated infrastructure on a sloped site.

1.6 **Methodology for Building Level Designation**

   .1 This methodology applies in stand alone, terraced or buildings that connect to other buildings;

   a) Stand Alone Building (See Figure 3.1.1.)

      • The lowest ground entry level is always designated as 1000 level, ascending by 1,000’s i.e. 1000 level, 2000 level, etc.

      • The first level below ground is B1 level, and floors below this descending by B1’s i.e. B1 level, B2 level, B3 level.

      • The parking Level below ground is P1 level, and floors below this descending by P1’s i.e. P1 level, P2 level, P3 level.

   b) Terraced building or Building that connect to other buildings

      • The most central academic core campus buildings are connected either by interior pedestrian walkways or bridges (see Appendix A - Floor Level Reference Guidelines).

      • Floor levels connecting to another building always lead to floors of the same designated level (See Figure 3.1.2).
c) Exceptions

- In service or maintenance buildings, parkades and open air or slab on grade structures, etc., the ground entry level is designated as 100 level, floor levels ascending by 100's, i.e. 100 level, 200 level etc.

See SFU Floor and Room Numbering Instructions Appendix B – Table 3.2.1 Reference Levels by Building Floors for existing buildings.

1.7 Methodology for Room Number Designation

1. This methodology applies to room numbering for all buildings:

- Room numbers are 4 digits. The first digit indicates the floor level.
- Start at the main entry, with odd numbers on the right, even numbers on the left.
- Along a corridor, odd and even numbers alternate across the corridor.
- Public corridors, utility rooms and other non-assignable public circulation spaces have 4 digit numbers.
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ROOM NUMBERING

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• Stairwells and elevators are designated with the prefix “S”, “E” followed by a one digit number and show the floor level (e.g. S2-1, E2, etc). Use the same one digit number for the entire shaft (all floors).

• Rooms within the main entry parent room (such as Lab support rooms except rooms within the general open space area or shared pathway) will be assigned decimal room number off the parent room, i.e. parent room, Room 1200, and interior room, Room 1200.1.

• Rooms within parkades are designated with the prefix “P” followed by two or three-digit numbers (e.g. P200). The uppermost parking level immediately below the 1000 (lowest grade entrance) building level, will be designated “P100” and progress downward to “P200” and “P300”.

• Wherever possible, stack the room numbers, so the numbers “telegraph” vertically with the floors immediately above and below it.

• Multi-story spaces: mezzanine spaces opening into an atrium space are numbered as a separate floor level, i.e. the lowest atrium floor level establishes the atrium number.

• If rooms are leased space, follow by the SFU Leasing agreement

• All numbering schemes must be assigned by Planning Support prior to final documents

<table>
<thead>
<tr>
<th>S1-2</th>
<th>Stair Shaft Numbers</th>
</tr>
</thead>
<tbody>
<tr>
<td>E1</td>
<td>Elevator Numbers</td>
</tr>
<tr>
<td>P200</td>
<td>Parking Level Numbers</td>
</tr>
<tr>
<td>B2000</td>
<td>Ground Below Level Numbers</td>
</tr>
<tr>
<td>2000</td>
<td>Public Corridor Numbers</td>
</tr>
<tr>
<td>2000</td>
<td>Room Numbers (Including Utility Rooms)</td>
</tr>
<tr>
<td>2000.0</td>
<td>Rooms Within a Suite of Room Numbers</td>
</tr>
</tbody>
</table>

.2 Room Numbering Designation for Renovation in Existing Building

• Become familiar with the building or buildings in question.

• In coordination with Records Management, determine whether the new room(s) can be coordinated with existing room numbers.

• The room number is “reserved” in Archibus space inventory for the renovated space.

.3 Floor and room designation in a building that is connected to other buildings:

• Review and become familiar with adjacent buildings connected to the new (or existing) building. Room numbers in the new building should be coordinated with the level designations at or near the same elevation.
• All floors in the adjacent building complex should ascend together, so that individuals moving from one side to another may leave the one and enter the other at the same level.

• When a new building is added to a complex of existing buildings, the floor numbering should coincide with the current floor numbers of the complex.

1.8 Methodology for Door Number Designation

.1 Door Numbering:
Door numbers are assigned by the project representative/consultant but must be derived from the SFU approved room number assignments and follow the standards illustrated in the examples below:

<table>
<thead>
<tr>
<th>Room ID</th>
<th>Door number example</th>
<th>Rule</th>
</tr>
</thead>
<tbody>
<tr>
<td>1001 (room with single door)</td>
<td>1001</td>
<td>Apply the room number</td>
</tr>
<tr>
<td>1001 (one entryway multiple doors and Vestibule)</td>
<td>1000A, 1000B, 1001A, 1001B, etc.</td>
<td>Add sequential letter alphabet after each room number or entrance number</td>
</tr>
<tr>
<td>1001.1 (suite of rooms with multiple doors)</td>
<td>1001.1A, 1001.2A, 1001.2B, etc.</td>
<td>Add letter suffix after each room number. Continue with next letter if the interior room has multiple doors</td>
</tr>
<tr>
<td>S1-1 (stair at ground level)</td>
<td>S1-1A, S1-1B, S1-1C, etc.</td>
<td>Add letter suffix after the stairwell level number. Continue with next letter if the interior room has multiple doors</td>
</tr>
</tbody>
</table>

1.9 Transition and Grandfathered Identification Systems

.1 During major renovations of existing buildings, every attempt must be made to realign the room and floor level numbering systems to follow the methodology outlined. Consult with SFU Records Management.

***END OF SECTION***
1.1 **GENERAL**

1.2 **SFU Sign Standards and Guidelines**

.1 For details on SFU interior signage standards, refer to *SFU Interior Wayfinding & Signage Standards (latest edition)*.

.2 For details on SFU exterior wayfinding and signage standards, refer to *SFU Burnaby Campus Exterior Wayfinding & Signage Project (latest edition)*.

.3 For details on SFU colours and branding, refer to the *SFU Colour Palette*, available at the following link [http://www.sfu.ca/communicators-toolkit/tools/brand-tools/colours.html](http://www.sfu.ca/communicators-toolkit/tools/brand-tools/colours.html)

.4 For further information or clarification, coordinate with SFU Facilities.

***END OF SECTION***
1.0 **GENERAL**

1.1 **Related SFU Technical Requirements**

.1 For floor drains, see *Section 22 05 00 Plumbing - General Requirements*
.2 For lighting controls of custodial rooms, see *Section 26 51 00 Interior Building Lighting*

1.2 **Co-ordination Requirements**

.1 Coordinate seismic restraint of equipment with Structural Engineer.
.2 Coordinate Roof Specialties with SFU Facilities.
.3 Coordinate Toilet Specialties with SFU Facilities.

1.3 **General Requirements**

.1 Provide materials and systems beneficial to use and occupancy, durability, and reuse during renovations.
.2 For renovation projects re-use existing equipment and specify equipment that can be re-used.
.3 For renovation projects existing equipment and materials to be turned over to SFU Facilities for re-use or parts - consult SFU Project Manager.
.4 Submittals

.1 Where Applicable Provide Shop Drawings
.1 Colour samples and maintenance instructions for Specialty products and assemblies and systems.
.2 For blinds submit one working sample of each blind (minimum 400 wide x 600 long).

1.5 **Quality Assurance**

.1 Where seismic restraints are required, and for the work noted below, the seismic restraint work including anchoring devices to be designed and certified by a Professional Engineer registered in BC, who is to also carry out periodic site reviews of the work of this Section during construction and at completion, and submit reports and Letters of Assurances in the Forms established by BCBC. Costs to be included in Contract.

2.0 **WALL PROTECTION AND CORNER GUARDS**

2.1 Shall be provided in high traffic corridors, and generally in areas subject to abuse. In corridors, consider wall protection to 3'-0" from finished floor.

2.2 Special consideration should be given building space usages such as food server and warehouse to ensure adequate wall protection and corner guards are provided
3.0 **DEMOUNTABLE PARTITIONS**

3.1 Consider demountable partitions when frequent changes (such as office areas) are expected.

3.2 Selection of system to also be based on long-term availability of components and finishes.

3.3 Carefully establish and coordinate electrical and communications requirements and components with SFU IT Services.

3.4 Include also the engineering and anchoring of all lateral bracing, which is to be independent of, or coordinated with, metal suspension systems for ceilings.

4.0 **WASHROOM MILLWORK**

4.1 Washroom Millwork shall be in accordance with Section 06 40 00 Architectural Woodwork.

5.0 **RECYCLING AND WASTE MANAGEMENT**

5.1 **Recycling and Waste Receptacles**

   .1 Multi-stream recycling stations shall be provided in accordance with SFU Facilities Services – Recycling Services guidance. Consult with SFU Facilities to confirm locations and selection of appropriate equipment.

5.2 **Space for Recycling and Waste Stations**

   .1 Interior space shall be allocated on floor plans for multi-stream recycling stations in accordance with SFU Facilities Services – Recycling Services guidance. Consult with SFU Facilities to confirm locations and to confirm locations and selection of appropriate equipment.

5.3 **Recycling and Waste Storage Room**

   .1 Secure, externally accessible, storage room, located near service entry to building that can accommodate short term storage of waste materials (e.g. garbage, recyclables, and confidential shredding material and special wastes). The minimum dimensions for the storage room are to be 22'-0" x 22'-0". Consult SFU Facilities to confirm storage specifications for recycling and waste.

***END OF SECTION***
1.1 GENERAL

1.2 Related SFU Technical Requirements

.1 Section 05 50 00 Metal Fabrications
.2 Section 10 28 00 Toilet, Bath, and Laundry Accessories

1.3 Description

.1 Toilet and Change Room Partitions, Urinal Vision Screens.

1.4 Performance Standards

.1 BC Building Code, including Building Access Handbook.
.2 CSA-B651-12 - Accessible Design for the Built Environment.

1.5 Quality Control and Assurance

.1 Submittals
   .1 Shop Drawings shall include complete backing/support requirements and engineering data.
   .2 Samples of hardware and fittings on request.
   .3 Color samples for selection.
   .4 Maintenance data shall include graffiti removal techniques.

.2 Warranty shall be a 10-Year limited manufacturer's warranty.

2.1 DESIGN REQUIREMENTS

2.2 General

.1 A structural engineer shall design the seismic restraint of all Toilet partitions.

.2 Washroom compartments may have floor or wall-mounted partitions.

.3 Add change tables should be to single occupant washrooms where space allows.

.4 Avoid steel walls; composite materials preferred.

.5 For restoration projects, re-use material whenever possible.

.6 Each compartment to be complete with the following hardware:
   .1 Combination coat hook/door bumper.
   .2 Combination stop/latch - with emergency lift feature.
   .3 Non-removable self-closing hinges - with emergency lift feature.
   .4 Door pulls for accessible compartments.
   .5 Seat at dressing cubicles.

.7 Install double toilet rolls all accessible washroom stalls.
2.3 Components

.1 Provide a continuous hardware option.

.2 Accessible compartments to be capable of being locked from the inside by a device that is operable with one hand, does not require fine finger control, tight grasping, pinching or twisting of the wrist and requires a force not more than 22 N to activate as per CAN/CSA-B651-M90.

2.4 Fabrication

.1 Edges are to be beveled and/or rounded.

2.5 Finishes

.1 All toilet partitions shall have durable institutional finishes that require minimal maintenance and are finished to hide abuse and markings.

***END OF SECTION***
1.1 **GENERAL**

1.2 **Related SFU Technical Requirements**

   .1 *Section 22 40 00 Plumbing Fixtures*
   
   .1 Technical details for “no touch” motion detector-activated plumbing fixtures and accessories including, faucets, urinals, water closets, towel and soap dispensers are covered under *Section 22 40 00*.

1.3 **Co-ordination Requirements**

   .1 Backing for Secure Mounting.
   .2 *Section 10 21 13 Toilet Compartments*.

1.4 **Description**

   .1 Washroom Accessories.

1.5 **Quality Control and Assurance**

   .1 **Submittals:**
   
   .1 Shop Drawings, samples for review when requested by SFU Facilities.

1.6 **Design Requirements**

   .1 **Materials**
   
   .1 The “generic” type dispenser allows SFU Facilities to source flexible pricing. The products used in these dispensers are of the large roll size and last much longer between roll changes thus reduces labour costs. The dispensers were tested through various trials prior to standardizing their use in all campus buildings. These newly designed dispensers are rapidly replacing the outdated “proprietorship” style dispensers.

   .2 **Components**
   
   .1 Kimberley Clarke Professional
   .1 Type: **09551 Twin Toilet Tissue Dispenser**
   .2 Colour: Black/Smoke
   .3 Unit Size: 20.43” x 13.12” x 5.8” (51.9 cm x 33.3 cm x 14.7 cm)
.2 Kimberley Clarke Professional

.1 Type: 09554 Single Toilet Tissue Dispenser

.2 Colour: Black/Smoke

.3 Unit Size: 10.9" x 10.8" x 5.5" (27.7 cm x 27.4 cm x 14.0 cm)

.3 There should be a 2" clearance behind the open cubicle door and the toilet tissue dispenser.

Single Toilet Roll Dispenser Standard Installation Instructions:

NOTES:

1). INSTALL THE DISPENSER 10" ON CENTRE FROM THE FRONT EDGE OF THE WATER CLOSET. THE BOTTOM OF THE DISPENSER IS TO BE LOCATED 2'–3" ABOVE THE FINISHED FLOOR LEVEL.

2). MAINTAIN A MINIMUM 2" – 3" CLEAR SPACE BETWEEN THE EDGE OF THE DISPENSER AND THE SIDE GRAB BAR.

3). TOILET PAPER DISPENSER: SCOTT PAPER, DESIGNER BRAND 09622, JUMBO BATH TISSUE JR. DISPENSER

NOVEMBER 2004
.4 Soap Dispensers
   .1 Distributor: Weber Supplies
   .2 Dispensing system using a refillable soap bag with front button operated valve.
      .1 Phoenix Eco Foam Soap
      .2 Dispenser type: Neptune Manual 1000ml
      .3 Product refill 1000ml refill bags. Product #70300.
   .3 Color for body shall be white; valve push plate grey.

.5 Sanitary Napkin Dispensers
   .1 Frost Products Limited.
   .2 Double Combo, Frost ref. #608-1 in white epoxy, or # 608-3 in stainless steel.
   .3 Mechanism shall be 25 cent.

.6 Sanitary Napkin Disposal Bins
   .1 Frost Products Ltd.
   .2 Reference part # 622.
   .3 Color shall be brushed stainless steel.
   .4 Note: In Accessible Washrooms and Toilet Compartments, install within reach of toilet seat and located so as to maintain toilet compartment and grab bar clearances required by Code.

.7 Grab Bars
   .1 As a minimum: installed as per BCBC; 30 - 40 mm in diameter; 40 mm clear of wall; tamper-proof fasteners; non-slip gripping surface.

.8 Garbage Containers
   .1 Rubbermaid Marshall Classic Container # 8170-88 (black), 18’ x 42” high, 23lb./10.4Kg. No wall-mounted and no in-wall garbage containers allowed.

.9 Hand Dryers
   .1 Where hand dryers are being considered for use the SFU preferred model is Dyson Airblade AB14.

1.7 Handover/ Turn-Over Procedures
   .1 Final cleaning inspection to be conducted by SFU Facilities prior to final completion or owner occupancy.

***END OF SECTION***
1.1 **GENERAL**

1.2 **Co-ordination Requirements**
   
   .1 Coordinate specific project requirements with the Burnaby Fire Department on a per project basis.

1.3 **Description**
   
   .1 Fire Extinguishers, Cabinets, Accessories and their installation.

1.4 **Performance Standards**
   
   .1 BC Fire Code, NFPA #10.

1.5 **Design Requirements**
   
   .1 Materials
      
      .1 Acceptable Fire Extinguisher Types
      
      .1 All new extinguishers to be made available to the Burnaby Fire Department for bar coding and applying a SFU Security number onto the extinguisher.
      
      .2 Dry Chemical - Ansul Cartridge operated only - ABC or BC rating (typical).
      
      .3 CO2 - as per B.C. Fire Code Regulations.

   .2 Execution
      
      .1 Fire extinguishers to be installed in locations, recesses, or cabinets so that they do not project more than 100 mm horizontally into exit passageways, public corridors, corridors used by the public or corridors serving classrooms or patient's sleeping rooms, and in a manner not to create a hazard for visually impaired persons traveling.
      
      .2 Where fire extinguishers are installed in cabinets they are to be provided with a sign acceptable to the Burnaby Fire Department.
      
      .3 Where fire extinguishers are installed on walls they are to be installed on SFU Standard backing boards.

***END OF SECTION***
1.1 **GENERAL**

1.2 **Related SFU Technical Requirements**

   1. Section 12 35 53 Laboratory Casework
   2. Section 23 38 16 Fume Hood Exhaust Systems
   3. Section 20 00 08 Mechanical Identification for the details for fume hood labelling requirements.

1.3 **Co-ordination Requirements**

   1. Design development guidance will be provided by SFU Facilities and SFU EHS to the Consultant defining in detail the laboratory function, requirements, and systems to be provided.
   2. Review design intent and additional requirements with SFU Safety & Risk Services.
   3. The selection of fume hoods and biological safety cabinets is to be made in consultation with SFU Facilities and principal researcher to ensure that the scientific, safety and engineering concerns are properly addressed.
   4. Operable windows are not to be installed in labs in order to allow negative pressures to be maintained relative to adjacent spaces and to prevent draft conditions.

1.4 **Description**

   1. Factory-manufactured fume hoods and biological safety cabinets designated for biohazard containment levels:
      1. Containment Level 1
      2. Containment Level 2
      3. Containment Level 3
      4. Containment Level 4
   2. All equipment must be CSA and/or ULC certified for use in Canada.

2.1 **MATERIAL AND DESIGN REQUIREMENTS**

2.2 **Design Requirements**


2.3 **Certification and Commissioning Requirements**

   1. Fume hood installations must be certified by a professional engineer. To certify the installation of a laboratory fume hood, a professional engineer is required to conduct an assessment of OHS Regulation requirements related to the installation of the fume hood, duct work, exhaust system, lab requirements, make-up and air balance requirements.
.2 Following installation of the fume hood and before it is used, the installation must be fully tested to confirm all air flow requirements are met, including face velocity, containment, balancing and makeup air. Face velocity requirements are as per current WorkSafeBC / OHS requirements.

.3 It must be demonstrated to the SFU Project Manager, and SFU Safety and Risk Management Services that the fume hoods have been designed and installed to meet all requirements of the SFU Technical Requirements.

2.4 Performance Standards

.1 Fume hoods shall conform to the following function-specific requirements, including as applicable:

.1 Laboratory Bio-Safety Guidelines, (latest revision), published Public Health Agency of Canada.

.2 Containment Standards for Veterinary Facilities, Canadian Food Inspection Agency, Publication 1921/E.

.3 Canadian Nuclear Safety Commission Standard R-52, Design Guidelines for Basic and Intermediate Level Radioisotope Laboratories.

.4 NSF (National Science Facilities) standards: for all biosafety cabinets; fully reticulating HEPA filters typical.

.5 CSA: including requirement for flow sensors.

.6 WCB: including requirement for outside controls.

.7 SFU Safety and Risk Services to determine additional regulatory and construction standards.

.8 Biological Safety Cabinets to conform to CSA Z 316.3 Biological Containment Cabinets (Class I and II). Installation and Field Testing shall meet the requirements of NSF 49.

.9 Performance.

.1 Life Cycle Costing is to be calculated based on a 15 year life.

2.5 General Requirements

.1 Set the fume hood sash at 15" (375 mm).

.2 The correct operating height of the sash must be clearly marked on the cabinet frame.

.3 A fume hood must be connected to a local exhaust ventilation system which will provide air velocities over the operational face area of the hood that meet the current Work Safe BC / OHS Requirements.

.4 New fume hoods shall have flow sensors as per CSA standards.

.5 Design of building structure to accommodate the provision of shielded radio isotope hoods (SFU to establish which hoods).

.6 Whenever a project permits, conform to the most stringent Containment Level requirements to allow flexibility of use.
.7 Hoods intended for use with Perchloric acid shall be specifically designed for that use and shall be reviewed with SFU Safety & Risk Services and SFU Facilities. Material that is resistant to Perchloric Acid must be used for the fume hood, duct work, fans and stacks. Stainless steel is not an acceptable material for this service.

.8 If hoods are to be relocated, it is preferred to use new hoods rather than re-using existing hoods.

2.6 Seismic Restraint Requirements

.1 A professional engineer registered in BC, shall be engaged by manufacturer, and shall seal shop drawings, confirmed by Letters of Assurance, for seismic restraints including anchorage.

.2 Means for attachment for seismic restraint to be incorporated in the manufacture of fume hoods and bio-safety cabinets. Restraints and anchorage shall be designed to the BC Building Code.

2.7 Components

.1 Fume hoods to be either stainless steel lined or epoxy lined. All fume hood materials must be non-flammable. Radioisotope hoods to be of stainless steel construction.

.2 Hoods intended for use with radioisotopes to have a reinforced work surface capable of supporting 500 kg.

.3 Window sash to be equipped with a tempered safety glass.

.4 Majority of bio-safety cabinets will be Class II Type A2. SFU Safety & Risk Services EHS department to determine if Class II Type B1 or B2 cabinets are required at a meeting between with consultants.

.5 Fume Hoods to be variable volume type.

.6 Fume Hoods to be equipped with occupancy sensor to allow reduce air flow when equipment is unoccupied.

.7 As per BCOHS regulation 30.21; an exhaust duct wash down system shall be part of the design in Perchloric Acid fume hoods.

2.8 Finishes

.1 All fittings or trim in fume hoods to be non-corrosive. Chrome-plated or similar types of 'non-corrosive' finishes are not acceptable.

2.9 Fabrication

.1 The fume hood must be double walled construction permitting mechanical and electrical service fittings to be mounted on the vertical front stiles.

.2 Heavy duty galvanized steel framework as well as the service fixture valves and boxes must be housed and concealed within the service chase on both sides of the hood.

.3 Exterior or interior panels must be independently mounted and easily removable, complete with panels required completing service connections. Exterior service panels are preferred where the installation permits.
.4 The exterior panels and front stiles must be minimum 1.2 mm powder coated epoxy steel. Air foil must be Type 316L 1.5 mm gauge stainless steel, number 4 finish.

2.10 Materials

.1 Consult with SFU Facilities for SFU Mandatory, approved, or not approved products and materials.

.2 Type 316L 16 gauge stainless steel number #4 finish and be of seamless one piece construction with all corners coved and radii.

.3 All welds ground smooth and polished. A liner must be bolted and cemented to the steel framework forming a rigid and completely sealed chamber.

.4 The duct stub must be 316L stainless steel.

.5 Hood baffles are required with top and bottom ventilation slots. These must be fully adjustable and of the same material as the hood liner.

.6 The vertical sliding sash must be full view type with 6 mm thick tempered safety glass panel and stainless steel pull, and be counter balanced for smooth operation. Sash shall latch when fully open and when released shall automatically close by gravity.

.7 Fume hoods and biological safety cabinets shall be equipped with a positive lockable latching system. The locking system must allow for the addition of a tradesman's lock that complies with lockout procedures.

.8 For a stainless steel liner, hood work surface must be type 316L 16 gauge stainless steel, seamless welded and integral with liner. The work surface must have 6 mm high marine type edge. The underside of the work surface must have a 20 mm thick plywood sheet bonded to it for rigidity and sound deadening.

.9 For an epoxy lined hood, the hood work surface must be 20 mm solid black epoxy sealed to the hood liner with a 6 mm high marine type edge sealed to the hood liner.

.10 A recess mounted electronic air monitor shall be mounted on the front face of the hood, indicating high, normal and low air flows, complete with audio and visual alarms.

.11 Where provided, the hood accessories must conform to the following specifications:

.1 Provide outside controls for all fume hoods as per OHS requirements.

.2 Sinks must be integrally welded to the work top or, if epoxy, sealed and recessed into the counter with 38 mm tail pieces.

.3 Flush type electrical receptacle consisting of a box 120 volt 15 amp U ground duplex stainless steel face plate must be located on the exterior of the fume hood preferably on the vertical stile.

.4 A flush mounted stop/start blower switch must be located in the fume hood front stile. The switch must be suitable for the specified horsepower characteristics of the fan and be labeled as to its function and status.

.5 The fume hood must be prewired and CSA approved.
.6 The hood must be equipped with a vapor proof lamp and light switch and all wired to a junction box on top of the hood.

2.11 Service Connection to Biological Safety Cabinets

.1 Natural Gas

.1 Natural gas connections to Biological Safety Cabinets are no longer permitted by the Public Health Agency of Canada (PHAC).

.2 Water, Drain and Vacuum Services

.1 Water, drain, air and vacuum are normally not recommended. In instances where users request any of these services, the Consultant to discuss and obtain approval from the SFU Facilities.

.3 Electrical

.1 A duplex outlet is required adjacent to each cabinet supplied from two separate circuits.

2.12 Labelling

.1 Fume Hoods and Biological Safety Cabinets to be labeled in accordance with the requirements of Technical Services, and this labeling must be coordinated with the similar identification number of the related fan located on the roof.

.2 Commissioning

.1 It must be demonstrated to the SFU Project Manager, and SFU Facilities that the fume hoods have been designed and installed to meet all requirements of the SFU Technical Requirements.

***END OF SECTION***
1.1 **GENERAL**

1.2 **Related SFU Technical Requirements**

   .1 *Section 06 40 00 Architectural Woodwork*
   .2 *Section 12 35 53 Laboratory Casework*

1.3 **Coordination Requirements**

   .1 SFU Facilities

1.4 **Description**

   .2 Flammable Liquid Storage Cabinets.
   .3 Acid Storage Cabinets.

1.5 **Performance Standards**

   .1 Construct flammable liquid storage cabinets in accordance with the requirements of the B.C. Fire Code. Storage capacity must comply with the B.C. Fire Code.

   .2 Acid storage cabinets: the final design must be approved by the SFU Facilities and SFU ERS.

   .3 Construction to be similar to the requirements for flammable liquids storage cabinets except as noted below.

   .4 Requirements of *Section 06 40 00 Architectural Woodwork* apply to this section.

   .5 Seismic restraints and anchorages shall be engineered to the BC Building Code.

   .6 All equipment must be CSA and/or ULC certified for use in Canada.

1.6 **Quality Control and Assurance**

   .1 Submittals
      .1 Shop drawings.

   .2 Quality Assurance
      .1 The work to conform to AWMAC Manual of the Architectural Woodwork Association of Canada
         [http://bc.awmac.com/](http://bc.awmac.com/)
      .2 Professional Engineer registered in BC, engaged by manufacturer, to seal shop drawings and carry out site reviews, confirmed by Letters of Assurance, for seismic restraints including anchorage.

   .3 Quality Control
      .1 Same as *Section 06 40 00 Architectural Woodwork*.

   .4 Warranties
      .1 Same as *Section 06 40 00 Architectural Woodwork*. 

2.1 **MATERIALS**

2.2 **Prescriptive Requirements**

.1 Material
.1 Products (SFU Mandatory, approved, or not approved for SFU projects - typ.).

.2 Components
.1 Flammable Liquid Storage Cabinet
.1 No SFU standards are available.

.2 Acid Storage Cabinet
.1 Construction similar to the requirements for Flammable Liquids Storage Cabinets except as follows:
  .1 Interior lined with glass reinforced cement board.
  .2 One fixed shelf shall be provided.
  .3 Bottom shall be liquid tight to contain spills.
  .4 Vents shall be provided in doors.
  .5 Hinges shall be corrosion resistant and surface mounted.
  .6 Exterior Caution Label; A 300 mm x 175 mm blue plastic plate with 38 mm white letters stating CAUTION ACIDS CORROSIVE will be provided by Building Operations. This plate is to be screwed to the cabinet by the manufacturer.

.3 Finishes
.1 Factory finish.

***END OF SECTION***
1.1 **GENERAL**

1.2 Coordination Requirements

   .1 SFU Facilities

1.3 Description

   .1 Cranes and Hoists.

2.1 **DESIGN REQUIREMENTS**

2.2 General

   Equipment design and installation requires full compliance with all applicable regulatory bodies including:

   .1 Worksafe BC
   .2 CSA B167-96
   .3 ASME B30.2-2001

   All equipment must be CSA and/or ULC certified for use in Canada.

   ***END OF SECTION***
1.1 GENERAL

1.2 Co-ordination Requirements

.1 Coordinate requirements with SFU Facilities and SFU Project Manager.

.2 All proposed systems must be reviewed and signed off by Technical Services prior to any tendering.

1.3 Description

.1 The design, supply and installation of fall protection systems for maintenance personnel (particularly when parapets are less in height than required for guards), and for window washing equipment and personnel.

.2 Meet all requirements of the Province of British Columbia Industrial Health and Safety Regulations pursuant to WorkSafe BC.

.3 Be responsible for determining the location and types of anchorages required to provide a complete system.

1.4 Performance Standards

.1 Province of British Columbia Industrial Health and Safety Regulations pursuant to WorkSafe BC.


.3 Engineer to design a complete fall protection system to prevent a worker from falling according to WorkSafe BC requirements.

1.5 Quality Control and Assurance

.1 Submittals

.1 Shop Drawings

.1 The Design Engineer’s seal, signature and a statement assuring code compliance must appear on each shop drawing.

.2 At completion, submit as-built drawings and 2 copies of a reduced plastic laminated as-built shop drawing showing anchor locations and detailed fall protection plan clearly depicting the intent and usage of each component and overall system, to be supplied to the SFU Facilities for posting near roof entrances.

.2 Quality Assurance

.1 Work to be carried out by a company specializing in the type of safety equipment required.

.2 All components to be designed and certified by a professional engineer registered in the Province of British Columbia.

.3 Roofing penetrations to conform to roofing membrane.
2.1 MATERIAL and DESIGN REQUIREMENTS

2.2 Prescriptive Requirements

.1 All facility fall protection should be reviewed and approved by SFU Facilities and SFU EHS.

.2 All miscellaneous metal work shall have the minimum standards described in Section 05 50 00 Metal Fabrications.

.3 All roofing work and roof repair work shall be in accordance with Section 07 50 00 Membrane Roofing.

.4 Public access to roofs should be prevented and deterred through strategic building design, coordinated with design consultants.

.5 Components

.1 Cast-in-place material: stainless steel type 304.

.2 Exposed anchor surfaces and exposed structural components: stainless steel type 304.

.3 Rotating heads are not allowed on campus, as they make safety inspections more difficult.

.4 Anchors must be certified that they meet the performance requirements of CSA Z91M.

.5 No adhesive or expansion shield anchoring of anchors.

2.3 SFU Guidelines for Rooftop “Fall Protection System” Design

.1 Overview

.1 SFU requires that all new buildings, major renovations, and roof replacement projects be reviewed with Facilities Services to determine if required to incorporate the design of a permanent, engineered, fall protection system. The system shall incorporate the use of rust resistant (e.g. galvanized metal), railing anchors, horizontal life lines, signage, etc.

.2 The lead design consultant is responsible for the functional requirements of the system design. The “Fall Protection System” design is more than a rooftop anchor installation design.

.2 Buildings or Rooftop Surfaces less than 10 feet above Grade

.1 Fall protection design is not typically required unless the hazard of falling is greater than the hazard of impacting a flat surface. Consideration must be given to what periodic maintenance is required to be performed while on these surfaces to ensure
that safe access is achievable using ladders, et.al.

.3 Buildings or Surfaces greater than 10 feet but less than 25 feet above Grade

.1 A fall protection system design is required for use by employees for the purpose of fall restraint and fall arrest. Design for window cleaning is only required on buildings where access is not practical from the ground via extension poles or a mobile lift.

.4 Buildings or Surfaces greater than 25 feet above Grade

.1 A fall protection system design is required for use by employees for the purpose of fall restraint, fall arrest, and window cleaning via a bosun’s chair. Attachment mechanisms for swing stage or other roof supported maintenance equipment should only be designed if specifically required for the project; like a high-rise building. A wall stabilization anchoring system is to be provided to prevent the working platform from dangerously swaying in the wind while suspended, where required by code or deemed necessary due to the combination of building accessibility, building height and wind speeds.

.5 Fall Protection System Designs Shall Include:

.1 Adherence to WorkSafe BC guidelines and regulations required.

.2 Adherence to applicable latest building codes required.

.3 Signed and sealed by a Professional Engineer

.4 Window cleaning anchor design must allow for separate anchors for the person (safety line) and the suspension equipment (bosun’s chairs, swing stages etc.) (suspension line).

.5 Drawing(s) indicating the anchoring locations and instructions for use regarding angles and tie off locations. Indicate ground areas requiring pedestrian protection while suspension equipment (bosun’s chairs, swing stages etc.) is being used for maintenance; over doorways, etc. The drawing shall be printed on a durable medium and mounted at each rooftop access location and fall protection access location inside of buildings.

.6 The drawings shall include instructions on any protection requirements for the building parapet walls and / or flashings to ensure that the ropes do not damage the building components and so that the building components do not damage the ropes.

.7 Imposed loads on the parapet walls shall be identified on the drawings and the information provided to the project lead designer, normally the Architect, to ensure that parapets are designed accordingly.

.8 The designer must ensure that rooftop mounted equipment, ducting, skylights, piping, vent stacks, etc. are accounted for and do not impact the operation of the system. Modify the design as required to ensure that the system is fully functional once the building is occupied.

.9 Areas of the roof that are accessible to the general public shall use guardrails to ensure protection against falls because they will not have the training and equipment required for using the anchoring system.

.10 Where interior fall protection systems such as in atriums are required, allowance must be made for the use of manlifts to access all interior surfaces and fixtures for
maintenance. Further allowance must be included in the building design for access of this equipment into the space required and floor/slabs must be capable of supporting the loading required by such equipment.

.11 An annual inspection checklist indicating each anchor shall be developed. Every anchor on the roof shall be uniquely identified, and the checklist will correspond to these identifiers. The checklist shall be prepared on 8.5” x 11” sheets. A copy of the checklist will be left in a mounted pouch at the entrance of the fall protection area for review by personnel accessing the fall protection area.

.12 Anchor design and load rating drawings shall be provided for each type of anchor in the system.

.13 Anchor fastening details must be provided for each type of fastening. The fastener load ratings must be indicated.

.14 Avoid adhesive and expansion shield anchors due to load testing inspection requirements.

.15 Anchor manufacturer’s shop drawings, installation instructions, and inspection / testing requirements.

.16 Anchor inspection detailed descriptions to be comprehensive enough to allow anchors and fastening mechanisms to be inspected by third party personnel.

.17 A copy of all components of the anchor system design shall be bound in a three-ring binder complete with a stamped and sealed cover letter from the Professional Engineer describing the system. The binder shall include all drawings, shop drawings, anchor detail drawings, fastener detail drawings and specifications, inspection checklists, instructions on the proper use and limitations of the system, instructions for inspections, testing requirements and frequency, letter of initial system certification stamped and sealed by a Professional Engineer. The contents of this manual will be scanned into SFU Facilities – Building & Infrastructure Records system for permanent record and future reference.

.6 Commissioning

.1 Roof anchor designer/manufacturer to provide a comprehensive seminar to SFU Facilities staff and Contractor personnel, on the purpose and nature of the tie-back and lifeline anchoring system.

***END OF SECTION***
1.0 **GENERAL**

1.1 **Related SFU Technical Requirements**

   .1 *Section 10 20 00 Interior Specialties*
   
   .2 *SFU Zero Waste Initiative Project*

2.0 **DESIGN REQUIREMENTS**

2.1 Building designs need to allow adequate service area space for garbage and recycling containers to be stored and collected or emptied with waste management vehicles. Containers and vehicles are described in 3.0 below. Minimum requirements for most buildings include:

   .1 Concrete pad for placement of front-load waste containers to prevent long-term surface damage.
   
   .2 3-sided enclosure around concrete pad such that waste bins are visible only from the direction of service vehicle approach. Design to be approved by University Architect.
   
   .3 Direct in-line service access to front-load waste containers at least 1.5 times the length of an industry standard front-load compactor truck.
   
   .4 Outside service area for recycling cart pickup using an industry standard side-load truck which loads from the right side only.
   
   .5 Ramp or ground level access from *the interior waste and recycling storage area* to the service area to allow recycling carts to be wheeled easily to the designated outside pickup area. *Refer to Section 10 20 00 for more information on the interior waste and recycling storage area.*
   
   .6 Service lane widths, turning radii and load bearing capability sufficient to accommodate all waste collection vehicles noted above. Fire truck access standards are typically sufficient.
   
   .7 Minimum access width of 12’ (feet) to any front-loads waste container enclosures.
   
   .8 Minimum vertical clearance above waste containers of 23’ (feet).
   
   .9 *Project specifications are to describe any proposed waste management systems or equipment within the building that differ from the standard equipment types listed in 3.0 below, and identify any anticipated need to recycle or dispose any significant amount of “specialty” waste materials that would require additional storage or handling equipment.*

3.0 **EQUIPMENT**

3.1 SFU uses a number of standard Waste Management containers and vehicle types and seeks to utilize the same types throughout the campus: These include:

   .1 3, 4 and 6 cubic yard steel containers for collection of garbage and recyclable cardboard, serviced using an industry standard front-load compactor truck which requires direct drive-in access.
   
   .2 35, 65 and 95 gallon wheeled Schaefer carts for collection of recyclable paper and mixed containers, serviced using an industry standard side-load recycling truck which loads from
the right side only.

.3 30 and 40 cubic yard compactor container for collection of garbage at high waste generation, facilities, serviced, using an industry standard roll-off container truck which requires direct back-in access.

.4 10, 20, 30, and 40 yard bins for concrete, gypsum, construction, yard waste, and steel recycling, serviced using an industry standard roll-off container truck which requires direct back-in access.

.5 Consult with SFU Facilities to confirm the waste management equipment that is appropriate for the project.

.6 Standard dimensions of waste containers, recycling carts and waste vehicles are as follows:

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
<th>Size (W x D x H)</th>
<th>Weight (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waste Containers</td>
<td>3 cubic yard front-load</td>
<td>79 x 42 x 48&quot;</td>
<td>320</td>
</tr>
<tr>
<td></td>
<td>4 cubic yard front-load</td>
<td>79 x 54 x 48&quot;</td>
<td>410</td>
</tr>
<tr>
<td></td>
<td>6 cubic yard front-load</td>
<td>79 x 66 x 58&quot;</td>
<td>550</td>
</tr>
<tr>
<td></td>
<td>30 cubic yard roll-off</td>
<td>96 x 256 x 79&quot;</td>
<td>3,270</td>
</tr>
<tr>
<td></td>
<td>40 cubic yard roll-off</td>
<td>96 x 256 x 90.5&quot;</td>
<td>3,400</td>
</tr>
<tr>
<td>Recycling Carts</td>
<td>35 gallon</td>
<td>22.75 x 22.35 x 39.5&quot;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>65 gallon</td>
<td>28.0 x 26.8 x 42.2&quot;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>95 gallon</td>
<td>28.0 x 30.5 x 46.5&quot;</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Vehicle Type</th>
<th>Size (W x D x H)</th>
<th>Gross Vehicle Weight (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Front-Load Compactor Truck</td>
<td>8.5 x 32.5 x 13.5'</td>
<td>25,000</td>
</tr>
<tr>
<td>Roll-Off Container Truck</td>
<td>9.75 x 33.3 x 9.75'</td>
<td>25,000</td>
</tr>
<tr>
<td>Side-Load Recycle Truck</td>
<td>9.5 x 31.5 x 12.5'</td>
<td>17,000</td>
</tr>
<tr>
<td>Side-Load Truck Extended</td>
<td>12.5 x 31.5 x 16.0'</td>
<td>-</td>
</tr>
</tbody>
</table>

***END OF SECTION***
1.1 **GENERAL**

1.2 **Related SFU Technical Requirements**

.1 *Section 06 40 00 Architectural Woodwork*

1.3 **Coordination Requirements**

.1 SFU IT Services
.2 Electrical Consultant.
.3 SFU Facilities

2.1 **DESIGN REQUIREMENTS**

2.2 **General**

.1 Faculty and typical Offices: Work station to be approx. 1.85m² and include file pedestal and locking box file pedestal, task light, tackboard, overhead open storage for full length of work station, pullout keyboard tray (with provision for computer mouse), task chair and one or two guest chairs as required.

.2 Filing: shall meet ANSI/BIFMA and CSA standards.

.3 Ergonomics: to meet ANSI/BIFMA and CSA standards, contact SFU EHS, and refer to SFU Ergonomics policy.

.4 Seismic: secure fixed furnishings to floors or walls to meet seismic requirements.

.5 Ensure fabrics meet BCBC flame spread requirements for interior spaces.

.6 Specify locally manufactured products whenever possible (within 500km).

.7 Materials to be durable to long term institutional use and be appropriate for future re-use.

2.3 **Audio Visual Screens**

.1 Coordinate to all electrical and communications outlets. Layouts to be reviewed by SFU IT Services.

.2 Do not block natural light sources or access to ventilation or operation of window screens or blinds.

.3 Use maximum 1625mm height partitions.

2.4 **Classroom Furniture:**

.1 Contact SFU Facilities for current classroom furniture standards.

.2 Confirm provision of designs suitable for left handed people by contacting SFU Facilities.

.3 Provide long life, easy to clean seat covers, (by wiping off) - PVC's are considered best life cycle option.

.4 Seating should be stackable.

.5 Frames to be chrome plated or better, in durability.

.6 Ergonomic task seating to be used in computer labs.
2.5 Conference Rooms

.1 Seating to be upholstered with arms.
.2 Tables to be easily movable.
.3 Edges to be durable and scratch resistant.

2.6 Tiered Lecture Halls

.1 Tables to be continuous and fixed to floors. Provide durable tops coloured and textured for glare prevention and ease of cleaning and minimum maintenance.
.2 Edges to be durable and scratch resistant with rounded corners. Fir is not to be used on desk edges because it is a soft wood that splinters easily.

2.7 Laboratories

.1 Plastic laminate or equal countertop to be used throughout, where special acid resistance is required use special acid resistant laminate.
.2 Laboratory chairs to be upholstered with washable non-absorptive material.

2.8 Libraries

.1 Contact SFU Facilities for furnishing standards.
.2 Seismic restraint to be engineered by registered professional.
.3 Provide stackable seating.
.4 Tables to be easily movable.
.5 Edges to be durable and scratch resistant.
.6 Student carrels to be systems furniture c/w integral wiring for power and communication.
.7 Soft Seating to be approved by SFU Facilities.

2.9 Offices

.1 Desks to be approx. 750 x 1650 x 735 high. Provide modesty panels, as required, with 400 - 450 clear to floor.

2.10 Interior Planters

.1 Construction of interior planters are not preferred and will only be approved on a project basis after consultation with SFU Facilities.
.2 Planting designs must be approved by SFU Facilities.

***END OF SECTION***
1.1 MATERIALS AND DESIGN REQUIREMENTS

1.2 Window Coverings

.1 Provide blinds on all windows, either horizontal or vertical, of standard manufacture.

.2 Venetian blinds are not permitted. Only use roll up type.

.3 Motorized blinds are not permitted and will only be considered by SFU Facilities on a project basis.

.4 Opacity/ U-Values of blinds will be determined on a project basis with SFU Facilities.

.5 Use heavy duty commercial quality for offices or labs. Not to be used for classrooms. Curtains, drapes or interior shutters are not to be used except in special circumstances.

.6 For renovation work, match blinds of remainder of building where appropriate.

.7 Black-out blinds to be considered with SFU on a project basis.

1.3 Window Films

.1 Window films for privacy and/or solar gain should be considered on all projects and must be approved by SFU Facilities.

***END OF SECTION***
1.1 **GENERAL**

1.2 Related SFU Technical Requirements

.1 Section 12 00 00 Furnishings

2.1 **MATERIALS AND DESIGN REQUIREMENTS**

2.2 All fabricated casework to be reviewed and approved by SFU Facilities.

2.3 On all shelving designed for use as chemical storage a 50 mm clear acrylic plastic lip must be installed on the shelf edge.

2.4 Provide seismic restraint for all cabinets and shelving.

***END OF SECTION***
1.1 **GENERAL**

1.2 **Related SFU Technical Requirements**

1.2.1 Section 06 40 00 Architectural Woodwork
1.2.2 Section 11 53 13 Fume Hoods

1.3 **Co-ordination Requirements**

**NOTE:** Shall have an overall coordination of Documents for Section 11 53 33 Emergency Safety Appliances, Section 11 53 13 Fume Hoods, Section 12 35 53 Laboratory Casework, and Section 23 38 16 Fume Hood Exhaust Systems.

1.3.1 Design Development Report issued to Consultant defining in detail the laboratory function, requirements, and systems to be provided.

1.3.2 Early in process, review design intent and additional requirements with SFU Facilities and SFU EHS.

1.4 **Description**

1.4.1 Casework for laboratories designated for biohazard containment levels:

1.4.1.1 Containment Level 1.
1.4.1.2 Containment Level 2.
1.4.1.3 Containment Level 3.
1.4.1.4 Containment Level 4.

1.4.2 Whenever project permits, conform to the most stringent requirements, to allow flexibility of use.

1.5 **Performance Standards**

1.5.1 Conform to function-specific requirements, including as applicable:

1.5.1.1 Laboratory Bio-Safety Guidelines published by Laboratory Centre for Disease Control, Health Protection Branch, Health Canada.
1.5.1.2 Containment Standards for Veterinary Facilities, Agriculture & Agri-Food Canada, Publication 1921/E.
1.5.1.3 Canadian Nuclear Safety Commission Standard R-52, Design Guidelines for basic and intermediate level radioisotope laboratories.

1.5.2 Seismic

1.5.2.1 Restraints and anchorage engineered to BC Building Code.
1.5.2.2 Provide edges to shelving and similar features to minimize spillage including during seismic activity.
1.5.2.3 Provide marine edging or similar at countertops to contain spillage.

1.5.3 Finishes

1.5.3.1 Select finishes to suit required resistance to:

1.5.3.1.1 Chemicals including acids, alkalis, solvents, and reagents.
1.5.3.1.2 Heat.
1.5.3.1.3 Moisture, humidity.
1.5.3.1.4 Abrasion.
1.5.3.1.5 Impact.
1.5.3.1.6 Radioisotope chemistry.
1.6 Quality Control and Assurance

.1 Submittals
   .1 Before Start of Work
      .1 List of all proposed materials for review, and color samples for selection plus for
         final approval.
      .2 Shop Drawings.
      .3 Sample mock-up.

   .2 At Completion
      .1 Maintenance data shall be itemized list c/w each finish type, color formulation.
      .2 Maintenance material shall be determined.

.2 Quality Assurance
   .1 Professional Engineer registered in BC, engaged by manufacturer, to seal shop
      drawings and carry out site reviews, confirmed by Letters of Assurance, for seismic
      restraints including anchorage.

.3 Warranties
   .1 Two (2) Year manufacturer's warranty to include replacing and refinishing due to
      defects or faulty workmanship.

2.1 MATERIALS

2.2 Performance Requirements

   .1 General
      .1 Select manufacturer recognized as specializing in the manufacture and installation of
         Laboratory Casework and fittings of the type required for project.
      .2 Metal casework pre-fabricated and factory-finished systems.
      .3 Tops to be continuous with no open seams, integral with backsplash, sealed joints to
         walls etc.
      .4 Rounded edges (mandatory when positive pressure suits are worn).
      .5 Minimize joints generally, and seal.
      .6 Maximize spacing of legs to maximize free under counter space and flexibility.
      .7 Provide under slung relocateable modular units (e.g. drawer / shelf units), generally
         12" free of floor.
      .8 Design for vibration control.

   .2 Environmental
      .1 Manufacture
         .1 Avoid adhesives, preservatives, hardeners, and synthesizing agents and finish
            coatings that contain formaldehyde and high V.O.C. content.

      .2 Life Cycle Costing
         .1 15-year.
         .2 Provide adjustable modular components to facilitate changes in lab procedures.

   .3 Disposal
      .1 Minimize use of packing materials such as cardboard for shipping and if used,
         recycle. Use blanket wraps for shipping whenever feasible.
2.3 Prescriptive Requirements

.1 Materials
   .1 Laboratories: no wood within laboratories, including casework, trim, wood doors and frames, etc. unless approved by SFU Facilities.

.2 Components
   .1 Worktop Material
      .1 Solid cast epoxy resin.
      .2 Stainless steel preferred (mandatory for Containment Level 4 labs).
      .3 Resin-impregnated natural stone.
      .4 Laboratory grade plastic laminate.
      .5 Other.

.3 Execution
   .1 Installation shall be by manufacturer-trained and certified installer.
1.1 GENERAL

1.2 Related Technical Requirements

.1 Division 27

1.3 Co-ordination Requirements

.1 SFU Facilities
.2 Co-ordinate with Architectural, Elevator, Electrical, Mechanical and Structural Consultants.
.3 SFU IT.

1.4 Description

.1 SFU requirements for Elevators.

2.1 GENERAL MATERIAL AND DESIGN REQUIREMENTS

2.2 Quality Control and Assurance, Submissions & Maintenance

.1 Elevator Manufacturer and Equipment Requirements

.1 Contractor must be willing to fully comply with the non-proprietorial requirements and demonstrate that technical support and parts can be made available to third parties.

.2 Controllers must come equipped with any special diagnostic tools, or any diagnostic software and connections available with a PC with manuals clearly defining the diagnostic codes and adjustment parameters.

.2 Elevator Maintenance

.1 The elevator vendor who installed the unit shall continue to service the elevator for no less than 3 years after Substantial Performance of the project.

.2 Documentation requirements during the maintenance period

.1 All maintenance including: regular inspections, adjustments, lubrications, call back for faulty operation, and the replacement of all parts and components which fail for any reason shall be documented by the elevator service contractor. This shall include parts replaced as part of warranty as well as parts to be replaced due to normal wear and tear.

.2 The elevator service contractor shall respond without extra charge to call backs on a 24 hour basis. However, all work other than call backs shall be done during regular working hours.

.3 The elevator service contractor shall provide a monthly summary of work performed for all service calls to SFU Facilities for the entire maintenance period.

.3 Validation of elevator performance during the maintenance period

.1 An example of the permissible number of call backs and percent improvement required each year is indicated in the table below based on year 1 performance:
<table>
<thead>
<tr>
<th>Number of Call Backs</th>
<th>Min. % Improvement Required Each Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year 1</td>
<td>Year 2</td>
</tr>
<tr>
<td>≥10</td>
<td>8</td>
</tr>
<tr>
<td>5 - 10</td>
<td>6</td>
</tr>
<tr>
<td>4</td>
<td>4</td>
</tr>
</tbody>
</table>

.2 The elevator service contractor shall review the performance statistics in person each year with SFU Facilities.

.4 SFU at their discretion can put any new elevator equipment under the global maintenance contract for the campus or enter into an extended maintenance term with the original equipment manufacturer.

.3 Technical Information

.1 The supplier shall include all technical information to allow the SFU staff to perform all maintenance of the equipment, including all diagnostic efforts to determine the cause of malfunction. This shall include complete as-built electrical drawings, parts list, and instruction manuals as listed below.

.2 One additional copy of technical information shall be provided in digital (CD) format.

.3 The following information and/or submissions are required:

.1 Three (3) copies of complete operating and maintenance manuals complete with up to date technical bulletins. Manuals shall contain complete parts lists with exploded views of all assemblies.

.2 Three (3) copies of complete adjusting, start-up, diagnostic and troubleshooting manuals and diagnostic codes.

.3 Three (3) copies of as built wiring diagrams.

.4 Three (3) copies of final shop drawings showing General Arrangement and Layout, Cabs and Entrances.

.5 A minimum of five (5) copies of each key used except keys specifically for maintenance and inspection personnel.

.6 Provide one (1) archive copy of the elevator contract data for purposes of reinstallation in the event the contract chip becomes corrupted and the data is lost. This is not intended to be a copy of the entire operating software of the elevator system.

.7 Manuals shall be sufficiently detailed and shall include spare parts lists, drawings, adjustment procedures, testing procedures, troubleshooting procedures, diagnostic instructions, recommended spare part lists and the manufacturers recommended maintenance tasks and frequencies.

.4 Maintenance Training

.1 Provide formal and proper training of the owner’s elevator staff for the new equipment provided.
.2 Prior to commencement of the warranty maintenance period provide an orientation and demonstration session for the preventive maintenance, repair and trouble-shooting of the new equipment and control systems.

.3 The orientation and demonstration shall be hands on at the elevator equipment and all drawings and manuals and the information contained in them shall be covered and verified at the site.

.4 Provide a walkthrough session prior to completion of the warranty period as a handover.

2.3 Qualification of Design Consultant

.1 All elevators at SFU must be designed by an Elevator Consulting Engineer approved by SFU Facilities.

2.4 Standards

.1 All equipment installed shall conform to the latest edition of the CSA B44 Safety Code for Elevators; the requirements of the BC Elevating Devices Safety Act and Regulation; the latest edition of the BC Building Code; the requirements of the local fire department and any related Provincial regulations; and the local regulations concerning access for persons with disabilities.

3.1 GENERAL REQUIREMENTS AND STANDARDS FOR PASSENGER ELEVATORS

3.2 Type of Elevator

.1 Where the choice could be made for either hydraulic or traction, the decision should lean towards traction elevators. Where initial cost is the prime consideration, and the traffic demand will be light, and if there are no soil problems, then the hydraulic type may be considered.

.2 For buildings with 2 or 3 stops, a twin post holeless hydraulic should be specified to eliminate the need for well hole drilling and eliminate the risks of buried cylinders. Telescopic plungers can be considered on a case by case basis but should be limited to three (3) stop elevators.

.3 Roped hydraulic elevators shall not be considered.

.4 Direct acting holed hydraulic elevator with buried cylinders will be considered only by prior written approval from SFU Building Operations.

.5 For buildings with 4 to 12 elevator stops, use High Efficiency, Environmentally-Friendly Gearless Traction Elevators or Conventional Geared or Gearless Traction Elevator equipment. The machine room shall be located directly overhead unless a variance is requested, in which case, locate the machine at some other floor, generally at the lowest landing, adjacent to the hoistway. An overhead machine room should be preferred unless there are mitigating factors why it cannot be provided.

.6 For buildings exceeding 12 elevator stops, generally use gearless traction elevator, with machine located overhead.

.7 Lifts for persons with disabilities, handicapped lifts or Limited Use Limited Application (LULA) lifts shall not be acceptable as passenger elevators as directed by the B44 Safety Code for
3.3 **Size of Elevators**

.1 Passenger elevators shall have a minimum capacity of 1135 kg for basic single unit applications unless building requirements mandate a larger platform size. Larger buildings with more than one elevator shall typically use 1360 kg to 1820 kg platform sizes based on the demand and other building requirements. Elevator sizes shall be chosen from typical North American manufacturer’s standard sizes unless the needs of the building dictate the use of non-standard sizes.

3.4 **Location of Elevators**

.1 Elevators should be located centrally in the building or where the walking distance to any point on the floor plate does not exceed a maximum of 45 m. Where the location of the elevator(s) exceeds 45 m from any point in the building then separate elevator service should be provided in distributed segments of the building where the walking distance from any point in the building to the elevator(s) does not exceed 45 m.

3.5 **Number of Elevators**

.1 The number of elevators required will depend on the consultants’ best judgement.

Note - The quantity of elevators should be selected should consider % of handling capacity based on the gross building population rather than square footage. Likewise, a requirement for a maximum waiting time should be considered. The “waiting” time is measured in a dimension called an “interval” that is measured in seconds. These vary for building type and usage, for instance a busy classroom or office block the handling capacity should be 10-12% of the building population in a five minute interval and the interval should not exceed 35 seconds. A residential building should have a handling capacity of 5-7% of the building population and a maximum interval of 40 seconds.

3.6 **Speed of Elevator**

.1 The speed of the elevator shall be within the following ranges and chosen to suit the specific building requirements;

.2 Hydraulic passenger elevators to be 0.5 to 0.75 m/s.

.3 Geared or High Efficiency Gearless traction passenger elevators to be 1.0 to 2.0 m/s.

.4 Gearless elevators to be 2.5 m/s and greater.

3.7 **Door Type and Size**

.1 At least one (1) elevator must meet the BC Building Code requirements to be able to carry a stretcher (or gurney) in the prone position. It is generally accepted that a 1135 kg elevator with 1066 (42") wide-side-opening doors meets this criteria.

.2 Where traffic demand is expected to be light, the “stretcher” elevator (in US English = a Gurney) can have a single speed side-opening door, in which case a standard 1,135 Kg passenger elevator meeting the stretcher requirements is adequate.

.3 Where there is already an elevator which can accommodate a stretcher the remaining passenger elevator(s) in the building should be provided with centre-opening doors for efficiency.

.4 Front and rear door arrangements should be avoided, and used only where the design of the
building makes any other solutions impossible. Where there are "staggered" floor levels which have to be served by an elevator, then rear doors are unavoidable.

4.1 **GENERAL REQUIREMENTS AND STANDARDS FOR FREIGHT ELEVATORS AND SERVICE ELEVATORS**

4.2 **Type of Elevator and Class**

.1 Elevators required specifically for freight and freight handlers only shall be designated as true freight elevators. Where a combination of freight and passenger use is required the elevator shall be designated as a passenger elevator but shall be designed with the freight use in mind to provide a service type elevator.

.2 Provide Class C3 loading where single piece or large concentrated loads must be moved which will exceed 25% of the rated capacity of the elevator (but will not exceed the rated capacity of the elevator). Provide Class C1 or C2 loading as appropriate where the elevator is required to be loaded or unloaded by an industrial truck.

.3 The use of freight platform lifts or material lifts as defined in the B44 Safety Code for Elevators shall not be acceptable unless very special conditions exist to justify these restricted use configurations.

4.3 **Number of Elevators**

.1 Where a freight elevator is required, generally one (1) will be adequate except where demand may require more.

4.4 **Size of Elevators**

.1 Freight and Service elevators shall be sized to suit the largest object which has to be moved and the capacity rating shall be appropriate for the anticipated needs. Elevator sizes shall be chosen from typical North American manufacturer’s standard sizes unless the needs of the building dictate the use of non-standard sizes.

4.5 **Speed of Elevator**

.1 The speed of the elevator shall be within the following ranges and chosen to suit the specific building requirements; Service elevators shall be treated as passenger elevators for determination of speed and other criteria.

.2 Hydraulic freight elevators 0.3 to 0.5 m/s.

.3 Geared traction freight elevator up to 2000 Kg 1.0 to 0.5 m/s – 1.75 m/s (i.e. 100 – 350 fpm).

.4 Geared traction freight elevator > 2000 kg. 0.5 m/s – 1.0 m/s.

4.6 **Type of Doors**

.1 For Service (Passenger) elevators provide power operated horizontally sliding passenger doors. The use of two (2) speed side-opening or two (2) speed centre-opening doors may be utilized to provide a wider opening to suit the anticipated needs. The use of three (3) speed doors or other special arrangements such as swing doors is not acceptable unless very special conditions exist to justify these more unusual arrangements.
.2 Vertical sliding bi-parting doors shall only be used on true freight elevators where no passenger use is required and where a maximum of opening width is required. Vertical sliding bi-parting doors shall be power operated.

4.7 Size of Doors

.1 Standard door width for horizontally sliding Service (Passenger) elevator doors is 1070 mm, although larger sizes are available. Where possible doors shall be chosen from sizes in 150 mm increments. A standard door height of 2135 mm should be used unless higher doors are required in which case 2440 mm high doors should be chosen.

.2 The minimum width for vertical sliding bi-parting doors should be 1830 mm and larger doors shall be chosen from 610 mm increments where possible to stay within typical standards.

4.8 Manufactured Equipment

.1 All components used in the installation of new elevators, or the modernization of existing elevator systems, shall have an established reliability record of at least 3 years.

5.1 MATERIALS AND SPECIFIC MECHANICAL/ELECTRICAL REQUIREMENTS

5.2 Requirements for All Elevators

Provide Seismic Safety Features in compliance with the latest version of the B44 Elevator Safety Code.

.1 Car Top Guard Rail.

.1 Provide a car top guard rail that meets the requirements of the code and the following requirements:

.1 The guardrails shall not defeat any isolation between the car frame and the car cab. The preferred installation is to have the guard rail tied to the cross head.

.2 Allowance for Additional Weight

.1 The complete elevator including the drive, support and counterweight shall be designed such that the weight of the basic cab can be increased with additional finishes or other additional equipment totaling not more than 350 Kg per cab.

.3 Guides

.1 Provide roller guides consisting of polyurethane tired wheels, at least 150 mm diameter for the car guides and 75 mm diameter for counterweight guides where applicable for all passenger elevators. Guides on freight elevators shall consist of solid slippers or sliding guide shoes.

.4 Travelling Cable

.1 Provide spare conductors in the travelling cables and communication wiring as follows; Provide spare wiring consisting of the greater of a minimum of 10% or ten (10) individual conductors and provide a minimum of eight (8) twisted shielded pairs of 20 AWG communication conductors for other equipment which maybe provided, over and above any pairs required by the elevator control system.

.5 Door Operators
.1 Automatic car door operators shall be of the heavy duty, high performance type designed for high performance and long life. Light or medium duty door operators are not acceptable.

.2 All door operators shall be provided with closed loop feedback operators capable of adjusting the closing torque to suit changing building conditions.

.3 Where front and rear doors are used provide full selective control of the door operation.

.6 Car Operating Panel

.1 Where centre opening doors are provided the elevator cab shall have two car operating panels, one on each side of the cab. Where front and rear doors are used the elevator cab shall have two car operating panels, one on the front side and one on the rear side of the cab. Where space permits car operating panels shall be mounted on the door return panels, otherwise on the side walls adjacent to the door return panel.

.2 In-Car stop switches shall be key-operated.

.3 Car operating panels with angled buttons designed to be universally accessible for use by both standing and seated persons are encouraged.

.4 Where possible mount the car call buttons in a single vertical column.

.5 Provide the following keyed switches and related features for each elevator; Light Switch, Fan Switch, Independent Service Operation Switch, Inspection Switch, Emergency Light Test Switch. Provide two (2) cutouts per panel with blank inserts for the future addition of other keyed switches. Any elevator equipped with Phase I Emergency Recall shall also be equipped with Phase II In-Car Emergency Service Operation and the related keyed switch.

.6 Buttons shall be of the vandal resistant type. Approved products are Dupar US84, 90 or 91 available from Dupar Controls. Car Tactile markings shall be Dupar US89, California Style white on black. All devices shall be mounted and secured to endure minor acts of vandalism. Approved keying shall be Dupar standard. Push buttons from the manufacturers standard range of products shall also be considered providing that spare parts are easily attainable, they are of a vandal resistant design and meet the performance requirements of these guidelines.

.7 A separate telephone activation button shall be provided.

.8 All illuminating devices shall be provided with long life LED illumination which is clearly visible in the ambient lighting level of the cab.

.9 The panel face plate shall be professionally engraved to identify each component, the position of switches, the elevator capacity, the owner’s identification number as well as any jurisdictional identification numbers applicable to the installation.

.7 Hall Buttons

.1 The lights shall be from a long life LED source.

.2 Hall button face plates shall been engraved to include the required message to not use the elevator in case of fire.
Hall Lanterns

.1 Where there are two or more elevators in a group, there shall be hall lanterns at all entrances.

.2 Lanterns shall be of the vandal resistant type and shall be located above or adjacent to the entrance. The illuminating elements shall be LED with a minimum usage rating of 100,000 hours. An electronic chime shall be provided which will sound when the lantern illuminates. The audible signal shall be a soft “chime” type sound, with adjustable intensity not less than 24 DBA. Harsh electronic beepers are not acceptable, and the type of chime is subject to owner approval. Sound the gong once for Up Bound, twice for Down Bound.

In-Car Lanterns

.1 Where a single elevator is being provided, it shall have an in-car direction lantern on each car door post.

.2 Where there are front and back entrances, there shall be such a pair of lanterns on each entrance, and it will operate in unison with the corresponding entrance. The illuminating elements shall be LED with a minimum usage rating of 100,000 hours.

Voice Announcer

.1 Provide equipment to allow an audible announcement in each elevator cab. The messages shall be appropriate to reflect the conditions pertinent to the elevator and shall be subject to the owner’s approval.

.2 Connect the equipment to the elevator control system and determine the necessary inputs so that the messages reflect the conditions pertaining to the respective elevator or group function.

.3 Mount the remote speaker in the car operating panel behind a protective grille. Ensure that the location of the speaker will allow the announcements to be clearly audible both in the car and in the adjacent hallway when the elevator doors are open. The system shall be equipped with site adjustable volume control.

.4 As a minimum the system shall include, but is not restricted to the following announcements:

.1 Announcement of the floor designation that the elevator is about to stop at.
.2 Announcement of the direction of travel of the elevator. The announcement shall be made when opening the doors in response to car or hall calls.
.3 An announcement warning to stay clear of the doors if the car door nudging feature is activated.
.4 An announcement warning that the elevator has been recalled to the ground floor as a result of emergency recall or other similar feature.

.5 The equipment provided shall be flexible and shall permit site programming so that the messages may be changed at any time to suit changing conditions in the building. All announcements shall be available in either English or both English and French. The voice shall be male or female as selected by SFU.

.6 The system shall have adequate capacity to store up to 40 different announcements and a total of 4 minutes of recording, as a minimum.

.7 Audible signals should still be provided in hall lanterns.
.11 Position Indicators

.1 In addition to the car position indicator required for Barrier Free Access each elevator shall be provided with a digital position indicator over the main floor entrance. Position indicators shall be LED or Vacuum Fluorescent type dot matrix or digital segment displays with characters at least 35 mm high.

.12 Emergency Cab Light

.1 A battery powered emergency cab light device shall be provided for each elevator. The illumination source shall be an integral part of the car operating panel or as a separate inconspicuous fixture.

.13 Firefighters Emergency Operation

.1 The fire alarm system shall have an “elevator bypass” system provided to allow the fire alarm system to be tested without disrupting elevator service.

.14 Group Operation

.1 Where two or more elevators are operating in a group, the operation shall be a group supervisory system, providing automatic collective control for each elevator and a group dispatching and hall call allocation system.

.15 Control Equipment

.1 The control equipment will be primarily solid state, micro processor based.

.2 All elevator controllers shall be equipped with easily accessible trip counters that will increment once for each elevator trip (not re-levelling or door cycling). Counters may be discrete counters that are accessible by on board diagnostic tools.

.3 Control systems shall include diagnostic systems. Where special diagnostic tools are required these must be provided with the equipment along with appropriate instructional manual sand documents. Any such tools and supporting documentation shall become the property of SFU.

.16 Provisions for Card Readers

.1 All elevator controllers should come equipped with a specially wired terminal strip so that an external card reader system can easily be added. The terminal shall have a pair of terminals for each car call other than the ground floor, such that if the terminals are ‘jumped’ the car call will operate, if not ‘jumped’ the car call cannot be registered. The control shall be arranged so that if an elevator is operating as a fire fighter elevator this security feature is overridden.

.2 Travelling cables with adequate conductors to provide signals from the elevator card reader in the cab shall be provided. As a minimum this shall be three (3) spare shielded pairs.

.17 Independent Service Operation

.1 There shall be independent service operation on each elevator. This will be initiated by a keyed switch in the car.
.18 Inspection Operation

.1 Each car shall be equipped with an inspection switch to remove the car from service and prevent operation from any means other than the inspection operation manual controls.

.19 Hoist way Access Operation

.1 A hoist way access keyed switch and operation shall be provided for each elevator at the top and bottom landings for access to the elevator car top regardless of the floor to floor height or speed of elevator. Keys must be submitted for SFU’s maintenance personnel.

.20 Emergency Power Operation

.1 Where standby power is provided, provide two (2) separate signals. One (1) pair to advise that the elevators are on standby power and the second pair to advise of the imminent transfer of standby power or back to normal power. The purpose of this signal is to allow the elevator to park only until power is transferred. Upon transfer to emergency power, the elevators shall resume normal operation.

.2 When emergency power operation is provided include, as part of the control system, suitable circuitry to shut down a moving car at the next possible floor when an advanced warning contact opens. The advanced warning contact will be supplied by the owner and will open 20 seconds prior to the activation of the transfer switch.

.3 The operation and proper operation of the test procedures, including the proper operation of the advanced warning signals shall be tested by the elevator contractor, the generator contractor and a written report and operation instructions shall be provided.

5.3 Requirements for Hydraulic Elevators

.1 Tank Heater

.1 A thermo statically controlled tank heater to maintain the oil at a constant minimum operating temperature is required. Alternatively, a viscosity control feature is also acceptable.

.2 Oil Level Indicator

.1 An outside oil level indicator is required to determine the oil level without removing the reservoir cover.

.3 Gate Valves

.1 A tank shut-off valve or gate valve is required in both the machine room and the pit.

.4 Motor Soft Start

.1 An electronic motor soft-start device is required and must be fully adjustable to limit the peak starting current to as little as 150% of the full load running current.

.5 Duty Rating

.1 All hydraulic elevator components including motor, pump, valve, piping and muffler
shall be designed for a minimum duty of 80 up starts per hour.

.2 Provide Seismic Safety Features in accordance with the latest version of the B44 Elevator Safety Code, for pipe rupture valves, pre-Approved products are Maxton OSVB44

.6 Sound Isolation

.1 Hydraulic elevators shall be equipped with sound isolation between the oil reservoir and the floor in the form of a sound isolation based rubber mat.

5.4 Requirements for Traction Elevators

.1 Sound Isolation

.1 Traction machines must be mounted on sound isolating pads, isolated in all directions.

.2 Car Balancing

.1 With car empty and doors closed, remove the upper car guides. Add suitable weights to the car so that it hangs plumb in this condition. Then adjust the counter weight so that the car and counter weight are in balance with a load in the car which is between 42% and 44% of the rated load.

.3 Motor & Drive

.1 Provide high efficiency permanent magnet AC motors with matching variable frequency/variable voltage drive system of the flux vector type. Control and drive systems shall be closed loop which include position and velocity feedback devices to regulate the speed of the elevator within +/-2% of contract speed with any load from empty to rated capacity.

.2 There shall be an isolation transformer between the power and the elevator drive system. The total harmonic and individual harmonic distortion shall not exceed 5% and 3% respectively and the requirements of IEEE-519 shall be adhered to with respect to power harmonics. For purposes of measurement the Point of Common Coupling (PCC) shall be defined as the elevator power supply terminals located in the elevator machine room.

.3 For geared and gearless elevators provide a full re-generative drive system to return power generated during dynamic braking or running with over hauling loads to the power supply lines.

.4 Automatic Rope Lubricators

.1 Provide automatic rope lubricators which consist of natural fiber pads connected to a lubricant reservoir. The devices shall be mounted adjacent to the hoist ropes in a manner that allows them to be adjusted to contact the ropes when desired.

5.5 Finishes

.1 Elevator Finishes shall be selected from the following; Variations to the finishes provided shall be approved by the SFU Project Manager.

.2 Where glass is used in or as part of cab enclosures it must be laminated safety glass.
.3 Finishes for Passenger and Service Elevators

.1 Landing Door Panels and Entrance Frames to have Plain white prime coat paint finish.

.2 Hall Operating and Signal Fixtures to be Stainless Steel Brushed Finish.

.3 Car Operating and Signal Fixtures to be Stainless Steel Brushed Finish.

.4 Car Door Panels to be Stainless Steel Brushed Finish.

.5 Cab Front and/or Rear Return Panels, Door Jambs and Header/Lintel to be Stainless Steel Brushed Finish.

.6 Cab Ceiling to be 14 gauge furniture steel factory baked enamel finish, color to be White as selected by the Architect.

.7 Cab Lighting to be Energy efficient fluorescent lighting, consisting of T8 lamps and electronic ballasts.

.8 LED illumination make LED recessed pot lights a power smart option.

.9 Cab Walls to be Raised, Horizontal, Removable Plastic Laminated Panels above the Cab Handrail. Raised Stainless Steel Brushed #4 Finish Removable Panels below the Cab Handrail. Plastic laminate or Stainless Steel panel reveals all as selected by SFU.

.10 Cab Kick plate/ Base plate to be Stainless Steel #4 Brushed Finish.

.4 Finishes for Passenger Elevators Only

.1 Suspended Ceiling/Lighting Coves to be Aluminum T-Bar with Aluminum Eggcrate Diffusers.

.2 Cab Finished Flooring to be Linoleum Flooring as selected by SFU. Where moisture is anticipated flooring shall be Resilient Sheet Vinyl flooring as selected by SFU.

.3 Cab Handrails to be Standard 1½" tubular stainless steel handrails on all non-access walls.

.5 Finishes for Service Elevators Only

.1 Suspended Ceiling/Lighting Coves to be Two (2) Light Coves on the cab side walls with factory baked enamel finish, color to be selected by the Architect.

.2 Cab Finished Flooring to be Steel Checker plate.

.3 Cab Handrails to be 4" High Flat Bar stainless steel.

.6 Finishes for Freight Elevators

.1 Freight Elevators shall be equipped with steel checker plate floors and painted metal cab and entrance finishes. Cab finishes including cab walls, doors or gates, ceiling, etc. shall be finished in a factory applied powder coat or baked enamel finish as selected by SFU. Entrance components including frames, headers and landing door panels shall be finished in a factory applied prime coat finish suitable for finished painting by others. Lighting for freight elevators to consist of recessed fluorescent light fixtures.

.2 Provide bumper rails to prevent damage to cab walls from pallet jacks etc.

5.6 Rails

.1 Standard size "T" section car and counterweight guide rails, with tongue and groove joints, together with suitable splice plates at the connections are required. As a minimum use 22 Kg/m rails for the car.
5.7 Voice Communications

.1 For each elevator provide a hands free emergency voice communication system and mount as a separate fixture or as an integral part of the car operating panel. Provide a telephone system for communications to be monitored by SFU Campus Safety and Security Services via an auto dialer. Provide a telephone for mounting behind the car operating panel faceplate. Make all connections required to activate the communication device with the wiring provided. Program the device to dial the number(s) provided by the Owner. A separate telephone activation button shall be provided. This button shall be provided with a tactile and Braille marking displaying the international symbol for a telephone.

.2 The telephones shall be non-proprietary third party phone systems that can be easily adjusted, reprogrammed, volume adjusted or other features easily adjusted.

.3 SFU IT requires a demarcation point for each telephone line installed for elevator use. This demarc is typically located in the elevator machine room. It allows SFU IT to test the phone line without entering the elevator equipment.

5.8 Door Protection

.1 Door re-opening devices shall be of the multi-beam infrared light detector type designed to detect obstructions without contact. Approved products are Janus - Panaforty, Formula Systems - Safe screen 547 and Otis - Lambda.

5.9 Hall Tactile Markings

.1 Provide quality embossed metal jamb plate markings. Provide EJ3 markings with WB Finish and four-hole mechanical mounting available from Stencil Cutting and Supply Company, Ph. 1-800-783-4633 or approved equivalent product. Markings shall be attached with pins or other mechanical means. Do not use stamped or etched plates, and do not use only adhesive for attaching.

***END OF SECTION***
1.1 **GENERAL**

1.2 Related SFU Technical Requirements

   .1 *Section 14 20 00 Elevators*

1.3 Coordination Requirements

   .1 SFU Facilities
   .2 Campus Planning & Development
   .3 University Architect.

1.4 Description

   .1 Platform lifts and other “elevating devices for disabled persons”.

1.5 Quality Control and Assurance

   .1 Refer to requirements of *Section 14 20 00 Elevators*.

2.1 **DESIGN REQUIREMENTS**

   .1 Platform lifts or other “elevating devices for disabled persons” may be deemed to provide an acceptable alternative to an elevator or ramp for access only in situations where they can be shown to reasonably meet the intent of the B.C. Building Code. Use of all such lifts in SFU projects shall be avoided unless it can be demonstrated that the use of such a device is the best solution and does not compromise long term solutions.

   .2 Where it is deemed necessary to provide a Lift for barrier free access, a LU/LA type of elevator is recommended with power operated side opening doors and fully automatic operation. A LU/LA lift must be installed to meet the latest B44 Safety Code Requirements.

   .3 The design requirements of *Section 14 20 00 Elevators* shall also apply to Lifts where applicable. This includes an inspection and approval by a BC Provincial Safety Officer.

   .4 The use of inclined stair platform lifts is prohibited without specific approval of the “University Architect”.

***END OF SECTION***
1.1 **GENERAL**

1.2 **Related SFU Technical Requirements**

   .1 *Division 33 Utilities*
   
   .2 *Division 01:*
   
   - Section 01 77 00 Closeout Procedures
   - Section 01 78 39 Project Record Documents
   - Section 01 78 23 Operation and Maintenance Data
   - Section 01 78 36 Warranties
   - Section 01 78 45 Maintenance Materials
   - Section 01 91 00 Commissioning
   - Section 01 79 00 Demonstration and Training
   - Section 01 35 05 SFU Policies, Work Procedures, and Forms
   - Section 01 35 29 Health, Safety and Emergency Response Procedures
   
   .3 *Division 27, Section 27 05 05 Communication Rooms Design Guidelines*

   .4 SFU Mechanical Systems Design Checklist – Special Requirements SFU Surrey Warmup Checklist

1.3 **Coordination Requirements**

   .1 Coordinate with SFU Facilities
   
   .2 Coordinate with other design disciplines.
   
   .3 Coordinate with SFU IT for infrastructure or any network/communications requirements.

1.4 **Description**

   .1 These Design Guidelines apply to all *Division 20* sections and all mechanical sections of *Division 33.*

2.1 **MATERIAL AND DESIGN REQUIREMENTS**

2.2 **General**

   .1 The Mechanical Consultant shall submit to SFU Facilities a design philosophy for the proposed building mechanical, plumbing and fire protection systems. Major components of the philosophy must be accepted in principle by SFU Facilities before the project can proceed to construction. Consultants are expected to produce designs that meet User needs and allow SFU Facilities to continue to meet those needs in the future in a safe efficient manner.

   .2 SFU buildings are generally not air conditioned for comfort. Cooling allowed for labs and server rooms where appropriate to meet functional requirements. Where conditions require air-conditioning, submissions for variance from this guideline are to be made as part of the initial submission of project design philosophy.

   .3 All HVAC equipment such as boilers, chillers, variable speed drives, air handling units with unitary control panels must be BACnet compatible.

   .4 Design spaces housing mechanical/electrical equipment with sufficient room for safe servicing, repair and replacement of equipment.
.5 All mechanical and plumbing designs shall be approved by SFU Facilities at Design Development, 60%, and 90-99% set. SFU Facilities comments must be considered and responded to in writing from consultants.

.6 Drawings shall show all mechanical and plumbing equipment in elevation or alternately shall specify mounting heights for the equipment.

.7 Submit to SFU Facilities a set of Issued for Construction drawings showing access paths to all equipment, paths for removal and replacement of proposed equipment and means of lifting equipment where its weight or its largest component exceeds 500 lbs.

.8 As Built/Record Drawings shall reflect all changes to specified means and access routes.

.9 Any variations from the prescribed Owners’ Technical Requirements must be approved in writing by SFU Facilities.

.10 Ladders: Where ladders are provided to access equipment, roofs or other locations, the latest regulations or at a minimum, the following shall apply:

.1 A cage shall be provided for all ladders that exceed 16 feet in height or where there is a danger of a worker falling from the ladder to the ground level, roof or floor including an elevated access from a platform having less than 1.2 meters (48 inches) clearance between the ladder and any adjacent guardrail. The cage shall commence not more than 2.2 meters (7 ft.) above grade and continuing at least 90 centimeters (36 inches) above the top landing with openings to permit access by a worker to rest platforms or to the top landing.

.11 The mechanical consultant shall refer to SFU Mechanical Systems Design Checklist for special requirements on SFU Surrey campus. Ensure the details in the Warm-up checklist are met.

2.3 Mechanical Room Detail

.1 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 Mechanical Rooms to have no public access to room.

.3 SFU Facilities is considered as the User of all service spaces and Mechanical Rooms. Obtain SFU Facilities input and approval for Mechanical Room and routing of service spaces.

2.4 Building Management Systems

.1 SFU Facilities has a central monitoring and control facility for building Mechanical Systems including Plumbing, HVAC, Fire Protection and other systems. Simple remote (web-access) monitoring is also required on all projects. Comply Section 25 05 00 Building Management Systems (BMS) Design Guidelines.

2.5 Site Services – General Requirements

.1 Refer to Division 33 for materials and installation guidelines.

.2 Under no circumstances shall any utility piping extend under buildings as direct buried and in not readily accessible locations. Entire length of utility piping must be readily accessible after project completion. This includes steam, condensate, any gas piping, heating water, cooling water, domestic water, fire protection water, chilled water, and storm and sanitary drainage not related to the building.
2.6 Equipment List

.1 Engineer/Consultant to compile list of major equipment and materials for insertion into tender documents. Contractor to complete list with manufacturer's name and model number.

2.7 Equipment Installation

.1 On piping include unions or flanges for ease of maintenance and disassembly.

.2 Provide space for servicing, disassembly and removal of equipment and components. Follow recommendations of manufacturer.

.3 Equipment drains: pipe to floor drains.

.4 Install equipment, rectangular cleanouts and similar items parallel to or perpendicular to building lines.

.5 Specify curbs under equipment and around pipe penetrations in mechanical rooms.

2.8 Electrical Motors

.1 Engineer/Consultant to include specification for motors when specifying packaged equipment.

.1 Example Only: Motor: EEMAC Class B, squirrel cage induction, 1725 r/min., continuous duty, drip proof, ball bearing, maximum temperature rise 40°C. Motors to be high efficiency and rated for inverter duty.

.2 Specify matched motors and variable frequency drives with low harmonic content and harmonic filters. Maximum acceptable harmonic content as per IEEE Standard 519 and 1100.

2.9 Fan Systems

.1 Selection of fan systems to consider maintenance and energy costs and sound levels. Final selection to be based on life cycle costs and to be approved by SFU Building Operations Technical Services.

.2 Direct drive fan systems are preferred.

2.10 Belt Drives

.1 Specify reinforced belts in matching sheaves. Multiple belts to be matched sets.

.2 Specify cast iron or steel sheaves secured to shafts with removable keys.

.3 For motors under 7.5 kW standard adjustable pitch drive sheaves, having plus or minus 10% range. Replace sheave with correct size after balancing.

.4 For motors 7.5 kW and over sheave with split tapered bushing and keyway having fixed pitch unless specifically required for item concerned. Specify sheave of correct size to suit balancing.

.5 Minimum drive rating 1.5 times nameplate rating on motor. Keep overhung loads within manufacturer's design requirements on prime mover shafts.
2.11 Drive Guards
   .1 Specify guards for unprotected drives.
   .2 Specify means to permit lubrication and use of test instruments with guards in place.

2.12 Unprotected Fan Inlets or Outlets
   .1 Provide wire or expanded metal screen, galvanized, 19 mm mesh.
   .2 Net free area of guard: not less than 80% of fan inlet area.
   .3 Securely fastened in place.
   .4 Guards and screens to be removable for servicing.

2.13 Equipment Supports
   .1 Specify for base mounted equipment chamfered edge housekeeping pads, minimum of 100 mm high and 50 mm larger than equipment dimensions all around. Provide engineered seismic restraints.

2.14 Preparation for Fire stopping
   .1 Insulated pipes and ducts: ensure integrity of insulation and vapor barrier at fire separation.

2.15 Painting
   .1 Refer to Section 09 90 00 Painting and Coating for additional painting specifications.
   .2 Specify at least one coat of corrosion resistant primer paint to ferrous supports and site fabricated work.

2.16 Spare Parts
   .1 Specify spare parts for any critical piece of equipment, or equipment which has a long lead time on parts. This is to be evaluated on a project by project basis as recommended by consultants and contractors prior to close out.
   .2 Furnish the following spare parts in accordance with Section 01 77 00 Closeout Procedures, as follows:
      .1 One casing joint gasket for each size pump.
      .2 One head gasket set for each heat exchanger.
      .3 One glass for each gauge glass.
      .4 One set of belts for each belt driven piece of machinery.
      .5 One filter cartridge or set of filter media for each filter or filter bank in addition to final operating set.
      .6 Parts shall be available from local suppliers.

2.17 Special Tools
   .1 Provide one set of special tools including computer hardware and software required to service equipment as recommended by manufacturers and in accordance with Section 01 77 00 Closeout Procedures.
   .2 Where greasing is required using non industry standard grease fittings, provide suitable adaptors for standard grease guns.
2.18 Access Doors, Materials and Installation

.1 Specify access doors to concealed mechanical equipment for operating, inspecting, adjusting and servicing.

.2 Flush mounted 600 x 600 mm for body entry and 300 x 300 mm for hand entry unless otherwise noted. Doors to open 180° have rounded safety corners, concealed hinges, screwdriver latches and anchor straps.

.3 In special areas such as tiled or marble surfaces, use stainless steel with mill finish.

.4 Remaining areas use prime coated steel.

.5 Locate so that concealed items are accessible.

.6 Locate so that hand or body entry (as applicable) is achieved.

2.19 Demonstration and Operating and Maintenance Instructions

.1 Prior to acceptance, specify tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment.

.2 Use operating and maintenance manual, as-built drawings, audio visual aids, etc. as part of instruction materials.

.3 Ensure correct length of time for instruction is noted in appropriate specification section.

.4 Owner may record these demonstrations on video tape for future reference.

.5 Refer to 01 91 15 Commissioning Training for additional details on the initial commissioning training.

3.1 OPERATION AND MAINTENANCE MANUAL

3.2 General

.1 Refer to Section 01 78 23 Operation and Maintenance Data for detailed requirements.

3.3 Shop Drawings and Products Data

.1 Submit shop drawings and product data in accordance with Section 01 33 00 Submittal Procedures. Information shall include:

.1 Mounting arrangements.

.2 Operating and maintenance clearances. For example, access door swing spaces.

.3 Equipment capacities and operating conditions.

.2 Shop drawings and product data shall be accompanied by:

.1 Detailed drawings of bases, supports, and anchor bolts.

.2 Acoustical sound power data, where applicable.

.3 Points of operation on performance curves.

.4 Manufacturer to certify as to current model production.

.5 Certification of compliance to applicable codes.

.6 Warranty information (extended or standard); standard warranties are for a period of 1 year from substantial performance.
3.4 Existing Systems

.1 Specify connections into existing systems to be made at time approved by Owner. Request written approval of time when connections can be made.

.2 Specify responsibility for damage to existing plant by this work.

3.5 Cleaning

.1 Specify cleaning of mechanical systems in accordance with Section 01 77 00 Closeout Procedures, 2.0 Cleaning.

.2 Specify cleaning of interior and exterior of all systems including strainers. Vacuum interior of ductwork and air handling units.

.3 In preparation for final acceptance, clean and refurbish all equipment and leave in operating condition including replacement of all filters in all air and piping systems.

.4 Specify new filters at turn-over, clean switch gear and VSD serving mechanical equipment inside and out.

.5 Specify removal of construction debris from the mechanical/electrical rooms.

3.6 SFU Standard Details

.1 SFU Standard details, where provided, are for information only. Detailed design is the responsibility of the designer.

.2 Details will follow MMCD guidelines, as well as the respective envelope/infrastructure standard if applicable.

***END OF SECTION***
1.1 **GENERAL**

1.2 **Related SFU Technical Requirements**

.1 *Division 26, Section 26 27 13 Metering*

.2 *Division 33, Section 33 10 00 Water Utilities - 2.4; Section 33 51 00 Natural Gas Distribution - 2.4*

1.3 **Coordination Requirements**

.1 Coordinate with SFU Facilities.

.2 Obtain details of space requirements, access, location and provision of associated services such as electrical, BMS, telecommunications wiring from SFU Facilities.

2.1 **MATERIALS AND DESIGN REQUIREMENTS**

.1 All SFU buildings shall have the following services metered:

<table>
<thead>
<tr>
<th>Type of Meter</th>
<th>Metric Output Units</th>
<th>Make/Model</th>
<th>Database</th>
<th>Recording Interval Duration</th>
<th>Protocol</th>
<th>Division of Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrical</td>
<td>kWh’s, kW</td>
<td>ION</td>
<td>ION Data Archiver</td>
<td>15 minutes on-going</td>
<td>TCP/IP</td>
<td>Division 26</td>
</tr>
<tr>
<td>Thermal Energy</td>
<td>Gigajoules Supply</td>
<td>Revenue</td>
<td>BMS Archiver</td>
<td>60 minutes on-going</td>
<td>TCP/IP</td>
<td>Division 20</td>
</tr>
<tr>
<td>Water</td>
<td>Cubic Meter (M^3)</td>
<td>N/A</td>
<td>BMS Archiver</td>
<td>Daily Monthly on-going</td>
<td>TCP/IP</td>
<td>Division 20</td>
</tr>
</tbody>
</table>

.2 Electrical Meters

.1 Refer to *Division 26, Section 26 27 13 Metering.*

***END OF SECTION***
1.1 GENERAL

1.2 Coordination Requirements

   .1 SFU Facilities

1.3 Description

   .1 Salvage of existing mechanical equipment or controls components on renovation or retrofit projects.

2.1 MATERIAL AND DESIGN REQUIREMENTS

   .1 The Mechanical Consultant shall prepare a list of those items that are potentially reusable by the Owner. Submit the list to the SFU Facilities before demolition commences.

   .2 The list will be reviewed with the SFU Facilities, revised to reflect the University's needs and returned to the Consultant before demolition.

   .3 The Consultant shall list, in the specifications, all items that are to be salvaged.

   .4 The following wording shall be included in the specifications:

       .1 The following items shall be carefully removed and handed over to the Owner.
       .2 The Sub-Contractor shall inventory all items identifying their source, the location, date of removal and stating the Company’s name.

   .5 Items for Disposal

       .1 Remove all redundant material not required by the owner from the Campus and dispose of legally.

***END OF SECTION***
<table>
<thead>
<tr>
<th>Contents</th>
<th>Label Graphic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fire Protection Water (Sprinkler Lines)</td>
<td>FIRE PROTECTION</td>
</tr>
<tr>
<td>Fuel Oil</td>
<td>FUEL OIL</td>
</tr>
<tr>
<td>Compressed Air</td>
<td>COMPRESSED AIR</td>
</tr>
<tr>
<td>Chilled Water Supply</td>
<td>CHILLED WATER SUPPLY</td>
</tr>
<tr>
<td>Chilled Water Return</td>
<td>CHILLED WATER RETURN</td>
</tr>
<tr>
<td>Condenser Supply</td>
<td>CONDENSOR SUPPLY</td>
</tr>
<tr>
<td>Condenser Water Return</td>
<td>CONDENSOR WATER RETURN</td>
</tr>
<tr>
<td>Process Chilled Supply</td>
<td>PROCESS CHILLED SUPPLY</td>
</tr>
<tr>
<td>Process Chilled Return</td>
<td>PROCESS CHILLED RETURN</td>
</tr>
<tr>
<td>Heating Water Supply</td>
<td>HEATING WATER SUPPLY</td>
</tr>
<tr>
<td>Heating Water Return</td>
<td>HEATING WATER RETURN</td>
</tr>
<tr>
<td>Hydronic Heat Recovery</td>
<td>HYDRONIC HEAT RECOVERY</td>
</tr>
<tr>
<td>Make Up Water</td>
<td>MAKE UP WATER</td>
</tr>
<tr>
<td>Domestic Hot Water Supply</td>
<td>DHW SUPPLY</td>
</tr>
<tr>
<td>Domestic Hot Water Return</td>
<td>DHW RETURN</td>
</tr>
<tr>
<td>Domestic Cold Water Supply</td>
<td>DCW SUPPLY</td>
</tr>
<tr>
<td>Tempered Domestic Water</td>
<td>TEMPERED DOMESTIC WATER</td>
</tr>
<tr>
<td>Storm Water</td>
<td>STORM WATER</td>
</tr>
</tbody>
</table>
# Pipe Colour Code Standards

<table>
<thead>
<tr>
<th>Contents</th>
<th>Label Graphic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sanitary Water</td>
<td><strong>SANITARY WATER</strong></td>
</tr>
<tr>
<td>Sanitary Vent</td>
<td><strong>SANITARY VENT</strong></td>
</tr>
<tr>
<td>Condensate Drain</td>
<td><strong>CONDENSATE DRAIN</strong></td>
</tr>
<tr>
<td>Industrial Cold Water Supply</td>
<td><strong>INDUSTRIAL CW SUPPLY</strong></td>
</tr>
<tr>
<td>Industrial Hot Water Supply</td>
<td><strong>INDUSTRIAL HW SUPPLY</strong></td>
</tr>
<tr>
<td>Industrial Hot Water Return</td>
<td><strong>INDUSTRIAL HW RETURN</strong></td>
</tr>
<tr>
<td>Cold Irrigation</td>
<td><strong>COLD IRRIGATION</strong></td>
</tr>
<tr>
<td>Hot Irrigation</td>
<td><strong>HOT IRRIGATION</strong></td>
</tr>
</tbody>
</table>

**NOTES:**

1.0) ARROWS ARE TO BE BLACK ARROWS ON WHITE BACKGROUND
2.0) ARROW ARE TO BE BANDED AROUND THE PIPE CIRCUMFRENCE
SFU Identification and Labeling Standard

Sep 12, 2019

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- Motor starter on MCC panel 25
- Motor Control Centre 25
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- General Mechanical Equipment 28
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- Unit split system 29
- Fume Hood/Fume exhaust fan 30
- VSD Control Warning On 31
- MCC/Disconnect Switches 32
- Fire Alarm Label on MCC 32
- Emergency Generator 33
- Disconnect Fume hood Warning 33
- Electrical Motor Starter Interlock Label on MCC 34
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- Mechanical equipment with emergency power supply label 34
- Fire and smoke damper 35
SFU Identification and Labeling Standard

SFU uses a 7 or 8 character alpha-numeric serial number for equipment identification. Except Fire Dampers, HVAC VAV Boxes, Fan Coil Units, Variable Speed Drives

The first set of two or three characters designates the building or area code (see list on pages 3 to 5).

The 2nd set of two characters designates the equipment/data type code (see list on pages 15 to 16).

The 3rd set of three characters is the unit number for that individual piece of equipment.

Format:  xxx-yy-zzz

xxx  = building/area code

yy    = equipment code

zzz   = unit number.

Example:  41-01-002

41  = South Sciences Building
01  = Fans
002 = unit number 002 (Note: for Electrical panels, the first digit number is the floor identification number, for mechanical equipment, there is no floor identification number)
## SFU Identification and Labeling Standard

**BUILDING/AREA CODES (Check with SFU Records for the latest Information)**

<table>
<thead>
<tr>
<th>Area code</th>
<th>Building Name (Building Code)</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>Campus (Site Services)</td>
</tr>
<tr>
<td>02</td>
<td>Academic Quadrangle (AQ)</td>
</tr>
<tr>
<td>03</td>
<td>Convocation Mall (CML)</td>
</tr>
<tr>
<td>04</td>
<td>W.A.C. Bennett Library (LIB)</td>
</tr>
<tr>
<td>05</td>
<td>Shrum Science Complex</td>
</tr>
<tr>
<td>06</td>
<td>Lesie &amp; Gordon Diamond Family Aud (DFA)</td>
</tr>
<tr>
<td>07</td>
<td>Lorne Davies Complex (LDC)</td>
</tr>
<tr>
<td>08</td>
<td>East Concourse Cafeteria(ECC)</td>
</tr>
<tr>
<td>09</td>
<td>Robert C. Brown Hall (RCB)</td>
</tr>
<tr>
<td>10</td>
<td>Spare</td>
</tr>
<tr>
<td>11</td>
<td>Strand Hall (SH)</td>
</tr>
<tr>
<td>12</td>
<td>Strand Hall Annex (SHA)</td>
</tr>
<tr>
<td>13</td>
<td>Facilities Services (FM)</td>
</tr>
<tr>
<td>14</td>
<td>Fuel Oil Storage (OS)</td>
</tr>
<tr>
<td>15</td>
<td>Transportation Centre (TC)</td>
</tr>
<tr>
<td>16</td>
<td>Spare</td>
</tr>
<tr>
<td>17</td>
<td>Blusson Hall (BLU)</td>
</tr>
<tr>
<td>18</td>
<td>Visitor’s Parkade West Mall (VP)</td>
</tr>
<tr>
<td>19</td>
<td>Service Station (GAS)</td>
</tr>
<tr>
<td>20</td>
<td>Water Tower (WT)</td>
</tr>
<tr>
<td>21</td>
<td>Water Tower Building (WTB)</td>
</tr>
<tr>
<td>22</td>
<td>Saywell Hall (SWH)</td>
</tr>
<tr>
<td>23</td>
<td>Greenhouses (GH)</td>
</tr>
<tr>
<td>24</td>
<td>Bee Research Building (BEE)</td>
</tr>
<tr>
<td>25</td>
<td>High Voltage Sub Station 69kV (HVS)</td>
</tr>
<tr>
<td>26</td>
<td>Shrum Science Building B (SCB)</td>
</tr>
<tr>
<td>27</td>
<td>Shrum Science Building C (SCC)</td>
</tr>
<tr>
<td>28</td>
<td>Shrum Science Building K (SCK)</td>
</tr>
<tr>
<td>29</td>
<td>Shrum Science Building P (SCP)</td>
</tr>
<tr>
<td>30</td>
<td>Transit Loop Building (TLB)</td>
</tr>
<tr>
<td>31</td>
<td>Pump House (FPS)</td>
</tr>
<tr>
<td>32</td>
<td>Maggie Benston Centre (MBC)</td>
</tr>
<tr>
<td>33</td>
<td>Childcare Centre (CCC)</td>
</tr>
<tr>
<td>34</td>
<td>Animal Care Facility (ACF)</td>
</tr>
<tr>
<td>35</td>
<td>Alcan Aquatic Research Centre (AAB)</td>
</tr>
<tr>
<td>36</td>
<td>Education Building (EDB)</td>
</tr>
<tr>
<td>37</td>
<td>Diamond Alumni Centre (DAC)</td>
</tr>
<tr>
<td>38</td>
<td>Applied Science Building (ASB)</td>
</tr>
<tr>
<td>39</td>
<td>Halpern Centre (HAL)</td>
</tr>
<tr>
<td>40</td>
<td>West Mall Centre (WMC)</td>
</tr>
</tbody>
</table>
SFU Identification and Labeling Standard

41 South Sciences Building (SSB)
42 Spare (Shrum Classroom Building)
43 East Theatre Annex (ETA)
44 East Academic Annex (EAA)
45 Science Research Annex (SRA)
46 Technology & Science Complex 1 (TASC1)
47 Technology & Science Complex 2 (TASC2)
48 Technology & Science Complex 3 (TASC3)
49 Biology Trailer (T3)
50 Harbour Centre (HCC)
51 Kelowna Trailers
52 Segal Grad School of bus (SEGAL)
53 611 Alexander (ALX)
54 Morris J. Wosk Centre for Dialogue (CFD)
55 Spare
56 Goldcorp Centre for Arts (GCA)
57 Charles Chang Innovation Centre
58 Spare
59 Spare
60 Surrey Sire Services (SUR)
61 Surrey Building (SRYC)
62 Spare
63 Surrey Centre Libray (SRYL)
64 Surrey City Parkway (SRYQ)
65 Surrey Whalley Ring Road (SRYR)
66 Spare
67 Spare
68 Spare
69 Spare
70 Spare
71 South East Classroom Block (SECB)
72 Winter Operations Building (WOB)
73 Emergency Supplies Trailer (EST)
74 Beedie Field Concession (BFC)
75 Spare
76 Burnaby Mountain District Energy Utility (BMDEU)
77 Trottier Observatory (TO)
78 LDC Stadium (LDC)
79 Spare
80 Spare
81 Cowichan Townhouse (COW)
82 Chilcotin Townhouse (CHI)
83 Kelowna Townhouse (KEL)
84 Kimberley Townhouse (KIM)
85 Kitimat Townhouse (KIT)
86 Penticton Townhouse (PEN)
87 Qualicum Townhouse (QUA)
88 Quensel Townhouse (QUE)
89 Squamish Townhouse (SQU)
90 President's Residence (PR)
91 Madge Hogarth House (MHH)
SFU Identification and Labeling Standard

92 Shell House Residence (SHR)
93 Louis Riel House (LRH) (Demolished)
94 McTaggart-Cowan Hall (MCH)
95 Hamilton Hall (HAM)
96 Residence Dining Hall (Residence Bldg A) (DH)
97 Shadbolt House (Residence Bldg B) (SBH)
98 Barbara Rea House (Residence Bldg C) (BRH)
99 Pauline Jewett House (Residence Bldg. D) (PJH)
100 Student Union Building (SUB)
181 Residence Phase 1 Building 1 (RES1)
182 Residence Phase 1 Building 2 (RES2)
200 Discovery Park (DIS)
201 Discovery 2 (Formerly MTF) (DIS2)
202 Discovery 1 (Formerly Xantrex) (DIS1)
301 Kamloops Trailers (T10)
400 UniverCity (UCTY)
401 Cornerstone Building (CSTN)
402 Naheeno (NAH)
412 Town and Gown Square (TGS)
604 Surrey Plaza (SRYP)
605 Sustainable Energy and Engineering Building (SRYE)
607 Image Tech Lab - Surrey Memorial Hospital (IMA)
PF001 Play Fields (PLAYFLD)
PF002 Playing Field #2 (PF2)
PF004 Playing Field #4 (PF4)
PF005 Terry Fox Field (PF5)
PF006 Beedie Softball Field (PF6)
PL001 A Parking Lot (PLA)
PL002 B Parking Lot (PLB)
PL003 C Parking Lot (PLC)
PL004 Parking Lot D (PLD)
PL005 E Parking Lot (PLE)
PL006 F Parking Lot (PLF)
PL007 G Parking Lot (PLG)
PL008 P3 Parking Lot (Discovery) (PLP3)
PL009 Parking Lot 1 (PL1)
PL010 Convocation Mall Parkade (PLCM)
PL011 Lorne Davies Complex Parkade (PLLDC)
PL012 Visitor North Parking Lot (PLVN)
PL013 Daycare Parking Lot (PLCCC)
PL015 Residence Townhouses Parking Lot (PLTH)
PL016 Residence Parking Lots (PLR)
PL017 Discovery Parking Lot (PLDIS)
SFU Identification and Labeling Standard

Equipment Type List

<table>
<thead>
<tr>
<th>Type/Subtype</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>15 kV Junction Boxes</strong></td>
</tr>
<tr>
<td>2 Way - 15kV JB</td>
</tr>
<tr>
<td>4 Way - 15kV JB</td>
</tr>
<tr>
<td>6 Way - 15kV JB</td>
</tr>
<tr>
<td><strong>15 kV Power Cable</strong></td>
</tr>
<tr>
<td><strong>AC</strong></td>
</tr>
<tr>
<td>Air Conditioning Unit</td>
</tr>
<tr>
<td>Air Curtain</td>
</tr>
<tr>
<td>Air Handling Unit</td>
</tr>
<tr>
<td>Chiller</td>
</tr>
<tr>
<td>Cold Table</td>
</tr>
<tr>
<td>Compressor - Condenser Unit</td>
</tr>
<tr>
<td>Cooling Tower</td>
</tr>
<tr>
<td>Dehumidifier</td>
</tr>
<tr>
<td>Display Cooler</td>
</tr>
<tr>
<td>Evaporative Air Cooler</td>
</tr>
<tr>
<td>Fan Coil Unit</td>
</tr>
<tr>
<td>Fluid Cooler</td>
</tr>
<tr>
<td>Heat Pump</td>
</tr>
<tr>
<td>Heat recovery coil</td>
</tr>
<tr>
<td>Heat recovery wheel</td>
</tr>
<tr>
<td>Humidifier</td>
</tr>
<tr>
<td>Ice Maker</td>
</tr>
<tr>
<td>Other AC</td>
</tr>
<tr>
<td>Package Unit</td>
</tr>
<tr>
<td>Reach-in Cooler</td>
</tr>
<tr>
<td>Roof Top Unit</td>
</tr>
<tr>
<td>Walk-in Cold Room</td>
</tr>
<tr>
<td>Walk-in cooler</td>
</tr>
<tr>
<td><strong>Air Dryer</strong></td>
</tr>
<tr>
<td>Air Dryer</td>
</tr>
<tr>
<td><strong>Air Filter</strong></td>
</tr>
</tbody>
</table>
SFU Identification and Labeling Standard

**Backflow Preventer**
AG  
Backflow Preventer Parts  
DCDA  
DCVA  
PVB  
RPBA  
RPDA

**Boiler**
Domestic Hot Water Boiler  
Heating Boiler  
High Pressure Boiler

**Circuit Breaker**
12 kV - CB  
480 V - CB  
69 kV - CB  
Circuit Breaker Panel  
Distribution Panel

**Compressor**
DDC

**Door**
Automatic Door

**Elevator**
Basement Traction/Freight  
Basement Traction/Passenger  
Cantilever Hydraulic/Type B Lift  
D/W Elevator  
Direct Acting Hydraulic/Freight  
Direct Acting Hydraulic/Passenger  
Direct Acting Hydraulic/Service  
Hy/Frt Elevator  
Hy/Pas Elevator  
Machine Room-less Traction/Passenger  
Other Elevator
Overhead Traction/Passenger
Stair Lift/Passenger
Tr/Frt Elevator
Tr/Pas Elevator
Traction/Dumbwaiter
Twin Post Hydraulic/Passenger
Vertical Lift

Emergency & Exit Lights
Exit Sign
Relay Control
Remote Light (double)
Remote Light (single)
Remote Light (Triple)
Unit Equipment for Emergency System
Unit Equipment w/ Light (double)
Unit Equipment w/ Light (single)
Unit Equipment w/ Light (Triple)

Emergency Generator
Fixed Emergency Generator
Mobile Emergency Generator

Emergency Power Equipment

Fan
Ceiling Fan
Cooling tower fan
Exhaust Fan
Fume Exhaust Fan
Pressurization Fan
Return Fan
Supply Fan
Transfer Fan

Fire Alarm System
Fire Alarm and Detection
SFU Identification and Labeling Standard

Fire Extinguisher
2.5 FOAM
ABC-10
ABC-10-C
ABC-10-CO2
ABC-18
ABC-2.5
ABC-20
ABC-5
ABC-9.5
ANSUL K-GUARD
BC-10
BC10-CO2
BC-2.5
BC-5
BC-6
BC-CO2-10
CO2-5
CO2-10
CO2-15
CO2-20
CO2-50
CO2-75
FM200
H1301
K-6L
KIDDE
LXD-30
RANGE GUARD

Fire Hose Cabinets
100' 1 1/2"
100' 2 1/2"
100' 2 1/2" / 1 1/2"
100' 2 1/2" / 75' 2 1/2"
100' 2 1/2" / 75' 1 1/2"
100' 2 1/2" / 100' 1 1/2"
75' 1 1/2"
75' 2 1/2"
SFU Identification and Labeling Standard

75' 2 1/2" / 1 1/2"

**Firestop System**
- Fire Damper
- Smoke Damper
- Fire/Smoke Combination Damper

**Fixed Extinguishing Syst.**
- Agent Storage Container
- Carbon Dioxide Gas
- Commercial Cooking Operations
- Fire Detection, Alarm & Supr. Syst.
- Novec

**Fume hood**
- Biohazards Fume Hood
- Chemical Storage Cabinet
- Fume Canopy

**Furnace**
- Hot water coil
- Roof Top Unit

**Hand & Hair Dryer**

**Harnesses**
- Fall protection harnesses

**Heater**
- Convective Heater
- Electric Unit Heater
- Force Flow Heater
- Gas Unit Heater
- Heat tracing
- Hot water coil
- Radiative Heater
- Reheat Coil
SFU Identification and Labeling Standard

Sil Flow Heater
Sump Heater
Unit Heater
Unit Ventilators

**Hydrants & Standpipes**
Compression
Slide Gate

**Life Line Anchors**
Tie Back and Life Line Anchors

**Lifting Devices**
Aerial Lift
Crane
Dock Leveler
Hoist
Lift

**Meters**
Electric
Gas
Water

**Miscellaneous**
Miscellaneous Other
UV light
Winch

**Monitoring Devices**
CO2 Sensor
Freeze stats
Gas Sensors
Level Alarm

**Motor Control Centre**

**Phone**
Code Blue, Emergency Telephone-APC
Plumbing Fixtures
Drench Hose
Eye Wash
Eye Wash /Emergency Shower
Eye Wash/Emerg. Shower/Drench Hose
Filter (Sand/Activated Carbon)
Pure Water System
Water Filter
Water Fountain

Pressure Vessel
Air Dryer
Air Receiver
Air Separator
Autoclave
Boiler
Chiller Condenser
Chiller Evaporator
Chiller Oil Separator
Chiller Unit
Compressed Air Tank
Domestic Hot Water Tank
Expansion Tank
Fire Suppression Tank
Heat Exchanger
Refrigeration
Sterilizer
Unfired Pressure Vessel

Pump
Cooling Pump
Distilled Water Pump
Fire Protection Pump
Fountain Pump
Fuel Pump
SFU Identification and Labeling Standard

Heating DHW Pump
Heating Pump
High Pressure Pump
Hot Water Supply
Other Pumps
Sanitary/Storm Pump
Transfer Pump

Sprinkler System
Dry Pipe
Pre-Action
Wet Pipe

Switch
12 kV - Switch
300KVA
400KVA
480 V - Switch
69 kV - Switch

Tank
Chemical dosing
Domestic Hot Water
Fuel Tank
Hot Water Tank
Retention Tank
Sea Water Tank
Septic Tank
Storage Tank
Swirl Tank

Transformer

Unit Substation

Variable Speed Drives
VSD
SFU Identification and Labeling Standard

Valve
Building Isolation Valve
Gas Valve
Pressure Regulator Valve
Pressure Release Valve
Seismic Gas Valve
Water Valve

VAV
Exhaust VAV
Supply VAV
VAV type a

Waste Handling
Cardboard Bailer
Compactor
Front Dump
Roll-off
Vertipak
EQUIPMENT CODES

01 FANS
02 PUMPS
03 COMPRESSORS
04 FURNACES
05 DOMESTIC HOTWATER TANKS/EXPANSION TANKS
06 BOILERS
07 FILTERS AND AIR WASHERS
08 AIR CONDITIONING/REFRIGERATION EQUIPMENT/AIR HANDLING UNIT/ROOF TOP UNIT/HEAT PUMP UNIT/AIR DRYER/FAN COIL UNIT
09 ELECTRICAL MANHOLES & PULL BOXES
10 EMERGENCY GENERATORS
11 FORCED FLOW AND UNIT HEATERS
12 ELEVATORS & ASSOCIATED TOOLS AND CABINETS
13 TRANSFORMERS
14 15KV UNIT SUBSTATIONS & ASSOCIATED TOOLS AND CABINETS
15 15KV JUNCTION BOXES
16 MOTOR CONTROL CENTRES
17 120/208 VOLT CIRCUIT BREAKER PANELS
18 277/480 or 600/347 VOLT CIRCUIT BREAKER PANELS
19 SHIELDED DATA LINE JUNCTION BOXES
20 CODED RELAYS AND 2801'S
21 RELAY PANELS
22 CLOCKS
23 MONITORING DEVICES AND GAUGES
24 METERING DEVICES
25 LIGHTS EMERGENCY BATTERY POWERED (SELF CONTAINED)
26 FIRE EQUIPMENT MISC.
27 EMERGENCY POWER EQUIPMENT MISC.
28 BATTERIES
29 THERMOSTATS & MISC. CONTROLS
30 PLUMBING AND FIXTURES
31 PIPING
32 VALVES
33 ENERGY MANAGEMENT INTERFACE PANELS
34 LOW VOLTAGE CONTROL CABLES
35 LOW VOLTAGE JUNCTION BOXES
36 SHIELDED DATA LINE CABLES
37 120/208 VOLT DISTRIBUTION PANELS
38 277/480 or 600/347 VOLT DISTRIBUTION PANELS
39 120/208 VOLT POWER CONDITIONERS & U.P.S.'S
40 277/480 VOLT POWER CONDITIONERS & U.P.S.'S
41 120/208 VOLT EMERGENCY CIRCUIT BREAKER PANELS
42 277/480 or 600/348 VOLT EMERGENCY CIRCUIT BREAKER PANELS
43 LIGHTS PARKING LOT
44 LIGHTS INCANDESCENT
SFU Identification and Labeling Standard

45 LIGHTS FLUORESCENT
46 LIGHTS OTHER DISCHARGE TYPES
47 LIGHTS EXIT
48 LIGHTS EMERGENCY ALL EXCEPT (BATTERY PACK UNITS)
49 LIGHTS INFRARED
50 MISCELLANEOUS
51 HAND AND HAIR DRIERS
52 TIME DEVICES
53 SWITCHES
54 FUSES
55 CIRCUIT BREAKERS
56 CAPACITORS
57 GROUND FAULT INTERRUPTERS
58 RECEPTACLES
59 APPLIANCES
60 KITCHEN EQUIPMENT
61 INFORMATION CABLES
62 COMMUNICATION CABLES
63 FIBRE OPTIC CABLES
64 15KV CABLES
65 HEATERS
66 MOTORS
67 METERS
68 ROOM SMOKE ALARMS
69 FIRE ALARM CPU'S
70 FIRE ALARM DGP'S
71 FIRE ALARM HEAT DETECTORS
72 FIRE ALARM SMOKE DETECTORS
73 FIRE ALARM PULL STATIONS
74 FIRE ALARM BELLS/STROBES
75 DELTA 1 K JUNCTION BOXES
76 DELTA 1 K SHIELDED CABLE
77 15K CONTROL CABLES
78 120/208 VOLT EMERGENCY DISTRIBUTION PANELS
79 277/480 or 600/347 VOLT EMERGENCY DISTRIBUTION PANELS
80 DEPARTMENTAL EQUIPMENT (VEHICLES)
81 LOW VOLTAGE BUS DUCTS
88 ENERGY MANAGEMENT PANELS
89 EMERGENCY MOTOR CONTROL CENTRES
90 BLDG. STRUCTURE & TECHNOLOGY
91 DDC (Direct Digital Control)
92 VAV (Variable Air Volume)
93 DOORS
94 LIFE LINE ANCHORS
95 TANKS
96 LIFTING DEVICES
SFU Identification and Labeling Standard

SFU IDENTIFICATION NUMBER
DESCRIPTION FOR ELECTRICAL EQUIPMENT

The electrical equipment identification number is used by the electrical department follows the standard format used by Facilities Management (described on page 2). The instructions and examples are the followings:

NOTE: The floor number has been given the floor level number based on as-built architect drawing floor naming, eg. 6000 level floor should be 6. This system of using floor numbers makes panel location easier. Since we are using a single character to indicate the floor level we must use the hexadecimal numbering system for floors above the 9000 level floor.

<table>
<thead>
<tr>
<th>Level</th>
<th>Floor Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>1000</td>
<td>1</td>
</tr>
<tr>
<td>2000</td>
<td>2</td>
</tr>
<tr>
<td>3000</td>
<td>3</td>
</tr>
<tr>
<td>4000</td>
<td>4</td>
</tr>
<tr>
<td>5000</td>
<td>5</td>
</tr>
<tr>
<td>6000</td>
<td>6</td>
</tr>
<tr>
<td>7000</td>
<td>7</td>
</tr>
<tr>
<td>8000</td>
<td>8</td>
</tr>
<tr>
<td>9000</td>
<td>9</td>
</tr>
</tbody>
</table>
eg. A01 would be on the 10000 level unit number 1. The floor number should follow the Archibus drawing floor naming.

<table>
<thead>
<tr>
<th>Code Segment</th>
<th>Data</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>02</td>
<td>Academic Quadrangle</td>
</tr>
<tr>
<td>2</td>
<td>17</td>
<td>120/208V Circuit Breaker Panel</td>
</tr>
<tr>
<td>3</td>
<td>341</td>
<td>The first digit is always the floor number. 341 means the 3000 level floor, Panel 41. Each floor panel number should start with 1 under one equipment code. Example: 02-17-401, means AQ building, 120/208V circuit Breaker Panel, fourth floor, the first unit.</td>
</tr>
</tbody>
</table>
When the job is complete please provide a cross-index list of SFU numbers and as-built drawing tag. Examples are below:

<table>
<thead>
<tr>
<th>SFU ID</th>
<th>As-built drawing tag for electrical panels</th>
</tr>
</thead>
<tbody>
<tr>
<td>02-17-339 = S</td>
<td></td>
</tr>
<tr>
<td>02-17-340 = T</td>
<td></td>
</tr>
<tr>
<td>02-17-341 = Z</td>
<td></td>
</tr>
<tr>
<td>02-17-342 = B</td>
<td></td>
</tr>
<tr>
<td>02-17-401 = JJ1A</td>
<td></td>
</tr>
<tr>
<td>02-17-402 = JJ1 B</td>
<td></td>
</tr>
</tbody>
</table>
SAMPLE LABELS FOR SFU EQUIPMENT

The examples show the labels that SFU will be using in the current or future renovation or new buildings. These are standards of uniform size and location for SFU staff to duplicate with SFU in-house label maker.

The type of label will be found in the specifications. SFU however would like the label size and location to be uniform. SFU uses software "Label View 10 pro" to make labels.

All equipment on campus has a unique asset number. Contact your SFU project manager to obtain new asset number. This asset number should be included on as-built documentation.
SFU equipment number:
Building Number-
equipment code-
Floor number/unit number

Transformer drawing tag
Font: Arial 16

Electric supply from panel drawing tag
(SFU ID), if there is a SFU ID number,
Font: Arial 16

Electric Feeds to panel drawing tag
(SFU ID), if there is a SFU ID number.
Font: Arial 16

Lamacoid label size: 4” Width, 2” Height
Black background/white letter/regular

Sample SFU Transformer Identification Labels

SFU equipment number:
Building Number-
equipment code-
Floor number/unit number

201-13-101

T1  150KVA, 600-120/208V
Supply: MDP  DIS2-106.1
Feeds: D2B  DIS2-106.1

Capacity description.
Font: Arial 16

Electric Feeds/Supply location.
Building code - room number.
Font: Arial 16

Floor number
Unit number
Capacity description.
Font: Arial 16
SFU Equipment Number:
Building Number-
Equipment Code-
Floor Number/Unit Number
Font: Arial 32

Panel Drawing Tag
Font: Arial 16

Electric Supply Panel Drawing Tag (SFU ID), if there is
Font: Arial 16

Lamacoid label size: 3.35” Width, 1.82” Height
Black background/white letter/regular

SAMPLE OF SFU BREAKER/DISTRIBUTION PANEL IDENTIFICATION LABELS

SFU Equipment Number:
Building Number-
Equipment Code-
Floor Number/Unit Number
Font: Arial 32

Panel Drawing Tag
Font: Arial 16

Electric Supply Panel Drawing Tag (SFU ID), if there is
Font: Arial 16

Lamacoid label size: 3.35” Width, 1.82” Height
Black background/white letter/regular

SAMPLE OF SFU EMERGENCY DISTRIBUTION PANEL IDENTIFICATION LABELS
SAMPLE SFU INDENTIFICATION NUMBERING DESCRIPTION FOR SFU EQUIPMENT

SAMPLE OF SFU BREAKER LABEL BESIDE BREAKER ON DISTRIBUTION PANEL IDENTIFICATION LABELS

SFU Equipment Number: Building Number - Equipment Code - Floor Number/Unit Number
Font: Arial 32

Panel Drawing Tag
Font: Arial 16

Floor Number
Unit Number
Voltage
Font: Arial 16

Panel Location, Building Code - Room Number
Font: Arial 16

Lamacoid label size: 2.875”. Width, 1.25” Height
Black background/white letter/regular

SAMPLE OF SFU BREAKER LABEL ON EMERGENCY DISTRIBUTION PANEL IDENTIFICATION LABELS

22-42-A02
4EA 277/480V
Location: SWH-012

22-89-A01
4ME 120/208V
Location: SWH-106

22-42-901
4E 277/480V
Location: SWH-913

22-78-992
2EB 120/208V
Location: SWH-9209

Lamacoid label size: 2.875”. Width, 1.25” Height
RED background/white letter/regular
SAMPLE: Emergency Distribution Panel EM

Label shall be put on the top Centre of the Panel

22-79-901
EM 277/480V
Supply: ATS SWH-913

22-42-A02
4EA 277/480V
Location: SWH-512

22-42-901
4E 277/480V
Location: SWH-913

22-89-A01
4ME 120/208V
Location: SWH-106

22-78-992
2EB 120/208V
Location: SWH-9209
SAMPLE SFU IDENTIFICATION NUMBERING DESCRIPTION
FOR SFU EQUIPMENT

SAMPLE OF SFU MOTOR STARTER LABEL ON MCC PANEL
IDENTIFICATION LABELS

SFU Equipment Number:
Building Number-
Equipment Code-
Unit Number
Font: Arial 32

Unit Number. No floor number reflects for mechanical equipment

Equipment Drawing Tag
Font: Arial 16

Equipment Description with serving area
Font: Arial 12

Location. Font: Arial 16

Lamacoid label size: 2.875”. Width, 1.25” Height
Black background/white letter/regular

SAMPLE OF SFU MOTOR CONTROL CENTRE LABEL
IDENTIFICATION LABELS

SFU Equipment Number:
Building Number-
Equipment Code-
Floor Number/Unit Number
Font: Arial 36

Floor Number

Unit Number

Description
Font: Arial 20

Voltage
Font: Arial 20

MCC Drawing Tag.
Font: Arial 20

Electrical Supply
From Panel Drawing Tag (SFU-ID).
Font: Arial 16

Electrical Supply
Location.
Building Code - Room Number.
Font: Arial 16

Lamacoid label size: 4” Width, 2.5” Height
Black background/white letter/regular

201-08-001
AHU-1  Air Handling Unit
Location: DIS2-RF000

47-16-701
Motor Control Center
MCC-NE2  480V

Elec Supply:
PD-N1(47-38-901)  TASC2-9001
SAMPLE OF SFU EMERGENCY MOTOR CONTROL CENTRE IDENTIFICATION LABELS

SFU Equipment Number:
Building Number-
Equipment Code-
Floor Number/Unit Number
Font: Arial 36

MCC Drawing Tag
Font: Arial 20

40-89-002
Motor Control Center
MCC-2Y 480V

Elec Supply:
SDC 1Y1(40-79-102) WMC-0136

Electrical Supply from Panel Drawing Tag (SFU ID)
Font: Arial 16

Floor Number.
Unit Number
Description
Font: Arial 20
Voltage
Font: Arial 20

Lamacoid label size: 4” Width, 2.5” Height
RED background/white letter/regular

Electrical Supply Location.
Building code - Room Number.
Font: Arial 16
SAMPLE SFU IDENTIFICATION NUMBERING DESCRIPTION FOR SFU EQUIPMENT

SAMPLE OF SFU VARIABLE SPEED DRIVES LABEL IDENTIFICATION LABELS

SFU ID of VSD serving equipment
Font: Arial 32

Add “-VSD”

100-01-028-VSD
Variable Speed Drive

VSD-AHU1-RF2

Elec Supply: 1M4(100-18-101), CCT 1,3,5

SUB-1110

Description
Font: Arial 16

VSD- serving equipment drawing tag
Font: Arial 16

Electrical Supply from MCC or Panel Drawing Tag (SFU ID) and circuit breaker # if there is
Font: Arial 16

Font: Arial 11

Electrical Supply Location. Building Code - Room Number.
Font: Arial 16

Lamacoid label size: 3.35” Width, 1.82” Height
Black background/white letter/regular

SAMPLE OF SFU SPARE BUCKETS ON MCC CENTRE IDENTIFICATION LABELS

Spare

Font: Arial 36

Lamacoid label size: 2.875” Width, 1.25” Height
Black background/white letter/regular
**SAMPLE SFU INDENTIFICATION NUMBERING DESCRIPTION**
**FOR SFU EQUIPMENT**

**SAMPLE OF SFU GENERAL MECHANICAL EQUIPMENT IDENTIFICATION LABELS**

- **SFU equipment number:**
  - Building Number-
  - equipment code-
  - unit number
  - Font: Arial 32

- **Equipment drawing tag**
  - Font: Arial 16

- **Electrical Supply from MCC or Panel**
  - Drawing Tag (SFU ID) and circuit breaker # if there is.
  - Font: Arial 16

- **Unit number. No floor number reflects for mechanical equipment**

- **Equipment description.**
  - Font: Arial 12

- **Electrical Supply Location.**
  - Building Code-
  - Room Number.
  - Font: Arial 16

- **Lamacoid label size: 3.35” Width, 1.82” Height**
  - Black background/white letter/regular
SFU Equipment Number:
Building Number-Equipment Code-Unit Number. Font: Arial 32

Add “-FC” to its condensing unit SFU ID

Lamacoid label size: 3.35” Width, 1.82” Height
Black background/white letter/regular

Font: Arial

Electric Supply from MCC or Panel Drawing Tag (SFU ID) and circuit breaker # if there is. Font: Arial 16

Equipment Drawing Tag Font: Arial 16

Electrical Supply Location. Building Code - Room Number. Font: Arial 16

36-08-006
Heat Pump
HP-1
Elec Supply: PANEL BB EDB-8605

36-08-006-FC01
Fan coil unit for 36-08-006
FC1A
Elec Supply: PANEL CC1 EDB-865

36-08-006-FC02
Fan coil unit for 36-08-006
FC1B
Elec Supply: PANEL CC1 EDB-865

36-08-006-FC03
Fan coil unit for 36-08-006
FC2A
Elec Supply: PANEL CC EDB-8620

36-08-006-FC04
Fan coil unit for 36-08-006
FC2B
Elec Supply: PANEL CC EDB-8620

36-08-006-FC05
Fan coil unit for 36-08-006
FC3A
Elec Supply: PANEL CC EDB-8620
SAMPLE SFU IDENTIFICATION NUMBERING DESCRIPTION FOR SFU EQUIPMENT

SAMPLE OF SFU FUME HOODS/FUME HOODS EXHAUST FAN IDENTIFICATION LABELS

SFU Equipment Number:
Building Number-Equipment Code-Unit Number. Font: Arial 32

27-01-010
Fume hood exhaust fan
EF-1
Elec Supply: C2A-X
SCC-C8075

27-01-010-FH
Fume hood served by 27-01-010
FH-5
Elec Supply: C2A-2
SCC-C8075

Equipment Drawing tag
Font: Arial 16

Electrical Supply from Panel Drawing Tag (SFU ID), if there is a SFU ID number and Circuit breaker # if there is

Power supply location
Font: Arial 16

Lamacoid label size: 3.35” Width, 1.82” Height
Black background/white letter/regular

Add”-FH” to its fume hood exhaust fan SFU ID where serves the fume hood
SAMPLE OF VSD CONTROL WARNING LABEL ON MCC / DISCONNECT SWITCHES

MOTOR CONTROLLED BY VSD
SHUT DOWN AT VSD FIRST

Lamacoid label size: 4.5” Width, 2.5” Height
Red background/white letter/regular, for small MCC alternate size of label should be 3.35”x1.82”

SAMPLE OF FIRE ALARM WARNING LABEL ON MCC

Fire Alarm

Lamacoid label size: 2.875” Width, 1” Height
Red background/white letter/regular
SAMPLE SFU IDENTIFICATION NUMBERING DESCRIPTION
FOR SFU EQUIPMENT

SAMPLE OF EMERGENCY GENERATOR LABEL

SFU Equipment Number:
Building Code-Equipment Code-Unit Number. Font: Arial 32

02-10-001
EMERGENCY GENERATOR
Academic Quadrangle

Building Name of Generator is serving

Lamacoid label size: 5.5” Width, 4.25” Height
Red background/white letter/regular
SAMPLE OF DISCONNECT FUMEHOOD WARNING LABEL

Fume Hood Disconnected
By FS April 7, 2016

NO STORAGE OR HANDLING HAZARDOUS MATERIALS

Lamacoid label size: 8” Width, 3” Height
Red background/white letter/regular

ELECTRICAL INTERLOCK LABEL ON MCC

Interlock:
36-01-011/36-02-015/36-02-024

Lamacoid label size: 3.0” Width, 0.75” Height
Black background/white letter/regular
SAMPLE OF 24/7 CRITICAL EQUIPMENT NOTICE LABEL

24/7 CRITICAL EQUIPMENT
DO NOT TURN OFF WITHOUT PRIOR AUTHORIZATION
5”X3”

SAMPLE OF MECHANICAL EQUIPMENT WITH EMERGENCY POWER SUPPLY

SFU Equipment Number:
Building Number-Equipment Code-Unit Number. Font: Arial 32

97-02-007
Pump, Heating, In-Line Centrifugal
P-B-7

Elec Supply:B2E1E(97-41-001)
	CCT 32,34,36

SBH-119.1

Emergency Power Supply from MCC or Panel drawing tag (SFU ID), if there is and Circuit breaker # if there is

Lamacoid label size: 3.35” Width, 1.82” Height
RED background/white letter/regular

Electrical Supply Location.
Building Code - Room Number.
Font: Arial 16
SAMPLE OF FIRE DAMPER TAG

26-FD-08-002

SD
F/S

Building Number
Floor
Unit Number

SAMPLE OF SMOKE DAMPER TAG

SAMPLE OF FIRE/SMOKE DAMPER TAG

SAMPLE OF FIRE EXTINGUISHER TAG

*46FX702*

Fire Extinguisher

Building Number
Floor
Unit Number
<table>
<thead>
<tr>
<th><strong>Equipment #</strong></th>
<th>Follow SFU Equipment Identification Standard when numbering equipment.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description</strong></td>
<td>While naming a piece of equipment write first the equipment type, second the subtype, and then other relevant identification information (separated by commas). For example: “Pump, Heating, Inline centrifugal, P-3”. For equipment not listed on the Equipment Type/Subtype list use the “Miscellaneous” category. Name the equipment accordingly. Do not name equipment “miscellaneous”.</td>
</tr>
<tr>
<td><strong>Equipment Type</strong></td>
<td>Refer to Equipment Type/Subtype list.</td>
</tr>
<tr>
<td><strong>Equipment Subtype</strong></td>
<td>Refer to Equipment Type/Subtype list.</td>
</tr>
<tr>
<td><strong>Manufacturer</strong></td>
<td>Manufacturer or Make of the equipment. For example: “Armstrong” or “American Standard”</td>
</tr>
<tr>
<td><strong>Model</strong></td>
<td>Equipment manufacturer’s equipment model number</td>
</tr>
<tr>
<td><strong>Serial No.</strong></td>
<td>Equipment manufacturer’s equipment serial number.</td>
</tr>
<tr>
<td><strong>Location</strong></td>
<td>Building code + room number. For Example: ASB-884. “Mechanical Room 3” is not acceptable. All areas on a building are numbered. FM buildings key plans indicated the room number for all areas. If a number is not available use “Sub location” to describe the location of the room/equipment.</td>
</tr>
<tr>
<td><strong>Sub location</strong></td>
<td>Give additional information about the location of the equipment. For example “M. R. 6 east side ceiling”</td>
</tr>
<tr>
<td><strong>Area Served</strong></td>
<td>Area that the equipment is serving. For example a fume exhaust fan can serve “ASB-8823”; a supply fan can serve “west wing of ASB building”; a pump can serve “heating loop”</td>
</tr>
<tr>
<td><strong>Alternate Tag</strong></td>
<td>Design or Engineering number or government ID number. For Example: “EF-3” or “AHU-1”</td>
</tr>
<tr>
<td><strong>Parent Tag</strong></td>
<td>If the piece of equipment is a sub component of a larger system the parent tag is the larger system equipment number. For example: if supply fan with number “3801053” is a subcomponent of AHU 1 with number “380853” then the parent of “3801053” if “3808053”</td>
</tr>
<tr>
<td><strong>Vendor</strong></td>
<td>The supplier company that have contractual obligations with SFU.</td>
</tr>
<tr>
<td><strong>Contract No.</strong></td>
<td>The purchase order number or the general contract number that included the piece of equipment.</td>
</tr>
<tr>
<td><strong>Purchased Date</strong></td>
<td>Purchased date or contract substantial completion date.</td>
</tr>
<tr>
<td>Warranty Expires</td>
<td>The date the warranty offered by the supplier/manufacturer expires.</td>
</tr>
<tr>
<td>--------------------------</td>
<td>---------------------------------------------------------------------</td>
</tr>
<tr>
<td>Life Expectancy</td>
<td>Equipment design life in years</td>
</tr>
<tr>
<td>Last Certified</td>
<td>If equipment requires regulatory agency certification for operation write down the date the certification was obtained.</td>
</tr>
<tr>
<td>Certificate Expires</td>
<td>The regulatory agency certificate expiry date.</td>
</tr>
<tr>
<td>Capacity / Flow</td>
<td>For fans: air flow volume in CFM or m3/min; for pumps: l/min or GPM; etc.</td>
</tr>
<tr>
<td>Head / Fan RPM</td>
<td>For pumps: head in m or ft; for fans Revolutions Per Minute.</td>
</tr>
<tr>
<td>Motor Hp/kW</td>
<td>HP or Kw</td>
</tr>
<tr>
<td>Motor Voltage / Phase</td>
<td>115/208/230/460V – 3 phase / single, etc.</td>
</tr>
<tr>
<td>Motor Amps Rating</td>
<td>Rating from nameplate</td>
</tr>
<tr>
<td>Motor Frame</td>
<td>For example: 48, 56C, Open, Close contraction</td>
</tr>
<tr>
<td>Motor RPM</td>
<td>Rated motor RPM</td>
</tr>
<tr>
<td>Driver Sheave</td>
<td>For example: 2P5V44 O.D. 4.40”</td>
</tr>
<tr>
<td>Driven Sheave</td>
<td>For example: 2Q5V80 O.D. 8.00”</td>
</tr>
<tr>
<td>Belt Qty / Size</td>
<td>For example: 2/A36</td>
</tr>
<tr>
<td>Prefilter Qty</td>
<td>For example: 6</td>
</tr>
<tr>
<td>Prefilter Size &amp; Type</td>
<td>For example: 20X20X2 Pleated</td>
</tr>
<tr>
<td>Afterfilter Qty</td>
<td>For example: 6</td>
</tr>
<tr>
<td>Afterfilter Size &amp; Type</td>
<td>For example: 20X20X16 Pocket/Bag</td>
</tr>
<tr>
<td>Lubricant (Y/N) Type</td>
<td>For example: Yes, oil</td>
</tr>
<tr>
<td>Refrigerant / Lbs &amp; Oz</td>
<td>For example: R22, 12 Oz</td>
</tr>
<tr>
<td>Cooling Surface</td>
<td>Sqft or m2</td>
</tr>
<tr>
<td>Cooling Medium</td>
<td>For example chill water</td>
</tr>
<tr>
<td>BTU Hour</td>
<td></td>
</tr>
<tr>
<td>BTUs</td>
<td></td>
</tr>
<tr>
<td>Input MBH</td>
<td>For boilers</td>
</tr>
<tr>
<td>----------</td>
<td>-------------</td>
</tr>
<tr>
<td>Operating Pressure</td>
<td>For boilers</td>
</tr>
<tr>
<td>Heating Surface</td>
<td>For heaters</td>
</tr>
<tr>
<td>Heating Medium</td>
<td>For example: gas or hot water</td>
</tr>
<tr>
<td>Gas flow rate</td>
<td></td>
</tr>
<tr>
<td>Gas Pressure</td>
<td>KPa or PSI</td>
</tr>
<tr>
<td>Additional Info</td>
<td>Write here additional information required to specify capacity or equipment type.</td>
</tr>
<tr>
<td>Elect. Supply SFU #</td>
<td>SFU panel or MCC number that supplies power to the equipment. For example: &quot;38-16-803&quot;</td>
</tr>
<tr>
<td>Panel or MCC #</td>
<td>Design or engineering number of the panel or MCC. For example: “MCC-8002” or panel “1B”</td>
</tr>
<tr>
<td>Supply Location</td>
<td>Building code + room number of electrical or equipment room where the panel or MCC is located. For example: “ASB-884”</td>
</tr>
<tr>
<td>PM Requirements</td>
<td>Do not write anything here. For use of SFU Facilities Management department.</td>
</tr>
</tbody>
</table>
# SAMPLE SFU IDENTIFICATION NUMBERING DESCRIPTION FOR SFU EQUIPMENT

## SFU Mechanical Equipment Data Form

<table>
<thead>
<tr>
<th>Equipment #:</th>
<th>0201001</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description:</td>
<td>Supply Fan, AHU-1 (Fire Alarmed) Interlock to 02-01-007</td>
</tr>
<tr>
<td>Location:</td>
<td>AQ-3008</td>
</tr>
<tr>
<td>Sublocation:</td>
<td>MECH, RM, #2</td>
</tr>
<tr>
<td>Area Served:</td>
<td>Supply air to theater, Corridor &amp; L2</td>
</tr>
<tr>
<td>Alternate Tag:</td>
<td>02-AHU-1-SF</td>
</tr>
<tr>
<td>Parent Tag:</td>
<td>0216301</td>
</tr>
</tbody>
</table>

### Vendor Information

- **Vendor:**
- **Contract No.:**
- **Last Certified:**
- **Life Expectancy:**

### Technical Specifications

<table>
<thead>
<tr>
<th>Capacity / Flow:</th>
<th>22747 CFM</th>
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<tbody>
<tr>
<td>Head / Fan RPM:</td>
<td></td>
</tr>
<tr>
<td>Voltage / Phase:</td>
<td>480 / 3</td>
</tr>
<tr>
<td>Frame:</td>
<td>238T</td>
</tr>
<tr>
<td>Driver Sheave:</td>
<td>OBCSF X 1 7/8</td>
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<tr>
<td>Belt Qty / Size:</td>
<td>5 / C173</td>
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<tr>
<td>Prefilter Qty:</td>
<td>18</td>
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<td>After Filter Qty:</td>
<td></td>
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<tr>
<td>Lubricant(Y/N) Type:</td>
<td>Grease</td>
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<td>Cooling Surface:</td>
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<td>Cooling medium:</td>
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<td>Operating Pressure:</td>
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<tr>
<td>Heating medium:</td>
<td></td>
</tr>
<tr>
<td>System:</td>
<td></td>
</tr>
<tr>
<td>Additional Info:</td>
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</tr>
</tbody>
</table>

#### Equipment Power Supply Information:

- **Eleco Supply SFU #:** 02-16-301
- **Drawing Panel or MCC #:** MCC-2
- **Supply Location:** AQ-3011

### PM Requirements (FM use only)

<table>
<thead>
<tr>
<th>Task Code:</th>
<th>Mechanic</th>
<th>AC Mechanic</th>
<th>Electric</th>
<th>Labour</th>
</tr>
</thead>
<tbody>
<tr>
<td>Priority Freq:</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Next Date:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Department:</td>
<td></td>
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</tr>
<tr>
<td>Equipment Condition:</td>
<td></td>
<td></td>
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</table>

<table>
<thead>
<tr>
<th>Account #:</th>
<th>Comments</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
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</tr>
</tbody>
</table>
### SFU Electrical Equipment Data Form

- **Equipment #**: 20117105
- **Description**: PANEL BOARD
- **Location**: DIS2-106
- **Sublocation**: Electrical closet 106
- **Alternate Tag**: 201-PB-P
- **Parent Tag**: 20137101

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<tr>
<th>Capacity (VA/WATTS)</th>
<th>Voltage / Phase</th>
<th>Secondary Voltage</th>
<th>AMP Rating</th>
<th>No of Circuits</th>
<th>Class</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **Vendor**: 
- **Contract No.**: 
- **Last Certified**: 
- **Life Expectancy**: 
- **Purchased Date**: 
- **Warranty Expires**: 
- **Certificate Expires**: 

### Equipment Power Supply Information:

- **Elec Supply SFU #**: 201-37-101
- **Supply Location**: DIS2-106.1
- **Drawing Panel or MCC #**: PANEL D2A

### PM Requirements (FM use only)

<table>
<thead>
<tr>
<th>Task Code</th>
<th>Mechanic</th>
<th>AC Mechanic</th>
<th>Electric</th>
<th>Labour</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Priority, Freq</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
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<tbody>
<tr>
<td>Next Date</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Department</th>
<th>Account #</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td></td>
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</table>

<table>
<thead>
<tr>
<th>Equipment Condition</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
</table>
1.1 **GENERAL**

1.2 **Related SFU Technical Requirements**

.1 ANSI 13.1 Scheme for Identification of Piping Systems.
.2 SFU Identification and Labeling Standard

1.3 **Coordination Requirements**

.1 Coordinate with SFU Facilities.
.2 Coordinate with other design disciplines.

1.4 **Description**

.1 Identification of mechanical systems and components in all University buildings, facilities and tunnels.

.2 The identification system is composed primarily of nameplates, labels, tags and engraved on Lamacoid nameplates and shall include:
   .1 Manufacture's name or recognized trademark
   .2 Model identification and serial number
   .3 Approval seals
   .4 Warranty contact information
   .5 SFU ID Number
      -Building Code Number
      -Equipment Code Number
      -Unit Number
      -Electrical Power Supply

2.1 **MATERIAL AND DESIGN REQUIREMENTS**

2.2 **Identification Logic**

.1 Identify each system and system component following the "SFU Identification and Labeling Standard" which should be followed from original design inception. Identification to be consistent throughout the project. Should the SFU Identification and Labeling Standard contradict this Section 20 00 08, it will take precedence.

.2 When identifying systems and components in existing buildings, the new items shall be numbered sequentially with existing systems include the zone or building area serviced by each system.

2.3 **General**

.1 Submit list of system and component labels to Consultant and Facilities Services for review prior to engraving.
2.4 **Labels (Identification)**

.1 Provide and apply laminoid labels according to SFU Identification and Labeling Standard:

.1 Gauges and Panels engrave with 6 mm high lettering. Note for electrical switch gear, coordinate with Division 16.
.2 Systems engrave with 25 mm high lettering.
.3 Fume Hoods engrave with 10 mm high lettering.
.4 Apply labels to the following systems:
   .1 Water.
   .2 Natural Gas.
   .3 Steam.
   .4 Fire Protection.
   .5 Condensate.
   .6 Compressed Air.
   .7 One label to be affixed to the system and a second applied to the associated switch gear.

.5 Gauges and Panels.

.2 All fume hood systems shall be identified with laminoid labels. Identical labels are to be affixed to each fume hood and associated fan and motor starter (note that three labels are required for each system). The wording which will identify the specific fume hood and associated fan will be supplied by the owner.

.3 Laminoid labels shall be mechanically fastened to the identified system and components in a conspicuous location.

2.5 **Labels for Perchloric Fume Hoods**

.1 Provide laminoid plastic labels with "fire red" face and white centre 135 mm x 65 mm x 2.5 mm thickness to act as a warning to Fume Hood users.

.2 For label layout refer to Standard Detail in *Division 20*. This label is in addition to that required above.

.3 Perchloric fume hood labels shall be secured to the upper front panel adjacent to the static pressure gauge.

2.6 **Piping Colour Codes**

.1 Piping will adhere to Pipe Colour Code Standards found in Appendix C-15. SFU Standard Pipe Duct Labeling Requirements.

2.7 **Color Coded Dots**

.1 Color Coded Dots
   .1 Provide self-adhesive color coded dots 13 mm in diameter.
   .2 Dots shall be Avery TR808 or an alternate approved by the Owner. Colors shall be yellow, black, red and green.

.2 Doors and ceiling panels providing access to devices mounted in concealed locations shall be identified by color coded dots.
.3 Color coding shall be to the following schedule:

- .1 Mechanical equipment and cleaning access: Yellow.
- .2 Control equipment, dampers, valves and sensors: Black.
- .3 Fire, smoke and sprinkler equipment: Red.
- .4 Pipe mounted equipment other than above: Green.

.4 Where access is through a suspend T-Bar ceiling affix dot to exposed T-Bar frame closest to the concealed equipment.

2.8 Valve Tags

- .1 Tags shall be 40 mm diameter brass with 10 mm stamped alpha-numeric coding filled with black paint.
- .2 Tags shall be complete with non-ferrous chain or "S" hooks.
- .3 Tags shall be as supplied by W.H. Brady or an alternate approved by the Owner.
- .4 Consecutively number all valves and controllers installed by Division 15 on a system basis using tags. Coordinate between the various mechanical trades to prevent duplication.
- .5 Identification coding is to start with a utility description followed by a maximum of three numerals:
  - .1 Water: WXXX
  - .2 Natural Gas: GXXX
  - .3 Steam: SXXX
  - .4 Fire Protection: FPXXX
  - .5 Condensate: CXXX
  - .6 Compressed Air

- .6 The first tag number in each series will be supplied by the Owner.
- .7 For installations in existing buildings the valve and controller numbers shall be numerically sequential with the existing series.
- .8 Provide six identification flow diagrams for each system incorporating the tag schedule stating the designation number, the service function and location of tagged items and normal operating position of valves. Flow diagram shall be on maximum size 11” x 17” sheets having a 3/4” border on the left side to permit insertion into a ring binder.
- .9 Mount one copy of the flow diagram in a glazed frame.
- .10 Provide copies of flow diagram for the Operating and Maintenance Manuals.

2.9 Stenciled Letters

- .1 Black stenciled letters and numbers 25 mm high, to sign painting standards.
- .2 Black stenciled direction arrows shall be 175 mm long by 56 mm wide.
- .3 Duct Work and Access Panels: Use the system designators stated on the drawing and specification.
- .4 Duct Identification and Direction Arrows shall be located on all duct runs in Mechanical Rooms and Penthouses:
  - .1 Maximum distance between markings shall be 8 meters.
  - .2 Where ducts pass through walls or partitions identify ducts on both sides of the section.
  - .3 Beside each access panel.
.5 Perchloric Fume Exhaust
.1 Identify each duct "Danger-Perchloric" using 50 mm high black letters in the following locations as described above in "Duct Identification and Direction Arrows":
.1 Adjacent to all major changes in direction.
.2 At least once in each room. Where duct is concealed in a chase, shaft, gallery or other confined space, identify at points of entry and leaving and at each.
.3 At access openings.

.6 Radioactive Isotope Fume Exhaust
.2 Identify each duct "Danger-Radioactive Isotope" using 50 mm high black letters in the following locations as described above in “Duct Identification and Direction Arrows”:
.1 Adjacent to all major changes in direction.
.2 At least once in each room. Where duct is concealed in a chase, shaft, gallery or other confined space, identify at points of entry and leaving and at each.
.3 At access openings.
.4

.7 Access Panels
.1 Panels shall be identified according to the following schedule of functions:

<table>
<thead>
<tr>
<th>Access Function</th>
<th>Symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cleaning and Service</td>
<td>C.A.</td>
</tr>
<tr>
<td>Controls including Sensors</td>
<td>C.</td>
</tr>
<tr>
<td>Dampers – Back draft, Balance and Control</td>
<td>D.</td>
</tr>
<tr>
<td>Fire Dampers</td>
<td>F.D.</td>
</tr>
<tr>
<td>Smoke Dampers</td>
<td>S.D.</td>
</tr>
</tbody>
</table>

2.10 Manufacturer's Nameplates

.1 Each piece of equipment shall have an original factory installed metal nameplate with raised or recessed characters.

.2 The nameplate shall fully describe the component as to manufacturer, size, model, serial number, voltage, cycle, phase, power, pressures, volume, etc.

.3 Locate nameplates so that they are easy to read. Do not insulate or paint over.

.4 Provide standoffs where nameplates cannot be located on cool surfaces.

.5 Ensure that regulatory registration plates are also attached to equipment - Pressure Vessel Rating, Underwriter's Laboratory Approval, CSA Approval, etc. An additional copy of the regulatory registration plate is to be provided for inclusion in O&M Manuals and/or SFU records.

***END OF SECTION***
1.1 **GENERAL**

1.2 Related SFU Technical Requirements

1.3 Coordination Requirements

1.4 Description

   .1 Guidance for the design and operation of HVAC systems in order to provide a suitable thermal environment for sedentary work (e.g. in office, classroom, library, laboratory).

   .2 The basis for design and operation are the applicable ASHRAE standards, however guidance is required for interpreting them in the context of SFU’s different campuses.

2.1 **MATERIALS AND DESIGN REQUIREMENTS**

2.2 Applicable Codes, Standards and Guidelines


      The purpose of this standard is to specify the combinations of indoor thermal environmental factors and personal factors that will produce thermal environmental conditions acceptable to a majority of occupants within the space.

   .2 ASHRAE 10 Interaction Affecting the Achievement of Acceptable Indoor Environments – latest version.

      This guideline raises awareness of interactions affecting the achievement of acceptable indoor environments

      ASHRAE 62.1 Ventilation for Acceptable Indoor Air Quality – Latest Version Natural ventilation design guidance (Section 5)

2.3 Principles

   .1 Use of passive design shall be evaluated by a project by project basis.

   .2 Adaptive thermal comfort: where occupants are free to adapt their clothing to the indoor temperature, mechanical cooling is not necessary. Where design conditions in such spaces have been shown to need mechanical cooling, submissions for variance are to be made as part of the initial design philosophy submission.

   .3 Humidity control: Vancouver’s temperate climate, with mild temperatures and moderate humidity levels year round, allows the humidity in a space to be uncontrolled and the space still be considered comfortable, unless there is a particular reason for humidity control e.g. rare book storage, laboratory operations.

   .4 Adaptation: Where possible space for future cooling coils shall be provided to mitigate risk of increased cooling degree days. Additionally, provisions must be made for airside terminal
.5 Thermal modeling simulation shall be used to verify mechanical cooling requirements.

.6 Mechanical cooling shall be provided only where process or code requirements dictate e.g. high heat loads in laboratories, IT server rooms, control rooms, AV rooms, electrical rooms, etc. In general, buildings are not to be air conditioned for comfort.

.7 Large classrooms (>50 students) may require 100% outdoor air supply for air quality and/or provision of mechanical cooling, due to high heat load.

2.4 Selection of Ventilation Strategy

.1 Select a ventilation strategy which is most suitable for the building design. Passive or natural ventilation should be used wherever appropriate. For buildings where passive ventilation is unable to meet either the thermal comfort requirements given in this guideline or the program requirements of the building, a mixed-mode ventilation strategy should be considered that uses a combination of natural ventilation and mechanical HVAC where necessary.

.2 Refer to CIBSE – Natural Ventilation in Non-Domestic Building – Chapter 2 “Selecting a natural ventilation concept” as a source of reference.

2.5 Design of Naturally Conditioned Space (i.e. no mechanical cooling)

.1 Naturally conditioned space shall be designed to satisfy the following criteria through passive design practices and shall be verified using thermal modeling simulation:

.1 Internal Temperature (Ti) >=24°C shall not exceed 150 occupied hours.

.2 Internal Temperature (Ti) >=27°C shall not exceed 50 occupied hours.

.3 Internal Temperature (Ti) >=30°C shall not exceed 20 occupied hours.

.2 Operable windows shall be provided, and design should account for different zones. Sensors shall interlock space heating. See ASHRAE Handbook Fundamentals, Natural Ventilation and Infiltration, Chapter 22.

.3 15% additional supply air capacity is required to provide a means of maintaining a suitable thermal environment during extreme temperature events. Where possible space for future cooling coils shall be provided.

2.6 Design of Active Systems

.1 Active systems shall be designed to achieve the following minimum conditions during occupied hours:

.1 Heating systems shall be designed to maintain an indoor temperature of 21°C for an external temperature of -9°C (BC Building Code 1% value for January).

.2 Cooling systems shall be designed to maintain an indoor temperature of 25°C for an external temperature of 25°C (BC Building Code 2.5% value for July).

2.7 Operation of Active Systems

.1 Space Heating Systems: Set point 21°C +/- 1°C
.2 Space Cooling Systems: Set point 25°C +/- 1°C

.3 Night Time Setback conditions:

.1 Buildings will be maintained between 15°C to 17°C during winter, depending on building recovery time.

.2 No ventilation, unless nighttime cooling control strategy is required.

.3 Under night setback or setup conditions in both heating and cooling seasons, the building setpoint can be varied during unoccupied periods. However, when the systems are turned back to occupied mode, the building air is required returned to operating temperature by the scheduled occupied time.

.4 An optimum start algorithm is used to calculate the latest time to turn the system back on. These algorithms look at the lowest zone temperature, the outdoor air temperature, controllers heating/cooling factor, algorithms for protecting required space temperature, global enable and disable, and the time lag to heat (or cool) to the setpoint in order to improve the estimate of the start time. They then retrieve and analyze historical temperature and thermal time lag information. These same algorithms can also be used to turn off HVAC systems at the end of the day while the building is still occupied.

.5 Research laboratories that require continuous ventilation: During unoccupied conditions reduced ventilation and temperature conditions are expected. Consideration should be given on a project by project basis.
1.1 GENERAL

1.2 Related Technical Requirements
   .1 Divisions 20, 21, 22, 23, 25

1.3 Coordination Requirements:
   .1 SFU Facilities Services
   .2 SFU IT Services

1.4 Description
   .1 SFU requirements for the Design Development Documents for Division 20, 21, 22, 23, 25.

2.1 MATERIAL AND DESIGN REQUIREMENTS

2.2 General Requirements
   .1 Engaged Consultants supplies the University at the preliminary stage of the building project, a Development Brief which contains information listed below:
      .1 Preliminary drawings clearly defining scope of work and equipment details.
      .2 Specifications of all mechanical systems and equipment.
      .3 Hydronic Schematic.
      .4 Airflow Schematic.
      .5 Control Schematic.
      .6 Plumbing Schedules.
      .7 Fire Protection Design Summary.

2.3 Off Site and Site Services
   .1 Through discussion with SFU Facilities the Design Development Brief shall include:
      .1 Motor schedule with approximate summary of loads.
      .2 Expected peak water use in fixture units.
      .3 Water use breakdown for plumbing, landscape, and fire protection.
      .4 Sanitary and storm water main line sizing to match water usage.
      .5 Roof drainage layout.

2.4 Building Service
   .1 The Design Development Brief shall include the following Building Service information:
      .1 Size and location of main mechanical, sprinkler, and water entry rooms.
      .2 Brief description of mechanical equipment operating on emergency power, and during fire alarm scenarios.
      .3 Preliminary mechanical schedule including valve, air handling unit, and pump schedules.

2.5 Other Services
   .1 The Design Development Brief shall include the following other information:
.1 Mechanical room alarm components and supervisory equipment.
.2 Zone Mechanical/ sprinkler rooms size and location.
.3 Other services to be provided such as heat tracing, ice melting, chemical treatment of water and hydronic systems as applicable.

2.6 Construction Power

.1 The Consultant obtains from SFU Facilities, the location and voltage level for construction power.

.2 The Design Development Brief shall include the following construction power information:

.1 The Consultant provides in his design, a drawing showing the basic equipment and wiring for the service.

.3 Construction power consumption and all associated equipment and installation material and labour shall be paid for by the project.

***END OF SECTION***
1.1 **GENERAL**

1.2 **Related SFU Technical Requirements**

   1. *Section 20 00 05 Mechanical - General Requirements*
   2. *Section 22 05 00 Plumbing - General Requirements*
   3. *SFU Standard Fire Hydrant Drawings*
   4. *Section 28 31 00 Fire Detection and Alarm*

1.3 **Coordination Requirements**

   1. Coordinate with SFU Facilities.
   2. Contact SFU Facilities for water supply information.
   3. Coordinate verification of the sprinkler system with the City of Burnaby. Contact City of Burnaby in advance of verification to provide opportunity for work crews to be present during verification.
   4. Whenever fire protection may be temporarily suspended, in buildings/facilities with Occupancy Permit, a Fire Watch must be called for which conforms to the requirements of the Fire and Rescue Services branch of the Burnaby Fire Department.

1.4 **Description**

   1. Additional SFU fire protection design and approval requirements. These general requirements also apply to fire system design requirements found in other sections.

2.1 **MATERIAL AND DESIGN REQUIREMENTS**

2.2 **Submission of Design Philosophy**

   1. The Mechanical Consultant shall submit to SFU Facilities a design philosophy for the proposed building mechanical and plumbing systems.
   2. Submit to SFU Facilities a design philosophy for the proposed building fire protection systems. Major components of the philosophy must be accepted in principle by Building Operations before the project can proceed to Construction. Consultants are expected to produce designs that meet user needs and allow Building Operations to continue to meet those needs in the future in a safe efficient manner.

2.3 **General**

   1. New and renovated facilities at SFU are to be fully sprinkler protected regardless of code requirements. SFU is largely self-insured and has adopted this 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 is consistent to standard industry practice. Deviations are intended to increase system longevity and provide flexibility for subsequent renovation.
   2. NFPA Codes (latest edition) shall be used to determine level of protection required.
   3. SFU’s fire protection systems shall meet latest applicable NFPA codes as modified by or Burnaby Fire Department policy in effect at SFU.
.4 Required fire flows must be calculated for all new buildings and be included in the approval process.

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

.6 All contract documents and ‘as built/record’ drawings must meet criteria outlined in NFPA 13, Chapter 6.0, Plans and Calculations. All calculations must be sealed by a Professional Engineer registered in British Columbia.

.7 Specify fire pumps only after consulting with SFU Facilities.

.8 Fire Hydrants
   .1 The Burnaby Fire Department requires minimum height dimensions of 381 mm to the bottom of the lowest butt or 457 mm to the centre of the lowest butt. Refer to SFU standard fire hydrant drawing for details.

.9 Information on water supply available for fire fighting must be obtained from SFU Facilities.

.10 General requirements for mechanical systems included in the fire protection system are contained in Section 20 00 05 Mechanical - General Requirements and Section 22 05 00 Plumbing - General Requirements.

.11 Fire Hose Cabinets are not preferred. Where applicable, existing fire hose cabinets shall be deleted (eg projects revising non-sprinklered to fully sprinklered spaces). Coordinate requirements with SFU and applicable codes.

2.4 Controls

.1 Building fire alarm systems operate separately from BAS.

.2 Contractor to allow for programming and creation of graphic displays on their existing graphical user interface. Active graphic points, complete with custom user messages will also be provided, i.e. each and every addressable device will be indicated on a graphical display (two graphics per floor minimum).

.3 The active state of field alarm devices (Fire Alarm and Supervisory Alarm) shall automatically open the appropriate floor plan display at the SFU Fire Signal Receiving Centre and at the Satellite Fire Signal Receiving Centre. Active point(s) objects on the display will indicate status with colour change as defined by CAN/ULC fire alarm and SFU standards. All other graphical display interface terminals shall be individually configurable to provide automatic graphic display or not, at SFU discretion. Vendor to configure these terminals as directed by SFU.

.4 Graphics must be completed and installed prior to system verification. All active graphic points to be tested at the SFU Fire Signal Receiving Centre by actual device operation. The test results for each graphic point is to be included in the verification report.

.5 All fire alarm system text descriptions used in the fire alarm system shall comply with SFU standards for format and building identification. The point description text shall be submitted and approved by SFU prior to installation.

.6 The fire alarm system shall be provisioned with 3 form C dry relay contacts at the control
unit for connection to the SFU Common Alarm Panel (CAP). One contact each for common Fire Alarm, Supervisory Alarm, and System Trouble. Contacts to be true dry metal contacts with >100MOhm impedance to earth at 24VDC.

2.5 Final Functional Testing

.1 Certify fire systems have been tested to meet requirements of SFU and authorities having jurisdiction.

.2 Insulate or conceal work only after testing and approval by Building Inspector.

.3 Conduct tests in presence of Building Inspector.

.4 Contact SFU Facilities in advance of verification to provide opportunity for work crews to be present during verification.

.5 State specifically what equipment and systems are to be tested.

.6 SFU Facilities requires that the successful vendor provide the same fire technicians for the duration of the site commissioning and verification. The verifying technician(s) shall provide the system demonstration and review of the verification report for acceptance by SFU.

.7 The verification must be carried out in accordance with CAN/ULC-S537 standards. The successful vendor must provide a copy of the verification report as per CAN/ULC-S537 standards.

.8 The contractor must rectify any/all deficiencies found during the system verification prior to submittal of the verification report.

.9 Any modifications to the system during verification must be re-verified according to CAN/ULC-S537 procedures.

.10 SFU staff will be present during the fire system verification to ensure that all of the necessary standards are adhered to and that all deficiencies are addressed before the system is accepted.

.11 SFU may, at its discretion, hire an outside commissioning consultant to accompany the successful vendor during their fire system verification to ensure that all procedures, codes and standards are adhered to (e.g., CAN/ULC 536, 537). SFU staff and/or its commissioning consultant will be the sole authority on system acceptance.

.12 Test fire systems in accordance with authorities having jurisdiction and as specified elsewhere.

.13 Piping

.1 Maintain test pressure without loss for 48hr unless otherwise specified.

.2 Test fire systems in accordance with authorities having jurisdiction and as specified elsewhere.

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

.15 Operate all test connections to verify water flow switch operation in approximately 30 seconds.
.16 Pressurize all dry system piping to 40 psi of air pressure for 24 hours in order to verify leak-tight installation. The piping system shall not allow a loss of pressure over 1 ½ psi in 24 hours. All leaks resulting in a loss over 1 ½ psi shall be repaired and the system retested.

.17 Operate the dry system inspector’s test connection. Record the following information: time for valve to operate, time to receive water at inspector’s test connection, static supply water pressure, system air pressure and air pressure at valve release. The inspector’s test connection shall receive water within 60 seconds of its operation.

.18 SFU Facilities, City of Burnaby and the Fire Department shall witness final inspections and tests.

.19 Provide as built drawings, and a fire alarm verification to SFU Facilities and City of Burnaby when the job is complete.

2.6 Fire Pumps and Generators

.1 See Section 20 00 05 Mechanical - General Requirements for requirements for Fire Pumps and Generators.

.2 See Section 25 05 00 Building Management Systems (BMS) Design Guidelines for requirements for control systems for fire pumps and generators.

2.7 Painting

.1 Specify painting of all exposed only fire protection piping and equipment. Color shall be red.

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

.3 Refer also to Section 09 90 00 Painting and Coating.

2.8 Use of Booster Pumps

.1 Fire fighting water pressures should not require booster pumps for buildings up to 7 stories. Obtain SFU Facilities approval for any booster pumps for buildings less than 7 stories.

2.9 System Drains

.1 System drains shall be pipe to floor drains, provide minimum 3” deep traps or to direct storm connection.

.2 All low point drain valves shall be mounted at maximum 2m AFF. and the associated piping shall allow for discharge into a floor drain or to the building exterior.

2.10 Spare Parts

.1 Specify spare parts to suit location and critical nature of projects.

.2 Furnish the following spare parts in accordance with Section 01 77 00 Closeout Procedures as follows:

.1 Design Consultants shall specify sufficient numbers of spare sprinkler heads of all types used on the project. One set of packing for each pump. One casing joint gasket for each size pump.

2.11 Building Fire Protection Water Service
.1 Each building shall have a separate water service. No building shall be fed from another building.

.2 Provide an approved backflow prevention assembly, complete with monitored tamper switches on isolation valves, for every building fire protection system. (Refer to SFU Technical Requirements, Section 22 11 18 Backflow/Cross Connection Control for details).

.3 Drains should discharge to a sanitary drain, not a storm drain.

### 2.12 Fire Sprinkler Systems/Standpipes

.1 Provide floor control valves and drains on each floor within a stair enclosure in multi-story buildings.

.2 Floor control valves and piping may be concealed if a sufficiently sized access panel is provided to allow for maintenance and testing.

.3 The design criteria for the fire sprinkler system shall be established per NFPA 13.

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

.5 Provide access to all fire protection equipment.

### 2.13 Products and Materials

.1 All materials and equipment in the system shall be new and current products of a manufacturer regularly engaged in the production of such materials and equipment. For example:

.1 Pipe, fittings and couplings, hangars and supports, earthquake bracing, valves, and sprinklers.

### 2.14 Fire Alarm and Related Equipment

.1 All fire alarm related equipment to be as follows (due to life cycle/duty cycle issues any exceptions to be approved by SFU Facilities):

.1 Flow Switch shall be Potter VSR-F, VSR-SF (smaller pipe diameters).

.2 Water Flow Alarm Pressure Switch shall be Potter WFS-5.

.3 Tamper Switch shall be Potter OSYSU-2 for OSY valves. Butterfly isolation valves shall be equipped with two internal, single-pole, double-throw monitoring switches.

.4 High-Low Water Pressure Switch shall be Potter PS120-2A.

.5 High-Low Air Pressure Switch shall be Potter PS40-2A.

.6 Pressure Switch (Excess Pressure Pump) shall be Furnas 69HAU1.

.7 Pressure Switch (Air Compressor) shall be Furnas 69HAU3.

.2 Each fire alarm device to have its own individual address.

### 2.15 Sprinklers Subject to Freezing

.1 Provide a dry system, not an anti-freeze system.

.2 Where sprinklers must be wet, and are subject to freezing, it must be heat traced, and connected to the fire alarm panel.
2.16 Dry Pipe Alarm Valve

.1 All dry pipe systems shall be ULC listed.

.2 Provide a dry pipe alarm valve, trim package, accelerator and air maintenance device, all by the same manufacturer. For example, Grinnell and/or Viking.

2.17 Air Compressor

.1 Provide ULC listed air compressor or maintenance device, sized to completely refill the system within 30 minutes. The air compressor must be quiet, (Max. 60 dbA) unless in a basement mechanical room.

.2 Air Compressor must be oil, floor mount, no tank, and must have a stand-alone Furnas 69HAU3 pressure switch for cut-in and cut-out, and a Potter PS40-2A for low air pressure.

.3 Set the dry pipe system air pressure at the maximum recommended by the information sheet for the dry pipe valve or at 20 psi greater than the standard calculated trip pressure.

.4 All ½” check valves must have a soft seat.

.5 Compressor must be wired to an emergency electrical panel.

.6 All Pre-Action System and Dry System compressors shall be dedicated to Life Safety and shall not serve any other purpose.

.7 All Pre-Action System and Dry System compressors shall be mounted using suitable vibration isolation, using flexible air line that is rated to a minimum of 1.5 times the maximum rating of the compressor and with at least 1m clear space above and on one side to allow for maintenance.

2.18 Inspector’s Test and Drains

.1 Provide inspectors test valves for each floor of each system. For dry systems the inspector’s test shall be located at the hydraulically most remote part of the system. Discharge into a drain riser located adjacent to the system riser or into a drain for a remote inspectors test valve when provided, for example, in dry systems. The valve shall be readily accessible.

.2 Provide main drains at all system and floor control valves. Discharge shall be into drain risers for a multi-story building. Drain risers and main drain for single story buildings shall discharge to a safe location outside the building wherever possible. Provide splash blocks to limit damage to landscaping. Where outside discharge cannot be achieved, discharge shall be to minimum 6-inch floor drain, with a funnel. Do not pipe any sprinkler system drain line directly into a drain; there must be at least a ½” gap between the pipe and the funnel/drain.

.3 Provide auxiliary drains at all low points of the system. Provide an auxiliary drain for each floor of the building within a building stairwell hydraulically remote from the floor control assembly. The drain shall consist of, as a minimum, a valve, a ¾” brass nipple with ¾” male hose threads, and cap.

2.19 Fire Department Connection

.1 The check valve and ball drip shall be located in the mechanical room.

.2 A fire department connection shall be provided on the system riser, and installed in an area accessible for the first response unit.
.3 A sign indicating “Auto Sprinkler” or similar shall be provided as a part of the escutcheon. A separate red sign with white lettering shall be permanently affixed to the building. The sign should read “Fire Department Connection”, with the letters 2” (inch) high, and the building address underneath with the letters 1” (inch) high.

.4 Provide 2 ½” polished brass hose valves with a cap and chain. Turn the outlet at an angle of 45° from the wall.

2.20 Hose Valve

.1 Hoses are not to be racked in the cabinets and shall be folded over and rolled up.

2.21 Spare Sprinkler Cabinet

.1 Provide spare sprinklers and escutcheons for 10% of each type and style of sprinkler used in accordance with NFPA 13 and proportioned based upon the number of each type and style of sprinkler used on the job. Include a wrench for each type of sprinkler in the cabinet. The cabinet is to be red with a nameplate indicating “SPARE SPRINKLER CABINET”.

2.22 Signs

.1 Provide all control, drain and test valves with signs identifying the type of valve and the area (floor or portion of the building) affected by the valve. Submit the wording to SFU Facilities for approval, for example:

LEVEL 3 SPRINKELR
© TAMPER SWITCH
SUPERVISORY M1-25

.2 The signs are to be hung by a chain from the device.

.3 Signs shall also indicate, especially on dry pipe systems, those valves which should be kept normally open or normally closed.

2.23 Pressure Gauge

.1 Provide a 3 ½” diameter pressure gauge with the appropriate scale at the main incoming water. Also at each valve station, base of every riser, above and below alarm valves, before and after check valves, at any compressors or pumps, and at any pressure switches.

2.24 Sprinkler Head Guard

.1 Provide ULC Listed sprinkler head guards for sprinkler heads subject to mechanical damage.

2.25 Drum Drip

.1 Provide a drum drip per NFPA 13 at the low drain points on a dry system.

***END OF SECTION***
1.1 **GENERAL**

1.2 **Related SFU Technical Requirements**

.1 *Section 20 00 05 Mechanical - General Requirements*

.2 *Section 21 05 00 Fire Protection - General Requirements*

1.3 **Coordination Requirements**

.1 Additional SFU design and approval requirements for standpipe and house systems.

2.1 **MATERIALS AND DESIGN REQUIREMENTS**

2.2 **General**

.1 Do the work in accordance to the latest edition of the following standards unless specified otherwise.

.1 ANSI/NFPA 14, Installation of Standpipe and Hose Systems.

2.3 **Engineering Data**

.1 Design system to ANSI/NFPA 14 and the following parameters:

.1 Stand alone or combined with sprinkler systems (hydraulic calculations required).

.2 Consult SFU Facilities for water information.

2.4 **Pipe, Fittings and Valves**

.1 Pipe

.1 Ferrous shall be to ANSI/NFPA 14.

.2 Copper tube shall be to ANSI/NFPA 14.

.2 Fittings and joints shall be to ANSI/NFPA 14.

.3 Valves shall be ULC listed for fire protection service.

.4 Pipe hangers shall be ULC listed for fire protection services.

.5 Drain valve shall be NPS 1", complete with hose end, cap and chain.

2.5 **Cabinets**

.1 To ANSI/NFPA 14 and ULC listed shall be flush type, 180° opening door with hinge same side as water supply and latching device.

.2 Cabinets to maintain fire resistive rating of construction in which they occur.

2.6 **Fire Hose and Nozzle**

.1 Hose shall be ULC listed, 38 mm nominal diameter, 23 m long, synthetic jacket, synthetic rubber lined.

.2 Nozzle shall be ULC listed, 38 mm nominal diameter, forged brass adjustable combination fog-straight stream with shut-off.

2.7 **Angle Valves**

.1 ULC listed for fire service. Where water pressure exceeds 690 kPa, provide ULC listed pressure reducing device.
2.8 Fire Department Valve

.1 ULC listed, NPS 2-1/2 forged or cast brass angle valve with thread compatible with Burnaby Fire Department, complete with hand wheel, cap and chain.

2.9 Pumper Connection

.1 To ANSI/NFPA 14, ULC listed Siamese type. Threads to be compatible with Burnaby Fire Department complete with threaded metal caps and chains.
.2 Polished bronze recessed with identifying sign cast on plate.

2.10 Finishes

.1 In finished areas, chrome plate valves, nozzles, fittings and hose rack.
.2 Cabinets
   .1 Tub shall be prime-coated.
   .2 Door and frame shall be #4 satin finished, stainless steel.

2.11 Installation

.1 Install and test to acceptance in accordance with ANSI/NFPA 14.
.3 Testing to be witnessed by Owner (SFU Facilities) and Burnaby Fire Department.
.4 Run inspectors test connections to sight glass.
.5 Specify drain pipes and valves to drain all parts of systems and so arranged that any one standpipe riser can be drained without shutting down any other parts of systems.
.6 Specify 90 mm diameter pressure gauge in accordance with Division 15 - Thermometers and Pressure Gauges at top of each riser and in accordance with ANSI/NFPA 14.
.7 Run all test and drain piping to an acceptable floor drain.
.8 Provide a flow switch on each system and connect to the building Fire Alarm system using a module specified for this use only. Module shall be programmed to cause the Fire Alarm System to activate a General Alarm when flow occurs.

***END OF SECTION***
1.1 **GENERAL**

1.2 **Related SFU Technical Requirements**

.1 Section 20 00 05 Mechanical - General Requirements
.2 Section 21 05 00 Fire Protection - General Requirements
.3 Section 28 31 00 Fire Detection and Alarm

1.3 **Description**

.1 Additional SFU design and approval requirements for Wet Sprinkler Systems.

2.1 **MATERIALS AND DESIGN REQUIREMENTS**

2.2 **Design Standards**

.1 Design and construction shall be in accordance with the latest edition of the following standards unless specified otherwise:

.1 NFPA 13.
.2 NFPA 20.

2.3 **Engineering Design Criteria**

.1 Design system to NFPA 13 using following parameters:

.1 Hazard shall suit occupancy.
.2 Pipe Size and Layout

.1 Hydraulic design of piping.
.2 Head layout: to NFPA 13 and as indicated.

2.4 **Pipe, Fittings and Valves**

.1 Pipe

.1 Ferrous to NFPA 13.
.2 Copper tube to NFPA 13.

.2 Fittings and Joints shall be screwed, soldered, welded, flanged for rolled grooved and press fit to NFPA 13.

.3 Valves

.1 ULC listed for fire protection service.
.2 Bronze to NPS 2", cast iron over NPS 2".
.3 Threaded to NPS 2", flanged or rolled grooved over NPS 2". For shut off service: OS&Y gate OS&Y gate to NPS 2", indicating.
.4 Butterfly over NPS 2".
.5 Swing checks valves.
.6 Ball drip.

.4 Pipe hangers shall be ULC listed for fire protection as specified in Division 21 and in accordance with NFPA 13.

2.5 **Sprinkler Heads**

.1 General: to NFPA 13 and ULC listed for fire service.
2.6 **Alarm Check Valve**

.1 Alarm check valve with retard chamber to NFPA 13, ULC listed for fire service.

2.7 **Supervisory Switches**

.1 General to NFPA 13, and ULC listed for fire service.

.2 Valves shall be mechanically attached to valve body, with N.O. and N.C. contacts and supervisory capability.

.3 Flow shall be with N.O. and N.C contacts and alarm capability.

2.8 **Excess Pressure Pump**

.1 Specify Pumps
   .1 Double acting displacement type, open cylinder design, direct drive, ULC listed, complete with relief valve.
   .2 Motor
      .1 EEMAC Class B squirrel cage induction 1725 rpm, continuous duty, drip proof, ball bearing, maximum temperature rise 50°C, [0.25] kW, 120/1/60.
      .3 Capacity shall be [7.6] L/min.

.4 Pump operation switch to operate excess pressure pump with pressure differential of [103] kPa.

.5 Shut-off valve and strainer on pump inlet. Relief valve, check valve and shut-off valve on discharge connections.

2.9 **Signs**

.1 Signs for control drain and test valves: to NFPA 13.

2.10 **Antifreeze**

.1 SFU strongly recommends the use of dry systems where fire protection water piping is subject to freezing. Antifreeze presents environmental and maintenance issues. Glycol type systems shall only be installed with written approval of SFU Facilities.

2.11 **Installation**

.1 Install, inspect and test to acceptance in accordance with NFPA 13.

.2 Install excess pressure pump across alarm valve in accordance with manufacturer’s instructions.

.3 Testing to be witnessed by Owner and Burnaby Fire Department.

2.12 **Pre-action Systems**

.1 To be a double interlocked system.

.2 An isolation valve must be installed above the alarm valve for testing and maintenance.

.3 Refer to *Section 28 31 00 Fire Detection and Alarm, 2.3 Pre-Action Control Panel for Sprinkler System.*

***END OF SECTION***
1.1 GENERAL

1.2 Related SFU Technical Requirements

   .1 Section 20 00 05 Mechanical - General Requirements
   .2 Section 21 05 00 Fire Protection - General Requirements

1.3 Coordination Requirements

   .1 Coordinate design with design of building fire alarm systems and associated detectors, manual stations, operating devices, supervisory panel, alarms and wiring are specified in Division 26.

1.4 Description

   .1 Additional SFU design and approval requirements for Carbon Dioxide Extinguishing Systems.

1.5 Quality Control and Assurance

   .1 Reference Standards

2.1 MATERIALS AND DESIGN REQUIREMENTS

2.2 Design Standards

   .1 Do the work in accordance with the latest edition of the following standards unless specified otherwise NFPA 12.

2.3 Engineering Design Criteria

   .1 Coordinate with Division 26 for electrical design, especially the pre discharge alarm.
   .2 Provide complete concentration calculations, hydraulic calculations, and drawings, bound in presentation binder.

2.4 General

   .1 All components to be ULC listed for fire service.
   .2 Refer to NFPA 12 for details of concentration and holding times for contents and use of spaces being protected.

2.5 Storage Containers

   .1 Floor mounted, anchored to wall and cylindrical shape. One bank to be for initial protection and one bank to be connected reserve.
   .2 Discharge shall be 24V electric solenoid valve compatible with fire alarm system specified in Division 26.
   .3 Specify
      .1 Visual indication of discharge at container.
      .2 Pressure switch for indication of discharge at main fire alarm panel.
.3 Directional flow valves.
.4 Assembly to permit weighing while cylinders are in place.

2.6 Piping and Fittings

.1 Galvanized iron with welded, screwed or flanged joints and fittings, to NFPA.

2.7 Nozzles

.1 Stainless steel or non-ferrous with satin finish.
.2 Specify frangible discs or blow-off caps as indicated or specified.

2.8 Warning Signs

.1 To NFPA 12. Fabricate from metal with brass chain suspension; white letters on red background.
.2 Locate warning signs and instruction plates at entrance to and inside each protected space.

2.9 Installation

.1 In accordance with approved or reviewed shop drawings and ULC listing.
.2 Ream piping and swab with Freon TF or chlorothene ND.
.3 Use Teflon on threaded joints.
.4 Anchor piping to prevent movement in accordance with NFPA 12.
.5 Hang and support piping in accordance with Division 22.

2.10 Piping System Leakage Test

.1 Specify pressure test with nitrogen, CO2 or air with tracer gas at 1 MPa for 10 minutes. Pressure drop not to exceed 35 kPa.

2.11 Concentration Test

.1 Specify concentration test at direction of and in presence of owner.
.2 Record concentration on 3 pens UL listed or FM approved gas analyzers. Provide sufficient number of analyzers to simultaneously record concentration levels in protected area on basis of a maximum of 37 m2 per analyzer channel. Minimum of one channel per protected area.
.3 Calibrate analyzers immediately before test using certified gas samples. Calibration to take place in presence of and to satisfaction of owner.
.4 Locate analyzers outside test area. Use 6 mm clear plastic hose connected to analyzers from test area. Location of sampling tube nozzles will be determined by owner.
.5 Run tests for one hour. Maintain concentration for time specified above.
.6 Ceiling tiles, floor panels, equipment or personnel shall not be injured or damaged by discharge of extinguishing agent. Ceiling tiles and floor panels shall not be unseated during
discharge. Do not use mechanical means or hold down devices for floor panels or ceiling tiles. Supervising personnel in test area shall wear breathing apparatus during test.

.7 If test results do not comply with requirements, retest at no additional cost to the owner.

2.12 Recharging

.1 After completion of all testing, ensure each cylinder in both initial and reserve banks contain correct weight of extinguishing agent and restore systems to normal condition.
1.1 **GENERAL**

1.2 **Related SFU Technical Requirements**

   .1 *Section 20 00 05 Mechanical - General Requirements*
   .2 *Section 21 05 00 Fire Protection - General Requirements*

1.3 **Description**

   .1 Gas flooding fire protection systems.

2.1 **MATERIALS AND DESIGN REQUIREMENTS**

2.2 **General**

   .1 Oxygen displacement gas systems may be considered where:

      .1 Water damage would be serious vis-à-vis replacement costs or replacement time.
      .2 Breakdown in equipment, procedures or processes would be exceedingly serious.
      .3 Provision of sprinkler system is impractical.
      .4 Where water is not permitted.
      .5 Where clean fire extinguishing agent is required.

   .2 Gas flooding systems using Halon shall not be used. Alternatives may be used from the following vendors:

      .1 Novec
      .2 Viking
      .3 Tyco

   .4 Review need for total flooding systems with SFU Facilities.

***END OF SECTION***
1.1 **GENERAL**

1.2 **Related SFU Technical Requirements**

- Section 20 00 05 Mechanical - General Requirements
- Section 21 05 00 Fire Protection - General Requirements

1.3 **Description**

- Additional SFU design and approval requirements for Pre-Engineered Wet Chemical Fire Protection Systems.

2.1 **MATERIALS AND DESIGN REQUIREMENTS**

2.2 **Design Standards**

- Do the work in accordance to the latest edition of the following standards unless specified otherwise. NFPA 17A Wet Chemical Extinguishing Systems.

2.3 **Products – General**

- ULC listed pre-engineered system.

2.4 **Storage Containers**

- Main and connected reserve bank of extinguishing agent and expellant gas containers.
- Pressure gauge on each container.
- Approved container mounting and retaining system.
- Main or reserve supply selector switch.
- Directional flow valves.

2.5 **Piping and Fittings**

- In accordance with ULC listing.
- Finish shall be chrome plated or polished stainless steel in exposed areas.

2.6 **Discharge Nozzles**

- Chrome plated brass or stainless steel in accordance with and ULC listing.

2.7 **Detection of Fires**

- In accordance with ULC listing.

2.8 **Operating Devices**

- In accordance with ULC listing.
- Provide one manual control ULC listed operating station.
- Shut down all devices in accordance with the listing.

2.9 **Building Fire Alarm Connections**

- Specify trouble and discharge terminal points for tying into building fire alarm system as specified in Division 28.
Building Fire Alarm System shall monitor the controller for: Discharge (Alarm), Trouble (Supervisory) using individual modules mounted external to the controller.

2.10 Installation

.1 Specify installation and test to acceptance in accordance with ULC listing.
.2 Testing to be witnessed by Owner (SFU Facilities) and Burnaby Fire Department.

***END OF SECTION***
1.1 **GENERAL**

1.2 Related SFU Technical Requirements

   .1 Section 20 00 05 Mechanical - General Requirements
   .2 Section 21 05 00 Fire Protection - General Requirements

1.3 Description

   .1 Additional SFU design and approval requirements for Pre-Engineered Dry Chemical Fire Protection Systems.

2.1 **MATERIALS AND DESIGN REQUIREMENTS**

2.2 Design Standards

   .1 Do the work in accordance with the latest edition of the following standards unless specified otherwise:
     .1 NFPA 17, Dry Chemical Extinguishing Systems.

2.3 Products General

   .1 Specify ULC listed pre-engineered system suitable for specific type of fat/grease used in deep-frying operations.

2.4 Storage Containers

   .1 Specify main and connected reserve bank of extinguishing agent and expellant gas containers.
   .2 Specify pressure gauge on each container.
   .3 Specify approved container mounting and retaining system.
   .4 Specify main or reserve supply selector switch.
   .5 Specify directional flow valves.

2.5 Piping and Fittings

   .1 Specify schedule 40 galvanized steel with galvanized malleable iron fittings and screwed joints.
   .2 Specify black iron, chrome plated or stainless steel in exposed areas.

2.6 Discharge Nozzles

   .1 Specify chrome plated brass or stainless steel in accordance with NFPA 17 and ULC listed.

2.7 Detection of Fires

   .1 ULC listed automatic detection system to NFPA 17.

2.8 Operating Devices

   .1 ULC listed operating system to NFPA 17.
   .2 Provide one manual control ULC listed operating station to NFPA 17.
2.9 Building Fire Alarm Connections

.1 Specify trouble and discharge terminal points for tying into building fire alarm system as specified in Division 28.

.2 Building Fire Alarm System shall monitor the controller for: Discharge (Alarm), Trouble (Supervisory) using individual modules mounted external to the controller.

2.10 Installation

.1 Specify installation and test to acceptance in accordance with ULC listing.

.2 Testing to be witnessed by Owner (SFU Facilities) and Burnaby Fire Department.

***END OF SECTION***
1.1 **GENERAL**

1.2 **Related SFU Technical Requirements**

   .1 *Section 20 00 05 Mechanical - General Requirements*
   .2 *Section 21 05 00 Fire Protection - General Requirements*

1.3 **Description**

   .1 Additional SFU design and approval requirements for packaged fire pumps.

2.1 **MATERIALS AND DESIGN REQUIREMENTS**

2.2 **Design Standards**

   .1 Design and construction shall be in accordance with the latest edition of the following standards unless specified otherwise:
      .1 Requirements and recommendations of NFPA 20 and Appendix A, for centrifugal fire pumps.
      .2 NFPA 37 for stationary combustion engine and gas turbines.
      .3 NFPA 30 for petroleum installations.

2.3 **Certified Factory Tests**

   .1 Specify test each pump at factory to provide detailed performance data and to demonstrate compliance with NFPA and specification.

   .2 Specify hydrostatic test to meet requirements of fire protection system to which it will be connected.

2.4 **Shop Drawings**

   .1 Indicate hydraulic and electrical characteristics including Net Positive Suction Head (NPSH) required make and model number.

   .2 See also *Section 20 00 05 Mechanical - General Requirements*.

2.5 **Engineering Design Criteria**

   .1 Select fire pump to satisfy fire protection system requirements, NFPA.

   .2 Water Supply
      .1 Obtain water information from SFU Energy and Water Services.

   .3 Diesel Driven Pumps
      .1 Ensure positive fuel prime at engine fuel pump.

   .4 Fire pumps can be electric but MUST be fed from emergency power.

   .5 See *Section 25 05 00 Building Management Systems (BMS) Design Guidelines* - interface requirements for BMS and Fire Alarm System for fire pumps.

   .6 Obtain approval list of acceptable manufacturers and products from SFU Facilities. System shall be compatible with existing SFU operating control systems.
.7 Manufacturer of Fire Pump, Driver and Controller shall have local technical personnel available for testing, maintenance and repair.

.8 Proposed equipment placement and access requirements to be reviewed and approved by Building Operations.

2.6 General

.1 Packaged ULC listed and labeled

.2 Accessories to NFPA 20 requirements and in addition.
   .1 Fire pump bypass fitted with OS&Y gate valves and check valves.
   .2 Audible and visual suction side alarm to NFPA 20.
   .3 Shut off valves to be OS&Y gate valves, supervised.

2.7 Installation

.1 Install as specified in accordance with ULC listing, NFPA 20 and approved or reviewed shop drawings.

.2 Field Acceptance Test. Test as specified, each fire pump, driver and controllers in accordance with NFPA 20.

.3 Testing to be witnessed by Owner (SFU Facilities) and authorities having jurisdiction.

***END OF SECTION***
November 26, 2018

Keith Horne, Mechanical Superintendent
Simon Fraser University
Facilities Services – Operations
8888 University Drive
Burnaby BC V5A 1S6

Re: New Connections

Dear Mr. Horne,

As per the discussions during our meeting on November 22nd, the Simon Fraser University (SFU) staff are responsible for ensuring safe potable water is supplied to the consumers as required under Section 8 of the Drinking Water Protection Act. This means that the distribution system is to be maintained such that the water is protected from contamination.

The maintenance of the water distribution system takes a multipronged approach. Any new connection(s) to the distribution system must conform to the standards prescribed in American Water Works Association (AWWA) C 851-14. Furthermore, high risk connection(s) must have an approved backflow assembly installed at the connection point.

Failure to follow the AWWA standard could constitute as contravention of the Section 23 (1) of the Drinking Water Protection Act. For your records, section 23 (1) states that:

Prohibition against contaminating drinking water or tampering with system

23(1) Subject to subsection (3), a person must not
(a) introduce anything or cause or allow anything to be introduced into a domestic water system, a drinking water source, a well recharge zone or an area adjacent to a drinking water source, or
(b) do or cause any other thing to be done or to occur, if this will result or is likely to result in a drinking water health hazard in relation to a domestic water system.

Please ensure that the standards are followed by the SFU staff and the contractors. If you have any further questions, please do not hesitate to contact me.

Regards,

Binny Sivia
Environmental Health Officer

Fraser Health Authority
Health Protection
297 – 2776 Bourquin Cres. West
Abbotsford BC Fax (604) 876-7901
V2S 6A4 Canada www.fraserhealth.ca
Procedure for Disinfecting Domestic Water Line Installations

Ref: AWWA CG51-14 Standard

Before any connection to existing Domestic Cold Water (DCW) systems the following procedures must be conducted.

1) Unidirectional flushing is required from beginning and end points in the piping system including branches over 6ft.

2) Pressure test piping system to 200psi introducing chlorine to bring residual above 100ppm. Test strips applied at beginning and end points to insure residual has reach minimum standard along entire piping system.

3) After a 24hr period apply unidirectional flushing and bring residual chlorine level below 1ppm along entire piping system including branches.

4) Once this has been achieved, two clear rounds of testing from a certified lab for E.coli and total coliform must be obtained before any connection can be made to an existing system.

5) Piping used for final connections should be swab with 12% chlorine solution.

This procedure must be conducted to the satisfaction and approval of the Fraser Health Authority Water Operating Permit Holder.

Note: Connections to Domestic Water Systems such as for Irrigation systems must have an approved Reduced Pressure Backflow Assembly (RPBA) installed at the connection point.
1.1 GENERAL

1.2 Related SFU Technical Requirements

.1 Section 20 00 05 Mechanical - General Requirements
.2 Section 22 05 00 Plumbing - General Requirements
.3 Section 22 05 00.1 Plumbing - Potable Water Procedures

1.3 Coordination Requirements

.1 SFU Facilities

2.1 MATERIALS AND DESIGN STANDARDS

.1 Potable water must be tested to conform with AWWA and SFU Facilities Requirements.

3.1 EXECUTION

.1 The contractor shall be responsible for all potable water testing and results.

.1 Testing is to be performed by SFU preferred vendor:

Maxxam Analytics
4606 Canada Way
Burnaby, BC V5G 1K5
(604) 734-7276

Alternate vendors may be approved – coordinate with SFU Facilities.

.2 Procedure for collection, delivery and analysis/testing to be confirmed with vendor.

General process as follows:

a Email CustomerService@Maxxam.ca in order to place bottle orders. In the bottle order request, the following items must be specified:
  • Number of samples to collect
  • Type of samples - whether drinking water source, well water or ground/surface water
  • Tests needed to be complete on the samples (Total coliforms, E.coli, Fecal coliforms, etc)
  • On the email or phone call placed for bottle order, specify the project, and if the samples are being submitted by a contractor or consultant, confirm PO# as applicable. This PO# should be reflected on the COC form accompanying the samples.
  • Specify date and time bottles are required and whether this is for pick up or delivery at a specified address.

b A Chain of Custody (COC form) will be provided by Maxxam with the bottle order. COC form can also be downloaded from the Maxxam website: http://maxxam.ca/resources/chain-of-custody-coc-forms/. Select generic COC form for regular/environmental waters and Drinking water COC form for drinking water source samples.
  • Visit this website link for instruction on how to fill out COC form and how to pack samples in a cooler; http://maxxam.ca/resources/video-library/instructional-video-library/ For the COC forms, all contacts that must receive a copy of the report should be reflected on the COC form.
  • The sample type requirements vary with the type of test required.
  • Best practice is to keep samples cold in the range 1-10 degree Celsius.

***END OF SECTION***
1.1 **GENERAL**

1.2 **Related SFU Technical Requirements**

1.2.1 Section 01 35 29 Health, Safety and Emergency Response Procedures
1.2.2 Section 22 05 00.1 Connection to SFU Potable Water System
1.2.3 Section 22 10 00 Plumbing Piping
1.2.4 Section 22 40 00 Plumbing Fixtures
1.2.5 Section 20 00 05 Mechanical - General Requirements

1.3 **Coordination Requirements**

1.3.1 Coordinate with SFU Facilities.
1.3.2 SFU is responsible to ensure safe potable water is supplied to the consumers as required under Section 6 of the Drinking Water Protection Act. All Related Sections must be followed and coordinated very closely with SFU Facilities.

1.4 **Description**

1.4.1 These Design Guidelines apply to all Division 22 sections and all mechanical sections of Division 33 including plumbing, fire protection, steam etc.
1.4.2 Specific requirements of applicable sections are considered in addition to requirements herein. Where conflicts exist, the specific requirement in other section shall govern.

2.1 **MATERIAL AND DESIGN REQUIREMENTS**

2.2 **Submission of Design Philosophy**

2.2.1 The Mechanical Consultant shall submit to SFU Facilities a design philosophy (Basis of Design) as well as drawings and specifications for the proposed building mechanical and plumbing systems.
2.2.2 Submit to SFU Facilities a design philosophy for the proposed building plumbing systems. Major components of the philosophy must be accepted in principle by SFU Facilities before the project can proceed to Construction. Consultants are expected to produce designs that meet user needs and allow SFU Facilities to continue to meet those needs in the future in a safe efficient manner.
2.2.3 All new service connections must be reviewed and approved by SFU Facilities.

2.3 **Performance Standards**

2.3.1 All plumbing installations shall comply with the following:
   2.3.1.1 BC Plumbing Code.
   2.3.1.2 SFU Owners’ Technical Requirements.

2.4 **Site Services – Special Requirements for Plumbing**

2.4.1 Avoid the use of storm pumps and sanitary sewer system pumps if possible.
2.4.2 Where standby/emergency power is available, storm and sanitary pumps shall be tied into it. Sump levels shall be monitored by Building Management System (BMS).
2.4.3 Backflow prevention is required on all primary water supplies into the buildings. Refer to
.4 Frost proof hose bibs shall be installed at reasonable intervals around building perimeter. At least one on each major building face.

2.5 Building Plumbing - General Requirements

.1 SFU operates under our own Water Operating Permit under the authority of Fraser Health Authority and the Provincial Government. As such, SFU is subject to all the Laws and Regulations specified under the most up to date BC Drinking Water Protection Act. Refer to 22 05 00.1 for details.

.2 No alteration or work is to be done on any of SFU’s Water Systems without the knowledge and approval of the Mechanical Superintendent. Work is to be carried out by qualified personnel including all permits, water treatment and testing as required.

.3 All domestic hot water systems will have recirculation lines unless otherwise specified by SFU Facilities Mechanical Department.

.4 Potable water plumbing system installations must have adequate flushing of lines to provide assurance that no contaminations are present. This is applicable to renovations and repairs as well.

.5 All drainage piping has a typical slope of 2% (1/4 in 12).

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

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

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

.9 For underground parkade drainage refer to Section 33 49 00 Storm Water Distribution Structures sentence 2.5.13.

.10 Review acid waste treatment with SFU Facilities and SFU’s Safety and Risk Services

.11 Plumbing equipment requiring frequent maintenance (once a year) shall be readily accessible.

.12 Specify, where required by WorkSafe BC tempered, piped in Eye Wash stations required.

.13 All isolation valves shall be operational, and contain fluid without leaks at 1.5 times the working pressure with one side of piping disconnected from the valve.

2.6 Tests

.1 Refer to Section 22 05 00.1 for Details

.2 Specify tests to be conducted in presence of SFU Facilities.

.3 Piping Tests

.1 Maintain test pressure without loss for 48hr unless otherwise specified.

.2 Test drainage, waste and vent piping to B.C. Building Code.

.3 Specify piping inspections and testing for gas, fuel systems, medical gases,
compressed air systems based on applicable codes and local Authorities Having Jurisdiction such as BC Safety Authority.

2.7 Mechanical Seals

.1 Specify Mechanical seals on all pump applications.
.2 Insure seals are compatible with intended service.

2.8 Dielectric Couplings

.1 Specify dielectric couplings where pipes of dissimilar metals are joined.
.2 Shall be compatible with and to suit pressure rating of piping system.
.3 For pipes NPS 2" 50 mm and under specify isolating unions.
.4 For Pipes NPS 2-1/2" 65 mm and over specify isolating flanges.

2.9 Drain Valves

.1 Specify at low points and at section isolating valves.
.2 Minimum NPS 3/4" 18 mm unless otherwise specified.
   .1 Shall be bronze, with hose end male thread and complete with cap and chain.
   .2 Shall be ball valves.

2.8 Sleeves

.1 Specify pipe sleeves at points where pipes pass through masonry, concrete or fire rated assemblies and at Mechanical Room floor penetrations to stories below.
.2 Where pipes penetrate through floor slabs they must be sleeved with a pipe that protrudes a minimum of 2" (50 mm) proud of the floor level to prevent flooding penetrating the floor below.
.3 Sleeves shall be Schedule 40 steel pipes.
.4 Sleeves shall have an annular fin continuously welded at midpoint, embedded in concrete or sealed to floor finish
 .1 Provide sleeves through foundation walls.
.5 Size minimum 1/4" (6 mm) clearance all around, between sleeve and un-insulated pipe or between sleeve and insulation.
.6 Terminate sleeves flush with surface of concrete and masonry walls.
.7 Specify fill for voids around pipes.
   .1 Caulk between sleeve and pipe in foundation walls and below grade floors with waterproof fire retardant non-hardening mastic.
   .2 Ensure there is no contact between copper tube or pipe and ferrous sleeve.
   .3 Fill future-use sleeves with lime plaster light weight concrete or other easily removable filler.
   .4 Coat exposed exterior surfaces of ferrous sleeves with heavy application of zinc rich paint to latest edition of CGSB 1-GP-181M.

2.9 Preparation for Fire Stopping

.1 Un-insulated unheated pipes not subject to movement shall have no special preparation.
2.10 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.
.3 Outside diameter to cover opening or sleeve.
.4 Inside diameter to fit around finished pipe.

2.11 Painting

.1 Refer to Section 09 90 00 Painting and Coating.
.2 Specify at least one coat of corrosion resistant primer paint to ferrous supports and site fabricated work.

2.12 Finished Area Floor Access Housing (Clean-Out Cap/Cover)

.1 Products: Zurn LC CO-2521 or approved equal. Alternates to be coordinated with SFU Facilities.

***END OF SECTION***
1.1 **GENERAL**

1.2 **Related SFU Technical Requirements**

   .1 *Section 22 05 00 Plumbing - General Requirements*

1.3 **Coordination Requirements**

   .1 Coordinate with SFU Facilities.

1.4 **Description**

   .1 Additional SFU design and approval requirements for plumbing piping.

2.1 **MATERIAL AND DESIGN REQUIREMENTS**

2.2 **General**

   .1 Specify Backflow/Cross Connection Control as per BC Plumbing Code. (Refer to SFU Owners’ Technical Requirements, *Section 22 11 18 Backflow/Cross Connection Control* for details).

   .2 Size water hammer arrestors to AWWA and manufacturers standards.

   .3 All equipment requiring periodic maintenance shall be mounted in locations where access using ladders, “confined space entry” are not required.

   .4 Specify floor drains for public washrooms only, or as required by code.

   .5 Bypass piping isolation and check valves are required on water booster systems.

   .6 Dryers are required on compressed air systems. Specify auto-drain valves.

   .7 Use only lead-free solder and water flushable non-acidic flux on potable water systems. Specify dual PRV's for services larger than 2" diameter.

   .8 Specify strainers for all domestic water systems.

   .9 All major sections of domestic cold water piping being replaced must be tested in accordance with governing code, and coordinated with SFU Facilities.

   .10 Specify two strainers in parallel for services larger than 2" diameter.

   .11 Only cast iron or copper pipe is to be used for above ground storm and sewer piping in all buildings.

   .12 Do not specify plastic piping as follows:

   .1 For use inside buildings or under buildings except for acid waste systems.

   .2 For underground sanitary, storm drainage if steam or condensate is drained to these systems, or can be drained into them in the future.

   .13 Do not specify cellular ABS or PVC pipe under traffic areas with less than 30" cover.
.14 Do not specify trap primers that contain fine screens.

.15 Where solar collectors are planned or contemplated, consult with Technical Services for approval of concept.

.16 Specify curbs and housekeeping pads under equipment and around pipe penetrations in Mechanical rooms.

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

.18 Do not specify glass acid waste piping under laboratory sinks that have storage shelf below or are intended for storage.

.19 Review proposed acid waste treatment with SFU Facilities.

2.3 Plumbing Piping Type

.1 Specify type “K” copper piping for hot water and recirculated hot water. Alternatives may be considered as long as they are submitted and approved by SFU Facilities.

.2 Do not specify flexible (similar to Big O type) drainage piping.

.3 Where practical polypropylene acid waste piping is acceptable, pending approval by SFU facilities.

***END OF SECTION***
1.1 **GENERAL**

1.2 **Related SFU Technical Requirements**

1.2.1 Please refer to the latest SFU Backflow Prevention Assembly Test Report.

1.3 **Coordination Requirements**

1.3.1 Coordinate with SFU Facilities.

1.4 **Description**

1.4.1 Plumbing Specialties - Additional SFU cross-connection control requirements.

2.1 **MATERIAL AND DESIGN REQUIREMENTS**

2.2 **Backflow/Cross Connection Control General Requirements**

2.2.1 Backflow devices are required to be registered with the City of Burnaby and with SFU – all documentation (location, project number, test certificates, type and size of device etc.) is to be submitted to Burnaby and SFU.

2.2.2 All devices to be approved by the Mechanical Department prior to installation. No backflow prevention devices less than ¾" will be allowed – Watts is preferred supplier.

2.2.3 All installations shall be in accordance with the recommendations contained in the latest edition of the BC Plumbing Code.

2.2.4 All backflow prevention assemblies shall conform to the latest CSA B64 Standards and shall be certified by CSA or by a certification body recognized by the Standards Council of Canada. For the current listing of CSA certified backflow preventers refer to the CSA website [http://www.csagroup.org/canada/](http://www.csagroup.org/canada/).

2.2.5 Vacuum breakers shall conform to the requirements of C.S.A. B64.5.

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

2.2.7 Tests are to be conducted in the period 30 to 60 days prior to date of Substantial Completion.

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

2.2.9 All devices must be installed within the buildings, in accessible locations, (not in cupboards), to facilitate testing and maintenance.

2.2.10 Test forms should include the SFU Backflow Prevention Assembly Test Report.

2.2.11 Do not locate reduced pressure backflow devices that require regular testing any higher than 1500 mm above the floor.
2.3 Backflow/Cross Connection Control General Requirements

.1 Water Service Entry:
   .1 Two Backflow Prevention Assemblies piped in parallel are required at the water
   service entry to all buildings, to allow for servicing without having to completely isolate
   the water supply to the building.

   .2 Whether a Reduced Pressure Backflow Assembly (RPBA) or alternate type of
   assembly is required will depend on the hazard category of the building in question.

   .3 The parallel Backflow Prevention Assemblies must be designed to allow for peak
   design flow during normal operation and for one unit to be taken off line for
   servicing while maintaining 50% or greater peak flow.

.2 Fire Protection Service Connection:
   .1 A double check valve assembly, (DCVA), is required at Fire Protection service
   connections per British Columbia Building Code-Plumbing Services (part 7). An
   additional parallel DCVA is not required.

.3 Irrigation Systems:
   .1 A DCVA at the service connection is to be provided in accordance with the usage.
   Note: where a higher hazard exists (due to chemical injection), additional area
   protection with an RP Assembly is required.

.4 Potable Water System in Buildings:
   .1 Backflow protection is required to be installed in local areas to protect potable water
   systems in buildings from labs and other hazardous water uses within the building.

.5 Chemical or detergent mixing stations:
   .1 An RPBA shall be installed immediately upstream of any chemical or detergent mixing
   station.

***END OF SECTION***
1.1 **GENERAL**

1.2 Related SFU Technical Requirements

   .1 *Section 22 05 00 Plumbing - General Requirements*

1.3 **Coordination Requirements**

   .1 Coordinate with SFU Facilities.
   .2 Coordinate with other design disciplines.

1.4 **Description**

   .1 Additional SFU design requirements for Plumbing Pumps.

2.1 **MATERIALS AND DESIGN REQUIREMENTS**

2.2 All sump pumps and sump water levels shall be monitored by SFU boiler plant; technical details of how this is done should be reviewed with SFU Facilities.

2.3 Specify following alarms:

   .1 High sump level
   .2 Sump pump cycling frequency.

2.4 **Cold Water Pressure Booster Systems**

   .1 If any project requires a booster system within the project consult SFU Facilities for water supply details.

***END OF SECTION***
1.1 GENERAL

1.2 Related SFU Technical Requirements

1.3 Coordination Requirements

1.4 Description

2.1 MATERIALS AND DESIGN REQUIREMENTS

1.1 Tank Registration:

.1 All pressurized storage tanks must be preapproved and registered in the SFU storage tank database in addition with the BC Safety Authority. This is under the responsibility of the project of which the tank is part of.

.2 All tanks attached to heating, cooling, domestic hot water systems, pressure piping shall be ASME rated tanks.

.3 An ASME label shall be affixed to the tank and remain visible after tank is insulated.

.4 All ASME rated tanks shall be inspected the Ministry of Municipal Affairs, Recreation and Culture, Safety Engineering, and Service’s Division.

.5 Above and underground fuel oil storage tanks shall meet the latest standards of the Canadian Council of Ministers of the Environment “Environmental Code of Practice for Aboveground and Underground Storage Tank Systems Containing Petroleum and Allied Petroleum Products” and the latest provincial and federal regulations governing the installation of above and underground fuel storage tanks, including the Environment Canada - Storage Tank Systems for Petroleum Products and Allied Petroleum Products Regulations (SOR/SOR/2008-197)

.6 Underground Fuel oil tank installations including piping shall be double wall with electronic monitoring systems designed to report on the integrity of the installation.

.7 Floor mounted tanks shall be on housekeeping pads or otherwise be raised off the floor.

.8 Tanks shall be seismically braced.

.9 Underground storage tanks shall be constructed of approved non-corrosive materials.

.10 Adequate hold down measures shall be taken to prevent groundwater uplift of the tanks when empty.

.11 All above and underground storage tanks containing flammable and combustible liquids and their piping systems shall meet the latest BC Fire Code (Sections 4.3 and 4.4) requirement
.12 All hazardous waste storage tanks shall meet the latest BC Hazardous Waste Regulations 3.4.2.16

.13 Some of the following Genset Fuel Tank Specifications are covered by one or more applicable codes, but this checklist should assist everyone to ensure best design practice reflecting SFU's expectations will be carried out:

- Double wall vacuum tanks are preferred, (safer, more reliable, no open containment).
- Use only black pipe, unless the project has an engineered underground installation.
- A labelled hand shut-off is required on the exterior of the building, between the main tank and the day tank.
- A labeled hand shut-off is also required at the day tank, between the day tank and the engine.
- Provide for changing the height of the day tank fuel return down pipe, (a removable or non-welded pipe is acceptable), or provide 2 return pipes, one above and one below the fuel level, as different engine systems have different requirements.
- Install baffles internally which will reduce entrained air and promote delivery of cool fuel to the genset.
- Ensure design accommodates an easy tank drain access.
- Provide a manual fuel port.
- Provide for two access points to permit easy fuel polishing.
- The fuel level gauge must be sealed.
- The mounting must be seismically designed and braced.
- The internal and external finishes must be coordinated to minimize rust corrosion through electrolytic action for long tank life.
- Install a filter/water trap between the main and the day tank upstream of (to protect) the transfer pump.

Regarding Fuel Control:

- Use low voltage fuel sensors.
- Specify and install generic non-proprietary components.
- Equipment must allow in-house staff to diagnose, repair and re-program the controllers.
- Spare parts must be maintained on campus.
- Consider redundancy and the use of duplex systems in some applications.
- Install a terminal board to allow the connection of a monitor system of SFU’s choice (BMS, Fire Alarm, genset). Further discussions should take place regarding genset, fuel and transfer switch monitoring.

.14 The requirements for acid neutralization and hazardous waste disposal should be reviewed on a case-by-case basis with SFU Facilities and Safety & Risk Services – Environmental Health & Research Safety. Separate procedures are required for handling low pH and other hazardous waste materials other than disposing down drains.

***END OF SECTION***
1.1 GENERAL

1.2 Coordination Requirements
   .1 Coordinate with SFU Facilities.
   .2 Coordinate with other design disciplines, Structural and Architectural.

1.3 Description
   .1 Additional SFU design requirements for Roof Drains.

2.1 MATERIAL AND DESIGN REQUIREMENTS
   .1 A 4” insulated roof drain is the minimum requirement for a new building.
   .2 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.
   .3 Provide N+1 redundancy roof drains in all cases (e.g. provide 2 roof drains in the case where 1 would suffice by design)
   .4 Where roof areas are enclosed by parapet walls, provide scupper(s) for relief in emergency flooding situations as per the B.C. Plumbing Code.
   .5 Cast iron roof drains have to be insulated.

***END OF SECTION***
1.1 GENERAL

1.1 Related Technical Requirements

.1 Section 23 21 05 District Hot Water Heating System

1.2 Description

.1 Additional SFU design requirements for Domestic Water Heaters.

2.1 MATERIALS AND DESIGN REQUIREMENTS

.1 Electric water heaters should typically not be used, but exceptions can be considered by SFU Facilities on a project by project basis. If an electric water heater is selected, it must be equipped with leak protection and an insulating blanket.

.2 Where on demand domestic hot water heaters are specified, make provisions for water expansion without relying on pressure relief valve for control of water pressure.

.3 Design controls schemes for controlling hot water temperature for stable supply of domestic hot water in quantity and stable temperature required within the building.

***END OF SECTION***
1.1 GENERAL

1.2 Coordination Requirements
   .1 Coordinate with SFU Facilities.
   .2 Coordinate with other design disciplines.

1.3 Description
   .1 Additional SFU design and approval requirements for Heat Transfer devices.

2.1 MATERIALS AND DESIGN REQUIREMENTS

2.2 Detailed Description
   .1 Campus building heating systems are supplied from the Central Plant with a Primary Supply Water Temperature up to 120°C. Building design should be optimized to provide maximum ΔT between Primary Supply and Primary Return Water Temperatures.
   .2 Design parameters/load requirements must be reviewed with and approved by the Mechanical Department and the Chief Engineer.

2.3 Heat Exchangers
   .1 Design with sufficient room for service and at elevations accessible without portable ladders.
   .2 Design to ensure adequate head to allow gravity drain to condensate receiver especially with modulating steam valves.
   .3 Specify ASME rated heat exchangers.
   .4 Specify pressure relief valves.
   .5 Specify double wall plate and frame heat exchangers to serve DHW storage tanks.

***END OF SECTION***
1.1 **GENERAL**

1.2 **Related Technical Requirements**

.1 Section 10 28 00 Toilet, Bath, and Laundry Accessories

.2 Section 22 05 00 Plumbing - General Requirements

.3 Section 22 11 18 Backflow/Cross Connection Control

.4 Section 22 10 00 Plumbing Piping

1.3 **Coordination Requirements**

.1 Coordinate with SFU Facilities.

1.4 **Description**

.1 Additional SFU design and approval requirements for Plumbing Fixtures.

2.1 **MATERIALS AND DESIGN REQUIREMENTS**

2.2 **General**

.1 Architects and Mechanical Engineers must propose the fixture types very early in the design to enable them to be tested on campus.

.2 Hard-wired, ‘No-touch’ motion detector-activated plumbing fixtures and accessories are required for faucets, urinals, water closets and are to be considered for paper towel and soap dispensers.

.3 All fixtures and trim shall be CSA approved.

.4 Emergency showers and eye wash stations shall meet ANSI Z358.1 Standards Latest Edition.

.5 All plumbing fixtures and trim used in barrier free locations shall comply with the British Columbia Building Code.

2.3 **Plumbing Fixtures**

.1 All fixtures are to be approved by SFU Facilities Mechanical Department.

.2 All toilets are to be wall mounted unless approval given by SFU Facilities.

.3 Toilets are not to be low or dual flush toilets.

.4 Toilets are to be fitted with a 1.28 Gal/Flush flushometer.

.5 Specify water conserving type of fixtures and trim. For projects not certified under LEED or REAP, refer to Table 1.0, Plumbing Fixture Water Efficiency, for fixture flow requirements.

.6 Low flow faucets are not to be specified unless approval given by SFU Facilities.

.7 Waterless Urinals are not to be specified unless approval given by SFU Facilities.

.8 All fixtures within the building shall be generally and where possible of the same manufacturer.
.9 Specify make of fixtures with manufacturers’ local representation.

.10 All plumbing fixtures and trim used in handicapped accessible locations shall comply with the latest version of the British Columbia Building Code.

.11 Emergency Showers and Eye Wash Stations:
   .1 Emergency water at all emergency showers and eyewashes supply shall be tempered and not exceed 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. Floor surfaces slope to drain.
   .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.

.12 Drinking water 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 must include an appropriate fixture for filling water bottles.
   .2 For all new buildings, drinking water fountains shall be located inside buildings at level 1 entrance lobbies and should be visible from the exterior.
   .3 All new buildings shall have drinking water fountains installed on the shortest dead leg possible off of a line that is flowing regularly. This line would preferably be serving a washroom.
   .4 Chilled drinking water founts are permitted but only bottle fill type, not filter type.
   .5 Drinking water fountains shall NOT have filters and hence no backflow preventers will be required.
   .6 Non-testable backflow devices are not permitted.
   .7 One vendor that supplies drinking water fountain and bottle filling stations that meet the above requirements is Elkay (web site: elkaypro.com).

.13 Domestic Water Dispensing and Filtration Equipment
   .1 The installation of water dispensing/filtration equipment for office and kitchenette type areas is acceptable only with approval from SFU Facilities. An approved backflow device must be installed as per Section 22 11 18 Backflow/Cross Connection Control to prevent water from being drawn out of the filter system back into the water supply line. The hazard presented by the desired equipment must be such that the required backflow protection is non-testable and therefore requires no annual certification. Equipment requiring the annual certification of a backflow device will not be acceptable for installation.
2.4 Plumbing Fixture Water Efficiency

.1 New or replacement fixtures shall meet water efficiency performance requirements in Table 1.0. The table also shows comparative reference points in other standards and codes.

.1 Efficiency requirements for shower heads and faucets are about 20-30% more efficient than BC Building Code requirements; these levels of efficiency are proven and easily achievable in most projects with minimal incremental costs.

.2 Toilet efficiency requirements are equivalent to BC Building Code requirements introduced in 2011, and reflect current and proven best practices.

Table 1.0. Fixture Water Efficiency Requirements

<table>
<thead>
<tr>
<th>Requirement (Maximum Volume or Flow Rate)</th>
<th>Comparative Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Toilets 4.8 litres/flush average</td>
<td>Equivalent to existing BC Building Code</td>
</tr>
<tr>
<td>Urinals 1.9 litres/flush</td>
<td>Equivalent to BC Building Code</td>
</tr>
<tr>
<td>Shower head 7.6 litres/minute</td>
<td>BC Building Code is 9.5 litres/min</td>
</tr>
<tr>
<td></td>
<td>Equivalent to LEED 2009 prerequisite</td>
</tr>
<tr>
<td>Kitchen Faucet 6.8 litres/minute</td>
<td>BC Building Code is 8.3 litres/min</td>
</tr>
<tr>
<td></td>
<td>Kitchen faucets usually need higher flow than lavatories for good user experience</td>
</tr>
<tr>
<td>Lavatory Faucet – non sensor/metering 5.6 litres/minute</td>
<td>BC Building Code is 8.3 litres/min</td>
</tr>
<tr>
<td></td>
<td>Lavatory faucets do not require flows as high as kitchen faucets for good user experience</td>
</tr>
<tr>
<td>Lavatory Faucet – sensor/ metering 0.76 litres/cycle</td>
<td>Equivalent to LEED 2009 prerequisite</td>
</tr>
</tbody>
</table>

***END OF SECTION***
1.1 GENERAL

1.2 Coordination Requirements

.1 Coordinate with SFU Facilities for distilled water applications and services.

1.3 Description

.1 Additional SFU design and approval requirements for Specialty Piping Systems.

2.1 MATERIALS AND DESIGN REQUIREMENTS

2.2 General

.1 All specialty piping systems must be submitted, reviewed, and approved by SFU Facilities.

.2 Medical gas piping shall be in accordance with CSA Z-305.1. Non-Flammable Medical Gas Piping Systems.

2.3 Distilled Water Systems

.1 Consideration shall be given to limiting outlets to one per laboratory. Consult with SFU Facilities.

.2 De-chlorination prior to distillation may be required at some locations. Consult with SFU Facilities.

.3 Distilled water may be conveyed via the following:

.1 High density polyethylene pipe using proper fittings and connectors. This is the recommended piping system for distilled water.

.2 Tin lined copper pipe with the proper tin compression or belled couplings. Care must be taken to ensure that no copper comes in contact with the distilled water at connections or elsewhere.

.3 Teflon with the proper fittings and connectors.

.4 Nylon with the proper fittings and connectors. Expansion is a serious problem.

.5 Polyethylene with the proper fittings and connectors. This material has a low softening point - 140° F. Care must be taken when selecting the bonding solvent.

.6 Polypropylene with the proper fittings and connectors. Fillers in the polypropylene shall be as little as possible.

.7 Polyvinylchloride (P.V.C.) with the proper fittings and connectors. This material has a low softening point - 160° F. Care must be taken when selecting the bonding solvent.

.8 Stainless steel with the proper fittings and connectors. Use Type 304-L and its welding alloy. Plastics other than the aforementioned are not recommended.

.4 Distilled water faucets compatible with the distilled water supply piping are required.
2.4 Localized Stills

.1 For high quality distilled water, localized stills are recommended over high quality distribution from a central source.

.2 Where local stills are required, it is recommended that chilled water from the chilled water system be used for condensing purposes.

2.5 Vacuum

.1 Vacuum piping may be required at some locations. Consult with owner.

2.6 Compressed Air

.1 Copper is recommended for compressed air piping.

***END OF SECTION***
1.1 **GENERAL**

1.2 **Coordination Requirements**

.1 Coordinate with SFU Facilities
.2 Coordinate with other design disciplines.

1.3 **Description**

.1 SFU requirements for cleaning air handling and exhaust systems.

2.1 **MATERIAL AND DESIGN REQUIREMENTS**

.1 When applicable, follow the latest LEED procedures regarding air system cleaning.

.2 All air systems altered or installed by this project shall be cleaned by a Cleaning Sub Trade employing high capacity cleaning equipment specifically designed for the work and operated by trained personnel.

.3 The following air systems shall be cleaned as specified by the Engineer:
   .1 Relief.
   .2 Exhaust.
   .3 Supply.
   .4 Air Conditioning.
   .5 Return.

.4 Components as specified by the Engineer within each system shall be thoroughly cleaned to the Engineer’s satisfaction and shall include but not be limited to the following:
   .1 Intake and relief louvers.
   .2 Bird screens.
   .3 Auto dampers, back draft dampers.
   .4 Filter frames.
   .5 Coils.
   .6 Fans and motors - complete assembly.
   .7 All plenum surfaces.
   .8 Silencers.
   .9 Terminal reheat coils.
   .10 Supply air grilles, registers and diffusers.
   .11 Ductwork.
   .12 Mixing boxes, VAV boxes.
   .13 Return, exhaust and relief air grilles and diffusers.

.4 **Access and Shut Down Requirements**

.1 Where none exist the cleaning sub trade shall provide access as required for the work and shall reseal and make good any duct or insulation damaged in the process of this work to the same standard as existing insulation.

.2 Air systems must not be shut down without prior approval from the owner.

.5 **Cleaning**

.1 On new construction or renovation projects, the ductwork shall be cleaned whenever practical before the air systems are balanced.
.2 On energy conservation retrofit projects, the ductwork shall be cleaned before any work is undertaken on the air path -modifications, repairs, calibrations, balancing, etc.

.3 Remove cheesecloth from grilles, diffusers, registers, etc., left over from the temporary use of the air systems.

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

.5 Cleaning shall generally be by high capacity power vacuum. High pressure compressed air or wire brushing. Non-toxic solvent cleaning shall be used where dirt or scale cannot be removed otherwise. Coils shall be de-scaled.

.6 Re-install any grilles, registers and diffusers, which may have been removed for cleaning purposes.

.7 Air Filters

.1 On new construction projects the Cleaning Sub Trade shall remove the temporary filters and supply and install new filters as specified in the contract documents after cleaning the air systems.

.2 After cleaning existing air systems, the Cleaning Sub Trade shall replace existing filters with new filters as specified in the documents.

.8 Debris Removal

.1 All trash - old filters, boxes, insulation, etc., shall be removed from the site as set out in Division 1.

.9 Report

.1 After completion of the work, the Sub Trade shall provide to the Contractor four copies of a certificate stating that all systems have been cleaned as specified and that all access panels for all cleaning openings are in place. This certificate shall be placed in the Operating and Maintenance Manuals.

.10 Access Panels

.1 Label all new access panels. Refer to Section 20 00 08 Mechanical Identification for label specification.

***END OF SECTION***
1.1 **GENERAL**

1.2 Related SFU Technical Requirements

.1 *Section 20 00 05 Mechanical - General Requirements*
.2 *Section 22 05 00 Plumbing - General Requirements*
.3 *Section 25 05 00 Building Management Systems (BMS) Design Guidelines*

1.3 Coordination Requirements

.1 SFU Facilities
.2 SFU IT

1.4 Description

.1 SFU Owners’ Technical Requirements for HVAC design specification details.

1.5 HVAC System Shutdown

.1 All system shutdowns have to be coordinated with SFU Facilities. Refer to SFU Standards and Procedures Manual – HVAC System Shutdown Scheduling.

2.1 **MATERIALS AND DESIGN STANDARDS**

2.2 Submission of Design Philosophy and Documentation

.1 The Mechanical Consultant shall submit to SFU Facilities a design philosophy (Basis of Design) as well as drawings and specifications for the proposed building mechanical and plumbing systems.

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

.3 All new service connections must be reviewed and approved by SFU Facilities.

2.3 Performance Standards

.1 The HVAC design shall comply with the following:
   .1 BC Building Code and its latest bulletin / addendums.
   .2 SFU Owners’ Technical Requirements.

2.4 General Requirements

.1 For all equipment design safe access for servicing and replacement including anchor points for lifting.

.2 Use air systems in combination with perimeter radiation. Perimeter radiation shall be capable of being operated independent of the air system (see *Section 25 05 00*). Perimeter radiation must be capable of supplying building skin loss.

.3 Avoid use of ceiling radiant panels unless approved by SFU Facilities Mechanical
.4 Avoid all air systems.

.5 See Section 25 05 00 Building Management Systems (BMS) Design Guidelines for additional control system requirements.

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

.7 Provided reheat coils in each interior zone.

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

.9 Proposed fan volume control schemes based on building static pressure must have prior approval from SFU Facilities.

.10 Do not specify variable pitch in motion fans.

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

.12 Refer to Division 27, Section 27 05 05 Communication Rooms Design Guidelines environmental/ventilation requirements.

.13 Filters must meet project requirements and where applicable, conform to SFU standard filter sizes (coordinate with SFU Facilities).

.14 Specialty requirements will be needed for lab environments as needed.

.15 Air filters provided for use in Fan Coil Units adhere to the following:

.1 Filters for use in Fan Coil Units shall be a nominal trade size such as 12” x 24” x 1” and have an efficiency rating of MERV 8 or better.

.16 Buildings with no air conditioning shall have circulation air increased by minimum of 25% or have sufficient air volume and temperature to meet BC Safety Authority requirements for continuous occupancy with respect to maximum space temperature.

.17 Radiant heating panels shall not face windows. Design installation of radiant heating panels so that heater radiates energy to the intended target.

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

.19 VAV systems shall have reheat coils at all VAV boxes.

.20 Window mounted air conditioners and exhaust fans are not acceptable, except for temporary buildings.

.21 All exhaust ductwork within the building occupied floors/areas shall be under negative pressure.

.22 Specify separate ventilation systems for Mechanical Rooms.

.23 Do not specify sidewalk supply registers for classroom applications.
.24 Controls specifications shall meet SFU Owners’ Technical Requirements. Overall responsibility of Mechanical system design and necessary controls shall be Mechanical Consultants responsibility.

.25 Provide minimum of 8 air changes per hour (ACH) for all laboratories during occupied hours and, where possible, an unoccupied nighttime setback to 4 ACH. Laboratories designed with 4 ACH unoccupied nighttime setback must have adequate motion detection to override nighttime setback conditions when occupied, as well as adequate VAV supply and exhaust control. Alternate proposals to be reviewed with SFU Facilities and approved by SFU Safety & Risk Services – Environmental Health and Research Safety.

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

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

.28 Specify lockable isolation valves (lug style) on all equipment and all branches of heating and chilled water distribution systems.

.29 Design installation of all equipment that may have to be removed from service for repairs while remainder of system remains in service.

2.5 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 or less)

.2 Co-ordinate with architectural discipline.

2.6 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.

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

2.7 Tests

.1 Insulate or conceal work only after testing.

.2 Piping
   .1 General: maintain test pressure without loss for 48hr unless otherwise specified.
   .2 Hydraulically test steam and hydronic piping systems at 1-1/2 times system operating pressure.
.3 Test natural gas systems to latest edition of CAN-B149.1 and requirements of authorities having jurisdiction.

.4 Test fuel oil systems to latest edition of CSA B139, CSA B139S1 and authorities having jurisdiction.

.5 Test drainage, waste and vent piping to B.C. Building Code.

.6 Test domestic hot, cold and recirculation water piping at 1-1/2 times system operating pressure.

.7 Provide x-ray testing of 3% of the welds in steam piping 2 ½ Dia. or larger.

2.8 Painting

.1 Refer to Section 09 90 00 Painting and Coating.

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

***END OF SECTION***
1.1 **GENERAL**

1.2 **Co-ordination Requirements**

.1 Coordinate with SFU Facilities.
.2 Coordinate with other design disciplines.

1.3 **Description**

.1 Thermal insulation for piping.

1.4 **Definitions**

.1 For purposes of this section:
  .1 CONCEALED - insulated mechanical services and equipment in hung ceilings and non-accessible chases and furred spaces.
  .2 EXPOSED - will mean "not concealed" as defined herein.

2.1 **MATERIALS AND DESIGN REQUIREMENTS**

2.2 **General - Products**

.1 Specify all components of insulation system to have maximum flame spread rating of 25 and maximum smoke developed rating of 50 in accordance with CAN4-S102. CAN/ULC-S102-M.

.2 Materials to be tested in accordance with ASTM C411.

.3 Powdered form of insulation and conduit in conduit type of piping systems for underground steam and condensate piping shall be approved by SFU Facilities.

.4 Closed cell, rigid type, of insulation with water proof jacket is preferred for direct buried underground steam and condensate piping.

.5 Insulation systems shall be in accordance with the latest edition of the following standards unless specified:
  .3 CAN4-S102-M - Surface Burning Characteristics of Building Materials and Assemblies.
  .5 ANSI/NFPA 90B - Warm Air Heating and Air Conditioning Systems.
  .6 CGSB 51-GP-9M - Thermal Insulation, Mineral Fiber, Sleeving for Piping and Round Ducting.
  .7 CGSB 51-GP-11M - Thermal Insulation, Mineral Fiber, Blanket for Piping, Ducting, Machinery and Boilers.
2.3 Formed Mineral Fiber to 200°C

.1 Application for piping valves and fittings on:
  1. Condensate.
  2. Hot water heating.
  3. Domestic hot water.
  4. Domestic hot water recirculation.
  5. Waste arm and p-trap at handicapped sinks.

.2 Materials
  1. CGSB 51-GP-9M, rigid mineral fiber sleeving for piping.

.3 Thermal Conductivity "k" shall not exceed 0.034 W/m.°C at 24°C mean temperature when tested in accordance with ASTM C335.

.4 Thickness Table:

<table>
<thead>
<tr>
<th>Fluid Temperature</th>
<th>Thickness Required for Nominal Pipe Sizes (NPS) (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>≤ 25</td>
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<tr>
<td>151-200</td>
<td>64</td>
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<tr>
<td>121-150</td>
<td>51</td>
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<td>96-120</td>
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<td>51-96</td>
<td>38</td>
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<tr>
<td>30-50</td>
<td>25</td>
</tr>
<tr>
<td>Condensate returns</td>
<td>38</td>
</tr>
</tbody>
</table>

2.4 Formed Mineral Fiber with vapor barrier from 4°C to 85°C

.1 Application for piping, valves and fittings on:
  1. Domestic cold water, temperature.
.2 Refrigerated drinking water.
.3 Chilled water.
.4 Rainwater piping.

.2 Material
.1 CGSB 51-GP-9M, rigid mineral fiber sleeving for piping.
.2 CGSB 51-GP-52M, vapor barrier jacket and facing material.

.3 Thermal Conductivity "k" shall not exceed 0.034 W/m.°C at 24°C mean temperature when tested in accordance with ASTM C335.

.4 Thickness Table

<table>
<thead>
<tr>
<th>Fluid Temperature</th>
<th>Thickness Required for Nominal Pipe Sizes (NPS) (mm)</th>
</tr>
</thead>
<tbody>
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<td></td>
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<td>30-50</td>
<td>25</td>
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<tr>
<td>5-20</td>
<td>13</td>
</tr>
<tr>
<td>Below 5 °</td>
<td>25</td>
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</tbody>
</table>

2.5 Flexible mineral fiber with vapor barrier to 85°C

.1 Application On
.1 Underside of roof drains body.
.2 Rainwater piping for 5m from drain.
.3 Plumbing vents (within 2m of roof/wall penetration.
.4 Traps subject to freezing.

.2 Material
.1 CGSB51-GP-11M, mineral fiber blanket for piping and CGSB 51-GP-52M vapor barrier jacket and facing material.

.3 Thickness shall be all sizes, 25mm.

2.6 Flexible Elastomeric -40°C to 100 °C

.1 Application for piping, valves and fittings in mechanical rooms and above group outdoors on refrigeration suction and hot gas lines.

.2 CAN/CGSB-51.40 flexible elastomeric unicellular sheet and pipe.
.1 Covering.

.3 Thickness.

2.7 Fastenings

.1 Tape shall be self adhesive, aluminum, ULC labeled for less than 25 flame spread and less than 50 smoke developed.

.2 Lap seal adhesive shall be quick-setting for joints and lap sealing of vapor barriers.

.3 Lagging adhesive shall be fire retardant coating.

.4 For elastomeric insulation system and underside of roof drain body use the following:
.1 Contact adhesive with quick-setting for seams and joints.
.2 Tape shall be self adhesive PVC.

2.8 Insulation Cement

.1 To CAN/CGSB-51.12.

2.9 Jackets

.1 PVC Fittings and Jacketing (minimum 0.3 mm thick) shall be used wherever possible, and comply with:
  .1 CAN/CGSB – 51.53-95
  .2 ASTM E-84 Surface Burning Characteristics, 25/50 Flame/Smoke.

2.10 Removable Prefabricated Insulation and Enclosures

.1 General Performance
  .1 High temperature insulation blanket formed of silica aerogel and reinforced with a non-woven, glass-fiber batting or material with similar performance.
  .2 Insulation must be hydrophobic
  .3 Estimated maximum use temperature 200°C (392°F)
  .4 Insulation thickness as required to achieve a touch temperature of less than 50°C
  .5 All material shall be non-asbestos

.2 Construction
  .1 Sewn with lock stitch at a minimum of 4 to 6 stitches per inch. The thread must be able to withstand the skin temperatures without degradation and have a break point of at least 15.87 kg (35 lbs).
  .2 Hog rings, staples and wire are not an acceptable methods of closure.
  .3 No raw cut jacket edges shall be exposed after install.
  .4 Jackets shall be fastened using hook and loop (Velcro) straps and D-rings.
  .5 Provide a permanently attached Laser Etched nameplate (2" x 3.5") on each jacket to identify its location and item number.
  .6 The insulation shall be designed to minimize the convection current in the space between the hot metal surface and the inner layer of insulation.
  .7 All jacket pieces which match mating seams must include an extended 2" flap constructed from the exterior fabric (or equivalent) and shall be secured using hook & loop closure (i.e. Velcro) parallel to the seam.
  .8 Insulation must be sewn as integral part of the jacket to prevent shifting of the insulation. Insulation pins are NOT an allowable method of preventing the insulation from shifting and shall NOT be used.

.3 Components to be Jacketed
  .1 Ball valves
  .2 Circuit setting valves
  .3 Control valves
  .4 Flanges and unions
  .5 Gate valves
  .6 Globe valves
  .7 Pressure relief valves
  .8 Wye strainers

.4 Preferred vendor of insulation jackets shall be Thermaxx Insulation Jackets.
3.1 **EXECUTION**

3.2 Application

.1 Specify application after required tests have been completed and approved by Engineer. Insulation and surfaces shall be clean and dry when installed and during application of any finish. Apply insulation materials, accessories and finishes in accordance with manufacturer's recommendations and as specified herein.

.2 Insulation on roof drain body shall be held in place with 100% coverage of adhesive and wire ties.

.3 On piping with insulation and vapor barrier, install a half round high density insulation under hanger shield. Maintain integrity of vapor barrier over full length of pipe without interruption at sleeves, fittings and supports. Insulation is to stop on either side of a fire separation penetration and the piping is to be properly fire stopped.

3.3 Installation


.2 Preformed: sectional up to NPS 12, sectional or curved segmented above NPS 12.

.3 Multi-layered shall be staggered layers with butt joint construction.

.4 Vertical pipe over NPS 3 shall be insulation supports welded or bolted to pipe directly above lowest pipe fitting. Thereafter, locate on 4.5 m centers.

.5 Expansion joints in insulation shall terminate single layer and each layer of multiple layers in straight cut at intervals recommended by manufacturer. Leave void of 25 mm between terminations. Pack void lightly with P3 flexible mineral insulation, or provide alternate insulation/jacket system. Alternatively consider fiberglass weave jacket with loose insulation and cam snap fasteners.

.6 Seal and finish exposed ends and other terminations with insulating cement.

.7 Expansion joints in piping shall provide for adequate movement of expansion joint without damage to insulation or finishes.

.8 Orifice plate mounting flanges, flanges and unions at equipment, expansion joints, valves, other components requiring regular maintenance shall omit insulation and bevel away from studs and nuts to permit use of tools without damage to insulation install insulation and finish to permit easy disassembly and replacement without damage to adjacent insulation and finishes.

.9 Insulation is not required for chrome plated piping, valves and fittings.

3.4 Fastenings

.1 Secure pipe insulation by tape at each end and centre of each section, but not greater than 900 mm on centers.

***END OF SECTION***
1.1 **GENERAL**

1.2 Related Technical Requirements

.1 *Section 23 21 05 District Hot Water Heating System*

1.3 Coordination Requirements

.1 Coordinate with SFU Facilities.
.2 Coordinate with other design disciplines.

1.4 Description

.1 Additional Pipe and Pipe Fittings design requirements.
.2 Specify threaded pipe up to maximum of 2” diameter. Piping larger than 2” diameter must be welded.

2.1 **MATERIALS AND DESIGN REQUIREMENTS**

.1 All piping and fittings shall comply with the British Columbia Building Code 1998, Part 7, and Plumbing Services which outlines acceptable material for the various plumbing systems required. Refer to other sections within this document for material that are restricted at SFU but acceptable in the Plumbing Code.

.2 Pipe Flange Connections/Unions

.1 All bolts and studs to shall be lubricated prior to installation using Loctite Silver Grade Anti-Seize or equivalent.

.2 Isolation valves, unions and/or flanges, shall be provided so as to permit servicing and/or repair of all equipment. The isolation valves shall be of good quality and of one manufacturer for the entire project.

.3 Specify rising stem valves (OS&Y) where safety of occupants and operators would be enhanced by such a valve.

.3 Steam Piping, Fittings and Valves

.1 All components of steam and condensate piping before building PRV shall have at least 150 lbs, 1300 kPa RF USAS, and rating (at 200 º C).

.2 All underground piping larger than 1” (25 mm) diameter shall be welded. Socket fittings not acceptable.

.3 All condensate piping shall be schedule 80 for sizes 50 mm and larger and schedule 160 for smaller sizes.

.4 Provide isolation valves on all equipment and on all floor piping for heating, cooling, domestic hot & cold, steam and condensate.

.5 All isolation valves shall be 2” and under and shall be ball valves.

.6 All butterfly valves to be studded.

.4 Sidewalk cleanout caps to be Zurn model CO-2521 or equal. Install flushed with finished surface.

***END OF SECTION***
1.1 **GENERAL**

1.2 Description

.1 SFU additional Copper Tubing and fitting requirements.

2.1 **MATERIALS AND DESIGN REQUIREMENTS**

.1 All refrigerant piping installations shall be specified with valve testing and charging ports.

.2 Brazed connections are required for all refrigerant systems.

***END OF SECTION***
1.1 **GENERAL**

1.2 **Coordination Requirements**
   
   .1 Coordinate with SFU Facilities.
   .2 Coordinate with other design disciplines.

1.3 **Description**
   
   .1 HVAC water treatment system procedures and design requirements.

2.1 **MATERIALS AND DESIGN REQUIREMENTS**

2.2 **General Requirements**
   
   .1 The specification shall clearly state which systems are to be cleaned and subsequently treated with control agents.

   .2 Requirements

   .1 In new buildings the scope of work will cover all new systems.
   .2 Heating, cooling and condenser water systems shall be chemically cleaned and treated as appropriate.
   .3 In existing buildings where existing systems are to be modified or extended the mechanical consultant shall contact SFU Facilities to determine what sections should be cleaned and treated.
   .4 In renovation projects, where existing systems are extended or modified, the Consultant shall review his original analysis of the pertinent water systems with the SFU Facilities for a decision on the extent of the cleaning and whether or not it should be carried out by the contractor.
   .5 In energy conservation retrofit projects, the consultant shall review his original analysis of all the water systems with SFU Facilities for agreement on cleaning the systems.

   .3 **Technical Support**

   .1 The mechanical sub-contractor or, in the case of energy conservation retrofit projects, the controls-contractor, shall work with SFU Facilities to and supervise the sub-contractor/contractor in the cleaning and treatment of the listed. The company shall employ technicians fully trained in the cleaning and treatment of building piping systems.

   .4 **Characteristics of Control Chemicals**

   .1 Chemicals must be non-toxic when released to atmosphere, noncorrosive and non-staining if a leak occurs. Chemicals shall be compatible with all system components so that operation or life expectancy of the components is not affected by the application of the chemical treatment.

   .5 **Existing Metering Pumps and Pot Feeders**

   .1 The consultant shall ensure that existing metering pumps and pot feeders are in good operative condition or shall install new devices where none exist. Refer to this Guideline.
.2 All water treatment heating and cooling shall have chemical pot feeders, flow indicators, bypass filters and water meters.

.6 Cross Connection Control

.1 The consultant shall ensure that backflow prevention devices are incorporated to prevent control chemicals from migrating to potable water systems within the building or to the Campus Water Distribution System. Refer to Guideline Section 22 11 18 Backflow/Cross Connection Control for control devices and to AWWA requirements.

2.3 Pipe Cleaning Chemicals

.1 Dispersant/Purging compound as recommended by the Chemical Water Treatment Company. Compounds shall not cause odors.

.2 Corrosion Inhibitors
   .1 For closed heating and cooling water systems use Calgon MCS PLUS or similar product manufactured by IPAC.
   .2 For open condenser water systems use Calgon Phree Guard 2350 or similar product manufactured by IPAC.
   .3 Control Agent for Algae, Bacteria and Fungi (Biocide) for cooling tower water use Sodium Hypochlorite.
   .4 Acceptable Chemical Water Treatment Companies shall be IPAC.

2.4 Cleaning

.1 Under the supervision of SFU Facilities Representative, the Mechanical Sub-Contractor/Controls Contractor shall:
   .1 Position all control valves and other in-line devices and remove all strainer gaskets so that all system components can be flushed.
   .2 Drain system at all low points and flush with clean water to remove loose and suspended matter. Maintain flushing pressure and system venting to ensure that all circuits are flushed. System shall be drained and flushed a minimum of two times; continue until flushed water appears clean. Clean and replace baskets when flush complete.
   .3 Supply and add a cleaning dispersant/purging compound to the system as recommended by the Chemical Water Treatment Company and circulate for 24 hours at the recommended temperature.
   .4 Drain, flush, refill and repeat until water quality meets the acceptable level of 0.5 mm of suspended solids, including magnetite, as determined by the Chemical Water Treatment Company.
   .5 Ensure that the system is filled and that all operational components are returned to their proper operational settings.
   .6 Ensure that the system is tight. Correct any leakage in piping installed under this contract. If leakage occurs in an existing system, report to SFU Facilities.
2.5 Water Treatment

.1 Supply and add the chemical scale and corrosion inhibitor to the closed circuit heating or chilled water piping system under the direction of, and according to, the concentration recommended by the chemical water treatment company.

.2 Supply and add the chemical scale and corrosion inhibitor to the open circuit condenser water system under the direction of, and according to, the concentration recommended by the chemical water treatment company.

.3 Supply and add the algae, bacteria and fungi control agent to the cooling tower water under the direction of, and according to, the concentration recommended by the chemical water treatment company.

.4 Provide 50% additional quantity of each chemical for the owner.

.5 Obtain a receipt from the owner and give one copy to the consultant shall be sent to:

Facilities Services Department
Simon Fraser University
8888 University Drive
Burnaby, BC
V5A 1S6
Attention: Project Representative

2.6 Testing

.1 Chemical water treatment company shall provide a laboratory test report as required.
  .1 Provide laboratory test reports confirming the correct chemical concentrations have been achieved.

2.7 Monitoring

.1 Provide laboratory test reports and treatment recommendations for treated water samples taken by the owner's operating personnel.

.2 They will be sent to the chemical water treatment company monthly for the first three months, and once every three months thereafter for one year following the initial test.

.3 Each analysis shall provide concentrations of significant components of each water sample. At minimum, these shall be:

<table>
<thead>
<tr>
<th>Item</th>
<th>Reporting Units (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>total Suspended Solids</td>
<td>p.p.m.</td>
</tr>
<tr>
<td>Total Hardness</td>
<td>p.p.m.</td>
</tr>
<tr>
<td>Total Dissolved Solids</td>
<td>p.p.m. as calcium carbonate.</td>
</tr>
<tr>
<td>pH</td>
<td></td>
</tr>
<tr>
<td>Magnetite</td>
<td>p.p.m.</td>
</tr>
</tbody>
</table>

.4 The cost of the testing is to be borne by the Contractor.

.5 The Chemical Water Treatment Company shall send to the Owner on a scheduled basis, properly identified sample bottles for each of the systems to be tested as required.
.6 Test reports shall be sent as they occur to:

Facilities Services Department
Simon Fraser University
8888 University Drive
Burnaby, BC
V5A 1S6
Attention: Project Representative

2.8 Reports

.1 Test reports shall be sent as they occur shall be sent to:

Facilities Services Department
Simon Fraser University
8888 University Drive
Burnaby, BC
V5A 1S6
Attention: Project Representative

.2 A copy of reports shall be sent to the Consulting Engineer.

.3 Provide three (3) hard copies of written instructions for the chemical testing and treatment specific to this project for insertion into the operating and maintenance manuals as well as an electronic soft copy.

***END OF SECTION***
1.1 GENERAL

1.2 Related Technical Requirements

.1 Section 23 38 16 Fume Hood Exhaust Systems

1.3 Coordination Requirements

.1 Coordinate with SFU Facilities.

1.4 Description

.1 Additional SFU design and approval requirements for Ductwork.

2.1 MATERIALS AND DESIGN REQUIREMENTS

2.2 Ductwork

.1 Use of non-metallic ductwork shall be approved by SFU Facilities.

.2 All underground ducts must be approved by SFU Facilities at the design stage.

.3 Except for an emergency supply shafts all air shafts/ducts with greater than 1/8" static pressures either positive or negative shall be lined with sheet metal.

.4 All emergency supply ducts shall be tested to prove that specified air quantities can be delivered with installed equipment and without impairing the intended use of facilities.

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

2.3 Flexible Duct Connectors

.1 Specify installation of flexible duct connector on fume hood exhaust fan only after duct transition from square to round. For example, do not install flex connector joining ducts of different shapes.

.2 Ensure that flex connectors do not restrict fan outlet especially on small capacity fans.

***END OF SECTION***
1.1 **GENERAL**

1.2 **Coordination Requirements**

.1 Coordinate with SFU Facilities.

1.3 **Description**

.1 Additional SFU design requirements for Air Handling.

2.1 **MATERIALS AND DESIGN REQUIREMENTS**

2.2 **Air Handling**

.1 Design sufficient access to all components of the air handling unit.

.2 Ensure adequate clearance for coil replacement without necessity to dismantle adjacent equipment or building components.

.3 Design field fabricated and factory assembled units for maximum efficiency.

.4 Specify units with local manufacturer representative within an established business of over 5 years, and be available to attend the site within 4 hours in emergency scenarios.

.5 Select units based on life cycle costing and ease of maintenance.

.6 In selection of air handling units avoid large zones or too many zones. Multiple air handling units are preferred over single large unit especially with variety of building uses.

.7 All air handling units shall be designed to minimize air stratification. Specify anti-stratification equipment. Judicial placing of mixing dampers is not adequate.

.8 All air handling units shall have heating or preheat coils.

.9 Return and supply fan tracking shall be achieved by measuring air flow volume with duct static pressure as default.

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

.11 Proposed fan volume control schemes based on building static pressure must have prior approval from SFU Facilities.

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

.13 Air handling units used for 100% outside air under normal or emergency conditions shall have glycol heating/cooling coils.

2.3 **Centrifugal Fans**

.1 Do not specify in line centrifugal fans for fume hood exhaust without prior consent of SFU Facilities.
.2 Coatings of steel fans include epoxy, heresite and Eisenheiss for varying degrees of corrosion. Exact coating will be project specific.

.3 All fan installations shall be designed with adequate room for service without the use of portable ladders.

.4 Roof top fan systems to be designed and investigated to reduce sound levels. Silencers, sound attenuation devices, and variable speed drive controls must be considered to reduce noise levels. Absolute maximum acceptable sound level shall be 65dbA at 15m from any building face for nonresidential areas and 55dbA for residential areas. SFU abides with the 2012 BC Building Code, Division B Appendix A Volume 2 which describes acoustic assemblies for floors, ceilings and roofs. Additional acoustic information/guidelines can be found in LEED Version 4.

2.4 Axial Fans

.1 Variable pitch and motion control of axial fan capacity shall not be specified for SFU projects.

2.5 OPERATIONAL REQUIREMENTS

2.6 Strobic Exhaust Fans

.1 If work is to be completed on a Strobic exhaust system that may be contaminated with radiation at SFU, refer to SFU SRS latest “Procedure for Work Conducted Inside & Outside Exhaust Systems with Potential Radioactive Contaminants.”

***END OF SECTION***
1.1 GENERAL

1.2 Coordination Requirements

.1 Coordinate the type and location with SFU Facilities.
.2 Coordinate with other design disciplines.

2.1 MATERIALS AND DESIGN REQUIREMENTS

.1 Terminals with line voltage devices shall be CSA certified.
.2 Specify only pressure independent air terminal units.
.3 Design installation that meets specific manufacturer requirements with respect to inlet, outlet and noise criteria.
.4 In air conditioned buildings all interior air terminal units shall have reheat coils, unless the engineer can demonstrate that comfort conditions can be met without reliance on internal loads.
.5 All perimeter air terminal units shall have reheat coils.
.6 Ensure that units located above false ceilings have reasonable access for maintenance. Do not locate units above partition walls.
.7 Do not specify less than 30% of maximum air flow for variable volume terminals or the consultant shall demonstrate that appropriate ventilation rates are provided at lower air flow settings.

***END OF SECTION***
1.1 **GENERAL**

1.2 **Related Technical Requirements**

.1 Division 11, *Section 11 53 13 Fume Hoods*, especially regarding the restriction concerning operable windows in labs to maintain negative pressure at the fume hood.

.2 *Division 20, Section 20 00 08 Mechanical Identification* for the details for fume hood labelling requirements.

1.3 **Coordination Requirements**

.1 Coordinate with SFU Facilities and SFU Environmental Health & Safety of Safety and Risk Services.

.2 Coordinate with other design disciplines, architectural and structural.

.3 Division 11, *Section 11 53 13 Fume Hoods*, for design and commissioning requirements for fume hood systems.

2.1 **MATERIALS AND DESIGN REQUIREMENTS**

2.2 **General**

.1 Where the fume hood exhaust duct static pressure may exceed 4” of WC, provide passive make up air openings in building structure or design all elements of building envelope (including roofs and skylights) for an additional structural load that may be imposed on the building due high negative pressure created by fume hood exhaust fans and a coincident combination of wind and snow loads.

.2 Proposals for fume hood supply and exhaust air systems must meet Worksafe BC standard, and be approved by both SFU Facilities and SFU Environmental Health and Research Safety; prior to commencement of detailed design.

.3 Ducts from fume hoods shall proceed to the roof of the building in as direct a route as possible for discharge above the re-circulation cavity boundary of the structure.

.4 Where multiple fume hoods are manifolded together; an induction type fan system with direct drive is required.

.5 System shall be Engineered in such a way that no leakage of fume hood exhaust occurs in the Mechanical Room or other interior spaces.

.6 See *Section 11 53 13 Fume Hoods*, for design and face velocity requirements for fume hoods.

.7 Radio isotope cabinets to be on separate fans, not connected to other systems or other RI cabinets.

.8 Where fume hood fans are contained within mechanical penthouses, pressurize the penthouse with supply air from the building rather than from outside to avoid the possibility of drawing exhaust air into the service space and to provide flushing of contaminants if a minor duct leak occurs.

.9 Induction type fans are generally required otherwise a separate isolated fan room dedicated only to fume hoods shall be designed.
.10 Supply and install hasps and padlocks on all fume hood cabinet sashes to allow for locking out.

.11 Fume hood cabinet numbering shall be coordinated with exhaust fan serving it, exhaust fan motor control center or starter and room number. Provide cross labeling at fume hood, motor control center and exhaust fan.

2.3 Design Requirements

.1 All fume hoods and exhaust systems shall conform to Part 30 Laboratories, of the Occupational Health and Safety (OHS) Regulation under the inspection jurisdiction of WorkSafeBC and the latest edition for CSA-Z-316.5 Fume Hoods and Associated Exhaust Systems and show evidence of being performance tested in accordance with ASHRAE 110, Method of Testing Performance of Laboratory Fume Hoods.

.2 Fume hoods should be specified with face velocities within the range of 100 - 120 fpm.

.3 Fume hood cross draft shall be less than 50% of the face velocity of the hood as per ANSI Z9.5 Section 6.1.2.3.

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

.5 Duct work shall be resistant to the types of chemicals to be used or generated in the fume hood. Stainless steel is not to be used for Perchloric acid or hydrochloric acid, fume hood systems. A more resistant material such as CPVC must be used instead.

.6 The need for installing scrubbers for Perchloric acid or similar use fume hood systems is to be reviewed with SFU Environmental Health and Safety.

.7 Exhaust stacks shall be made from material that is resistant to the chemicals that are being handled inside the fume hoods. Stainless steel exhaust stacks to be schedule 5 type 316 stainless steel butt welded pipe with 2B finish in accordance with A.S.T.M. A.240. (See 2.2.3 above).

.8 Stainless steel ductwork shall be type 316 with 2B finish, minimum thickness’ suction side 24 ga. and discharge side 18 ga.

.9 Transverse joints in ductwork on suction side of fan shall be slip joints made in reverse direction of flow screwed or riveted. Longitudinal joints shall be double lock seams with the joints on top for horizontal sections.

.10 Vertical ducts shall be supported at every floor using 14 ga. stainless steel bands welded to the duct. Horizontal ducts shall be supported by stainless steel strap hangers 2’ x 14 ga. at 8’ centers and every change in direction.

.11 Power supply feeding fan should be the same source feeding the alarm.

.12 Exhaust fans shall be mounted on a housekeeping pad. Roof mounted fans shall be installed in accordance with standard detail.

.13 Exhaust fans shall have interior surfaces in contact with the air stream coated with a chemical resistant coating, scroll shall have access door, drain with plug and shaft seal. Axial or in-line centrifugal fans shall not be used.
.14 Canvas or any other flexible connections are not acceptable on the discharge side of the fan.
   (i.e. Only solid connections on the discharge side of the side of the fan are acceptable).

.15 Fume discharge shall be through free standing stacks minimum height 20' above roof level,
   terminated with a 2' long discharge cone.

.16 In new buildings, stacks shall be grouped together to provide an aesthetic appearance when
   viewed from street level.

.17 In existing buildings, stack locations shall be coordinated through SFU Facilities in order to
   select locations which will help facilitate the future upgrading of existing fume exhausts,
   again to provide an aesthetic appearance.

.18 Stacks may be braced from adjoining structures, but bracing and bases for free standing
   stacks shall be designed by a structural engineer.

.19 Maximum Duct Velocities
   .1 Suction side of fan 1500 f.p.m.
   .2 Discharge side of fan 2000 f.p.m.

.20 Minimum stack exit velocity
   .1 Point of exit from stack 3000 fpm, as per ANSI/AIHA Standard for Laboratory
      Ventilation, Z9.5-2003.

.21 Where multiple fume hoods are manifolded together and feed to a high plume exhaust fan
   system, the plume height must be sufficient to achieve adequate dilution to meet allowable
   concentration levels.

.22 All ductwork and stacks on discharge side of fan shall have welded joints.

.23 All welding shall be done using the TIG process with stainless steel filler rods and stainless
   steel wire brushes. After fabricating, stacks shall be washed with “vecom” pickling paste in
   the shop.

.24 Fume hoods need not be connected to emergency power.

***END OF SECTION***
1.1 **GENERAL**

1.2 **Coordination Requirements**

.1 Coordinate with SFU Facilities.
.2 Coordinate with other design disciplines.

1.3 **Description**

.1 Additional SFU design and approval requirements for Refrigeration systems.

2.1 **MATERIALS AND DESIGN REQUIREMENTS**

2.2 **General**

.1 All compressors 5 tons and smaller shall be hermetic type.
.2 Where Machine Room ventilation is installed as a requirement of Refrigeration Code CSA B-52, SFU’s Building Management System (BMS) shall monitor the status of the refrigerant leak detector panel.

2.3 **Condensing Units & Cooling Towers**

.1 Use of domestic water cooled condensing units is not permitted.
.2 Equipment Location
   .1 Fan Coils/DX Coils need to be positioned to have access to service all components.
   .2 Outdoor condensing units shall not be located adjacent to fume hood areas or less than 10 ft (3,000 mm) from roof edge without guard rail fall protection
.3 Server/Communication Rooms
   .1 Avoid placing equipment in ceiling above communication equipment.
   .2 Floor mounted units are preferred.
.4 Larger systems shall utilize dry coolers.
.5 Open cooling towers shall be installed with full flow filtration systems.
.6 Cooling towers over 8 ft high shall have service platforms with permanent ladders.
.7 Multicell cooling towers with separate sumps shall have equalizing line of sufficient size to maintain water level in all sumps. Provide sump isolation valves in equalizing line.

2.4 **Chillers**

.1 Specify minimum five year warranty.
.2 Use of packaged air cooled water chillers shall be supported by favorable life cycle cost.
.3 Installed chillers must follow BC Safety Authority Directives.
3.1 **REFRIGERATION INSTALLATIONS**

.1 Modular chillers or heat pumps must be installed with isolation valves on condenser and chilled water heat exchangers.

.2 Brazed joint connections are preferred for all refrigerant systems.

***END OF SECTION***
Building Automation Systems (BAS)

DESIGN GUIDELINES

Simon Fraser University

Revised: March 2018
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1 OVERVIEW

1.1. General

A. Simon Fraser University a large campus with numerous buildings of various ages. A significant number of these buildings are of a vintage that predates modern microprocessor based HVAC control systems and these older building control systems are continuously being upgraded. New buildings are also being constructed at the SFU Campus on an on-going basis. To assist in the operation and maintenance of campus buildings, SFU Facilities provide centralized monitoring and control of SFU buildings from a central location via microprocessor based DDC controls. To facilitate the centralized BAS monitoring and control standards have been applied to the selection of BAS equipment and for the application of BAS installations in buildings. The SFU BAS Design Guidelines serve to identify typical standards for the application of BAS’s in SFU buildings. These Design Guidelines have also been developed to assist SFU in ensuring that SFU buildings are provided with high quality BAS installations that fully meet their requirements.

1.2. Application of these BAS Design Guidelines

A. This document is intended to serve as a guideline for the Design of Building Automation System (BAS) installations in buildings at Simon Fraser University. The guideline serves to generally identify the existing SFU Campus BAS infrastructure and installed components and to record BAS design requirements specific to SFU installations. The SFU Project Guide Part C may be used by BAS Designers for guidance in the design of SFU BAS installations but shall not be reproduced, in whole, or part, for inclusion in BAS Design Specifications, or Tender or Contract Documents. The SFU Project Guide Part C discussing DDC controls does not include sufficient detail to be used as such. BAS Designers will be required to include additional detailed information in BAS Design Specifications to clearly identify all aspects of the BAS installation.

B. BAS Designs shall be based on sound industry standard practices. BAS Designers shall provide BAS Designs that have been specifically engineered for the application and shall exercise discretion in the application of these guidelines. All new building construction at SFU will utilize DDC BAS monitoring and control of building equipment and systems to some degree. Existing buildings are also being upgraded with retrofits to mechanical and electrical systems as well as to the building control and monitoring facilities. BAS Design Documents shall clearly identify the nature of the BAS installation work and shall include the contractual documentation and requirements where applicable.

C. All new BAS installations shall comprise equipment, data and data communications that are fully compliant with ANSI/ASHRAE Standard 135-2001 “BACnet” and Division27 Section 270508 – 1.4.8.

1. Legacy equipment manufactured by Schneider Electric or Delta Controls that are not compliant with ANSI/ASHRAE Standard 135-2001 shall NOT be used for NEW BAS installations.
2. Equipment installed on extensions of a BAS using non-BACnet legacy equipment, manufactured by Schneider Electric and Delta Controls, shall have the capability of directly communicating to the legacy equipment in the proprietary communications protocol as well as communicating with BACnet devices. New equipment that does not have the capability to communicate in both the proprietary protocol and BACnet is placed onto a legacy system; the device shall use the BACnet communications protocol. When equipment capable of communicating only with BACnet is placed onto an existing legacy system, a communication gateway device shall be placed on to the proprietary network. The gateway shall bridge the two disparate communication protocols and act as a translator that allows bilateral communication between the BACnet compliant devices and devices communicating using proprietary communication protocols.
1.3. List of Abbreviations

A. The following are a list of abbreviations used throughout these design guidelines and are also abbreviations used by the SFU relating to Building Automation Systems.

- ACC - SFU Auxiliary Control and Alarm Centre
- ANSI - American National Standards Institute
- ASC - Application Specific Controller
- ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers
- ASTM - American Society for Testing Materials
- AWG - American Wire Gauge
- B-AWS - BACnet Advanced Operator Workstation: The B-AWS is the advanced operator's window into a BACnet system. It is primarily used to monitor the performance of a system and to modify parameters that affect the operation of a system. It may also be used for configuration activities that are beyond the scope of this standard.
- B-OWS - BACnet Operator Workstation: The B-OWS is used for monitoring and basic control of a system, but differs from a B-AWS in that it does not support configuration activities, nor does it provide advanced troubleshooting capabilities.
- B-OD - BACnet Operator Display: The B-OD is a basic operator interface with limited capabilities relative to a B-OWS. It is not intended to perform direct digital control. The B-OD profile could be used for wall-mounted LCD devices, displays affixed to BACnet devices; handheld terminals or other very simple user interfaces.
- B-BC - BACnet Building Controller: A B-BC is a general-purpose, field-programmable device capable of carrying out a variety of building automation and control tasks.
- B-AAC - BACnet Advanced Application Controller: A B-AAC is a control device with limited resources relative to a B-BC. It may be intended for specific applications and supports some degree of programmability.
- B-ASC - BACnet Application Specific Controller: A B-ASC is a controller with limited resources relative to a B-AAC. It is intended for use in a specific application and supports limited programmability.
- B-SA - BACnet Smart Actuator: A B-SA is a simple control device with limited resources; it is intended for specific applications.
- B-SS - BACnet Smart Sensor: A B-SS is a simple sensing device with very limited resources.
- BAS - Building Management and Control System
- BTL - BACnet Testing Laboratory: A recognized, independent third party laboratory certified to test product for compliance to BACnet standards.
BTL Mark - A seal affixed to product certifying that it has been tested by a recognized BACnet Testing Laboratory and found to conform to BACnet standards.

CBAS - Campus Building Automation System
CCF - BAS Central Computer Facility
CCP - Communications Control Panel
CPU - Central Processing Unit
DAU - Data Archival Unit. A device that sits on the Automation Network Level and automatically collects data to be sent up to the central data archive server that resides on the Management Level network and is located in the MACC.

DCP - Distributed Control Panel
DDC - Direct Digital Control
DELTA - Delta Controls Inc.
ESC - ESC Automation Inc. is the installing contractor and local representative for DELTA Controls.

FAS - Fire Detection, Alarm and Communication System
FTS - Field Termination Schedule
H/O/A - Hand/Off/Auto Motor Control Switch/Circuit
HDAS - Historical Data Archiving Server
HVAC - Heating, Ventilating and Air Conditioning
IEEE - Institute of Electrical and Electronics Engineers
I/O - Input/Output
JCI - Johnson Controls, Inc.
LAN - Local Area Network
LCD - Liquid Crystal Display
LED - Light Emitting Diode
LON - Local Operating Network
LonTalk - The open control networking protocol developed by Echelon Corporation

MACC - BAS Master Alarm and Control Centre
NDS - Network Data Server
NEC - National Electrical Code
NEMA - National Electrical Manufacturers Association
OIW - Operator Interface Workstation
PC - Personal Computer
PICS - Protocol implementation conformance statement: All devices conforming to the BACnet protocol shall have a documented statement (PICS) that identifies all of the portions of BACnet that are implemented in the device.
POT - Portable Operator Workstation
PIM - Process Interface Module
RAM - Random Access Memory
RFI - Radio Frequency Interference
RH - Relative Humidity
ROW - Remote Operator Workstation
RTD - Resistance Temperature Device
SBT - Siemens Building Technologies Ltd.
1.4. Existing BAS Facilities

A. Informational Note: SFU existing facilities BAS consists primarily of Delta Controls and Andover systems.

1.5. Existing BAS Communication Network Facilities at SFU

A. There are two separate and autonomous BAS’s installed and operating on the SFU Campus, with individual central alarm monitoring and control facilities, interconnecting network communications facilities and BAS monitoring and control facilities installed within campus buildings. BAS installations within individual buildings are configured as stand-alone BAS installations capable of real-time monitoring and control. Each of the stand-alone building BAS installations communicates with a centralized Campus BAS System (either Delta or Andover). CBAS work stations are located in pairs (one for Delta and one for Andover), strategically around the campus in locations such as the Energy Management Office and the boiler house.

B. All controls additions or modifications involved in a building renovation and/or addition shall be an extension of the existing BAS located in the building being renovated. An exception to this clause may be made if a vendor, other than the vendor of the existing BAS, makes an acceptable bid to replace the entire existing BAS system as well as satisfying the requirements of the building renovation or addition specifications.
1. SFU retains the right to define what an acceptable bid is.
2. SFU retains the right to define the extent of work required to be completed before an existing BAS can be deemed to be replaced.
3. The vendor seeking to replace an existing BAS shall submit a comprehensive engineering proposal to SFU Facilities detailing the proposed replacement BAS. SFU Facilities will approve of the replacement BAS system design and scope before the system can be approved as an acceptable replacement.
2 BAS INSTALLATION GUIDELINES

2.1 General BAS Installation Requirements

A. This section of the SFU Design Guidelines identifies minimum requirements for BAS field installations. BAS designs shall include these requirements and BAS designers shall ensure that design specifications include these requirements.

B. BAS installations shall be fully native BACnet, and be based on sound industry standard practices that are in compliance with all applicable codes, statutes and ordinances.

C. All BACnet equipment and software supplied for the projects shall be supported by manufacturer supplied PICS (Protocol Implementation Conformance Statement) certifying that the device complies with the specified BACnet requirements.

1. At a minimum, a BACnet PICS shall convey the following information:
   a. Basic information identifying the vendor and describing the BACnet device.
   b. The BACnet Interoperability Building Blocks supported by the device.
   c. The standardized BACnet device profile to which the device conforms.
   d. All non-standard application services that are supported along with an indication for each service of whether the device can initiate the service request, respond to a service request, or both.
   e. A list of all standard and proprietary object types that are supported.
   f. For each object type supported:
      I any optional properties that are supported,
      II which properties can be written-to using BACnet services,
      III if the objects can be dynamically created or deleted using BACnet services, IV any restrictions on the range of data values for properties.
   g. The data link layer option options, both real and virtual, supported.
   h. Whether segmented requests are supported.
   i. Whether segmented responses are supported.

2. All products have a BTL Mark certifying that the product was independently tested by a third party testing facility and complied with BACnet conformance requirements.

D. Design Specifications for BAS Installations shall provide detailed specifications for the all components of the BAS including equipment, field devices, wire/cable, conduit, mounts, terminations, etc.

E. The BAS Designer shall fully coordinate BAS design requirements with the other project design team parties (where applicable). The BAS Designer shall coordinate field panel mounting locations, intended DCP/ASC locations, power supply requirements, communications outlet requirements, etc.

F. All new BAS Installations shall be integrated into existing DDC Andover and/or Delta Controls System.

G. The following are general installation guidelines for BAS installations:
   1. All equipment and materials furnished shall be new.
   2. All equipment and materials shall be cUL and/or UL listed and/or CSA approved where applicable. Equipment and components shall be labelled accordingly.
   3. Wherever possible all similar components (e.g. temperature sensors, differential pressure transducers, current transformer/relay combinations, signal transmitters, etc.) in a BAS installation shall be by the same manufacturer.
   4. Components shall be provided which are suitable for the intended application. Components shall be capable of maintained operation in the applicable environmental conditions and operation in contact with the controlled/monitored medium.
   5. With the exception of field mounted instrumentation and devices, all BAS components
shall be installed in field panels. Panels and enclosures shall meet, at minimum, the following requirements:

a. Painted steel panels with hinged locking door. All panels shall be keyed to the SFU standard key.
b. Ventilated to prevent excessive heat build-up, where required.
c. Field cabling shall be terminated on terminal stripes. Cable within enclosures shall be installed in cable trays with snap on covers.
d. Internal components shall be installed to allow easy access for diagnostics, maintenance, removal or replacement.
e. Panel or enclosure shall be suitable rated for the environment for which it is to be installed. Exterior enclosures shall be, at minimum, NEMA-4 rated.

6. Panels and enclosures shall only be located within mechanical rooms or at approved locations. Panel locations shall be coordinated during design by the BAS Consultant and shall be identified on project design drawings. For new construction projects the BAS panel locations shall be identified in the project mechanical design drawings. For retrofit applications the BAS panel locations shall be identified on building floor plan drawings to be included in the project BAS Specifications/Contract Documents.

7. All components of the BAS shall be Identification tagged. Identification tags shall be plastic laminated “luggage style” tags securely fastened to the end device. Tags shall be of a minimum size of 80 x 25 mm engraved with 12 mm bold lettering. Identification tags shall be provided for, at minimum, the following:

a. Sensors.
b. Transmitters.
c. BAS controlled valve and damper actuators.
d. End-Devices.
e. Distributed ControlPanels (DCP)'s.
f. BACnet Advanced Application Controller (B-AACS)
g. BACnet Application Specific Controllers (B-ASC)'s.
h. Field panels.

8. Warning notices shall be provided at all equipment controlled by the BAS and at all associated motor starters. The warning notices shall state that the equipment is under the control of the BAS and may start or stop at any time without warning. Provide warning notices at minimum at all MCC’s, at local disconnect switches, at AHU plenum doors, and electrical motors. SFU Building Operations shall furnish the warning notices to the BAS Contractor for use on each project. BAS Contractors shall be instructed to obtain the warning labels from SFU and to return unused labels at the end of the project.

9. Provide warning notices on all DCP control panel doors indicating that hand held radio transmitters are not to be keyed within 3 meters or the DCP.

10. All BAS wire and cable shall be identification tagged. Wire/cable shall be identification tagged at every termination location. Wire/cable and tubing terminating at DCP’s and ASC’s shall be tagged with the DCP/ASC controller termination number. Wire/cable and tubing terminating at field devices shall be tagged with both the DCP/ASC number and the DCP/ASC termination number. At any splices or terminal strips between the field device and DCP/ASC, the wiring shall be tagged on both sides of the termination point the same as for a field device termination.

11. 120 VAC power supply sources shall be provided to all BAS field panel and DCP mounting locations. All control panels will be on emergency power and integral UPS except for non-critical control panels.
equipment. The BAS tie-in panel is required to remain operational in the event of loss of normal power supply to the building. The tie-in panel shall continue to operate in the event of a power supply failure for thirty minutes and shall provide alarm annunciation, monitoring, and control of connected systems/devices from the MACC and ACC. The electrical power supply circuit shall be clearly labelled at the electrical distribution panel and at the BAS field panel location. As built documentation shall detail power supply circuit source panels and termination locations.

12. All installations shall be provided to readily allow access for maintenance.
13. All BAS data point value engineering units shall be the International System of Units (SI).

H. Facilities shall be provided for the mounting of SFU Plant Operation Telephone and Data Communications facilities. The BAS Contractor shall provide the following "blue board" mounting facilities at all BAS field panel and DCP mounting locations:

1. A 560 mm W x 600 mm H x 18 mm T fir plywood intercom mounting board. The bottom edge shall be 1200 mm from the floor. Each board is to be primed and painted with two coats of navy blue enamel. The “blue board” is intended for the installation of SFU Plant Operation Telephones and communication interfaces.

2. A shelf 350 mm deep running the length of each plywood mounting board. The shelf shall be mounted at a 30 Degree angle from the horizontal approximately 1000 mm AFF. The shelf shall include a 25 mm high lip along the bottom end. The shelf shall be painted to match the mounting board. The shelf shall be hinged and provided with support straps which can be removed from the shelf to allow the shelf to fold down when not in use. The shelf shall be capable of supporting a laptop computer and BAS record documentation for BAS Operator interface work.

3. BAS Data and Telephone Interface facilities including conduit and back boxes shall be installed immediately adjacent to the “blue board” mounting facilities.

I. The BAS specifications shall identify requirements for all work to be provided by the BAS Contractor including all boring, saw cutting, fire stopping, sleeves, equipment mounting and supporting, etc.

2.2. **BAS Electrical Installation Requirements**

A. All BAS wiring, conduit, junction boxes, pull boxes, cable tray, etc. shall be provided by the BAS contractor as required for a complete installation. The BAS Contractor shall provide all required access panels, coring, saw cutting, fire stopping, mounting, etc.

B. The BAS Contractor shall coordinate installation of conduit with building structure and other trades. Conduit installation above accessible ceilings shall be such that there will be no interference with the installation of lighting fixtures, fire protection, air outlets or other devices. Color coding of conduit is not required.

C. BAS wire/cable shall not share conduit with other building wiring. Low voltage cable shall not be installed in conduit with line voltage or higher voltage carrying cable. BAS data communication and network cable shall be installed in dedicated conduit and shall not share conduit with any other wire/cable.
The following are minimum requirements related to BAS electrical installations:

1. All installations shall be in accordance with the National Electric Code, the British Columbia (BC) electrical code, and all governing codes, statutes and ordinances.
   a. All NEC Class 1 (line voltage) wiring shall be UL listed in approved raceway according to NEC and Division 26 requirements.
   b. All low-voltage wiring shall meet NEC Class 2 requirements. Low-voltage power circuits shall be sub-fused.

2. With the specific exception identified within this document, all BAS wire and cable shall be installed in conduit.

3. In new construction projects exposed conduit installations are not permitted in normally occupied building spaces. In retro-fit applications exposed conduit shall only be allowed in specific applications as approved by the BAS Consultant and SFU.

E. Conduit:

1. Conduit shall be run in all exposed areas,
2. Conduit must be rigidly installed, adequately supported, properly reamed at both ends, and left clean and free of obstructions. Conduit sections shall be joined with couplings (according to code). Terminations must be made with fittings at boxes, and ends not terminating in boxes shall have bushings installed.
3. Secure conduit with conduit clamps fastened to the structure and spaced according to code requirements. Conduit and pull boxes shall not be hung on flexible duct strap or tie rods. Conduit, junction boxes, pull boxes, and control panels shall not be run on or attached to ductwork.
4. Conduit fill:
   a. Shall meet the requirements of the Electrical Specifications for line voltage or AC power runs.
   b. Shall not exceed 60% of the cross-sectional area of the conduit for low voltage signal carrying conductors.
   c. Signal wiring, data wiring, and power wiring shall not be run in the same conduit.
   d. Communication network wiring shall be run in a conduit dedicated to network communications.
   e. Line voltage AC carrying conductors shall NOT be mixed in with DC carrying conductors.
      i. Low voltage AC (≤ 24 VAC) signal wiring with DC signal wiring may be combined in the same conduit.
   f. Sensor wiring shall be run in conduits dedicated to sensor wiring.
5. Junction or pull boxes shall be installed:
   a. Every 25 meters for 12mm conduit runs,
   b. Every 30 meters for conduit greater than 12mm,
   c. After the equivalent of four (4) 90° bends have been made. Every offset counts as ½ of a 90°, and each saddle counts as one 90° bend,
   d. All junction boxes shall be installed in accessible locations,
6. Use of flexible or BX (or equivalent) shall be limited to a maximum length of one (1) meter, and shall be supported on each end.
7. Exposed conduit ends shall have bushings installed to protect wiring running through the end of the conduit.
8. Flexible conduit shall have anti-short inters installed at each end to protect the wire or cable running through the end,
9. All wiring shall be installed as continuous lengths, with no splices permitted between termination points.
10. Wire/cable for space temperature sensors, VAV terminal unit damper actuator, zone coil control valve actuator, VAV terminal unit ASC automation LAN and (where applicable) 24VAC power supply distribution wiring may be installed in ceiling spaces without conduit where code permits.
    a. Wire/cable installed in ceiling spaces without conduit shall be suitably rated and labelled.
    b. Wire/cable shall be securely supported and installed in a neat and workmanlike manner following building lines.
    c. Sleeves shall be provided for all wire/cable that penetrates wall partitions, concrete slabs, or rated partitions.
F. BAS low voltage monitoring and control wiring shall meet the following minimum requirements;

1. Minimum #20 AWG stranded copper conductors (larger gauge wire/cable shall be provided where required by BAS equipment and where applications warrant (e.g. long runs, etc.).
2. Twisted pair conductors.
3. All BAS input/output point wire/cable and communication cable shall be shielded.
   a. Non-shielded cables may be approved for BAS input and output field point wiring following certification from the BAS manufacturer that non-shielded cables will function satisfactorily for the life of the building and that the use of non-shielded cables will not negatively affect other building systems/cabling.
   b. The manufacturers certification shall guarantee to SFU that should it be determined that BAS system performance is negatively affected or another building system or equipment is negatively affected due to the non-shielded cable, the BAS manufacturer shall replace the cable at no cost to SFU.
4. All cabling shall be installed in a neat and workmanlike manner. Follow manufacturer's installation recommendations for all communication cabling.
5. Free air cabling installed in non-combustible rated buildings shall be fire rated cable with a minimum rating of FT-6.
6. Wiring located in combustible rated buildings above T-bar ceiling shall be run in free air using fire rated cable with a minimum rating of FT-4.
   a. Note: all free air cabling used in combustible rated buildings to interface to security or fire alarm systems shall be FT-6 rated.
   b. Install plenum wiring in sleeves where it passes through walls and floors. Maintain fire rating at all penetrations.
7. Cables shall follow building lines and be installed in bundles resting in a cabling support system (J-hooks).
8. Cable supports shall be attached to the wall or ceiling of the area they are running through. Cable supports shall not be attached to:
   a. Electrical raceways,
   b. Duct work,
   c. Ceiling suspension systems,
   d. Piping,
   e. Wilson joists.
9. Cabling bundles shall be held in the cable support system using Velcro straps.
10. Cable bundles shall be identified every ten (10) meters. The following nomenclature shall be used:
   a. “CONTROLS POWER” for bundles carrying EMCS or final control elements' control power wiring,
   b. “CONTROLS I/O” for bundles carrying EMCS input and output wiring.

G. Data Communication Cabling shall meet the following minimum requirements;
1. Unless otherwise specifically called for in the specifications, uniformity of manufacture to be maintained throughout the building for any particular item or type of equipment.
2. All data cabling shall use stranded conductors. Solid core conductors shall not be accepted.
3. Data cabling shall be run separately from power and signal wiring,
4. Data cabling shall be clearly labeled as “CONTROLS DATA HIGHWAY” at the beginning, the end, every twenty (20) meters of the run,
5. Communication runs be one continuous run from end to end without splices or connections,
6. Cabling shall be colour coded with different colours for each conductor,
7. BACnet MS/TP communications wiring shall be installed in accordance with ASHRAE/ANSI Standard 135. This includes but is not limited to:
   a. The network shall use shielded, twisted-pair cable with characteristic impedance between 100 and 120 ohms. Distributed capacitance between conductors shall be less than 100 pF per meter.
   b. The maximum length of an MS/TP segment is 900 meters (with AWG 22 cable. The use of greater distances and/or different wire gauges shall comply with the electrical specifications of EIA-485.
   c. The maximum number of nodes per segment shall be 32, as specified in the
EIA 485 standard. Additional nodes may be accommodated by the use of repeaters.

d. An MS/TP EIA-485 network shall have no T connections.
e. Controls Contractor shall produce a test report based on their installed cable schedules. The report should indicate for each cable the values of all measured parameters, when it was tested successfully and the signature of the technician that performed the test; location, cable type, cable number, and tester make and model. A copy of the test report must be submitted to the Consultant for approval. The entire report must be signed by an authorized person for the Controls Contractor at the end of the project.

H. BACnet Ethernet communications cabling shall meet the following minimum requirements

1. Data cable shall Category 6E Ethernet cable.
2. Data cable shall be four twisted pair 24 AWG solid copper, Plenum Rated FT-6 / CMP or Riser Rated FT-4 / CMR (as required by local codes) unshielded twisted cable meeting EIA / TIA 568B.1 Category 5e classification.
3. The maximum cable length for each run shall be limited to 90 meters.
4. All Category 6e cables must be Power Sum accepted and recognized by the manufacturer.
5. Cable Skew must be specified as 20Ns or less per 100 meters.
6. Cables must display the manufacturer's stamp stating that the cable is included in the latest UL verified publication for Category 6e standards.
7. All cables must be included in the System / Applications Certification Warranty.
8. All cabling installed inaccessible areas, (above drywall ceilings, and crawl spaces), must be installed in conduit or cable tray. Conduit fill must not exceed 40%.
9. Ethernet Cable Testing:
   a. The Controls Contractor is to use a Level III tester that is capable of testing the specified cable to the performance level(s) indicated in this document. The tester is to use the latest version of firmware and software to test the unshielded twisted pair (UTP) cabling system.
   b. The nominal velocity of propagation (NVP) must be set specific to each cable manufacturer before testing. Portable tester is to be calibrated on a minimum annual basis.
   c. The Consultant before the commencement of all field-testing may perform a visual inspection. The installation will be validated for compliance with the Industry Standards with particular attention given to the following criteria:
      I. Cable jacket removal and connector termination.
      II. Routing and pathway supports.
      III. Cable bend radius and cable tie slack.
      IV. Neatness, clamping, and harnessing of cabling and wiring.
      V. Wire and cable identification and labeling.
      VI. Nameplates, identification, plates, and markings.
   d. Provide two copies of testing and commissioning documentation for all items and their related components to the Project Manager and Owner’s Designated Representative before the designation of substantial completion for the project. Include maintenance manuals and operating instructions for Customer’s staff use. Substantial completion will not be granted until all documentation has been submitted and accepted by the Consultant.
   e. The permanent link performance of the installed cabling Data system must comply with EIA / TIA 568B-1 specifications for testing Category 5e systems. All horizontal channel testing shall be performed end to end for each port, (Dual NEXT). No conditional passes will be accepted.
   f. Testing of all 4 pairs of the horizontal cable (as specified in this document) is to include but not be limited to the following:
      I. Wire Map including; end to end continuity, open and shorts, pair polarity
      II. Cable length
      III. Attenuation
      IV. NEXT/FEXT
V. ACR
   VI. Return Loss
   VII. ELFEXT, PSELFEXT
   VIII. Propagation Delay, Delay skew
   IX. PSNEXT, PSACR.

g. All of the above parameters must be recorded and included in the test results.
h. Correct all cable faults. Splicing of any cables will not be permitted, for any reason, unless prior authorization is received in writing from the Consultant.
i. The Controls Contractor shall supply the Consultant with test results for approval and system acceptance. An additional copy of the test results is to be included for the maintenance manuals.

I. All wire/cable terminations shall be made at screw type terminal strips. Wire nut terminations and butt splices shall not be acceptable. Wiring runs shall be continuous runs without splices.

J. All BAS equipment and components shall be grounded to building ground facilities.

K. BAS shall only be capable of controlling electric motors when the associated hand/off/auto (HOA) motor control switches are in the "auto" position. BAS control shall be wired into the auto circuit of the hand/off/auto motor control circuit only. Where hand/off/auto switches do not exist they shall be provided by the BAS Controls Contractor.

L. Life safety and equipment protection interlocks shall be wired to override equipment whenever it is in operation.

M. Existing interlocks and override control facilities should typically not be removed or overridden by the application of new BAS control facilities without the specific instruction of the BAS Design Consultant and the approval of SFU Building Operations.

N. Current transformer and relay combination devices shall generally be used for BAS status monitoring of electric motors. There may be applications where other devices are more suitable. This shall be evaluated by the BAS Design Consultant for the application. BAS status monitoring of fractional horsepower motors less than 1/8 h.p. shall be provided by auxiliary contacts at the motor control circuit. The BAS Contractor shall be instructed to utilize spare auxiliary contacts if they exist or to provide new where required.

2.3. BAS Communication Provisions

A. The following minimum requirements shall be provided for SFU data communication interfaces:

1. The BAS data communication facilities shall be provided complete with suitable back boxes, blank cover plates and connection jacks, etc. mounted immediately adjacent to the BAS panel. Connection jacks are to be located inside the junction box.

2. In a SFU new construction project the BAS Designer shall coordinate with the appropriate design team consultants for the provision of the required communication facilities to be provided by others. In a retrofit application the BAS Controls Contractor shall provide an empty 27 mm (1") conduit and back boxes complete with pull tapes for the future installation of wire and terminations by others. Division 27, Section 27 0508 – 1.4.8. and drawing ITSTD – 20 &21.

2.4. BAS Installation Training Requirements

A. The BAS Specifications shall specify requirements for CBAS/BAS training to be provided as part of the work of all CBAS/BAS projects. CBAS/BAS Contractor shall submit an outline of the training courses to be given. The training outline shall be submitted with the initial shop drawing and submittals packages.
B. Training sessions shall include classroom type instruction and "hands on" instruction and shall be given by the BAS Contractor on site using the completed installations. Arrange for additional meeting room space with the Owner.

C. Provide training tailored to the various Owner operations personnel requirements. Duration and number of training sessions to be determined by the BAS Consultant and shall be specified to accommodate the installation requirements. Provide training in phases tailored to the following groups:

1. Basic monitoring and control operations.
2. Advanced monitoring and control operations.
3. Field maintenance and troubleshooting.

D. The BAS Contractor shall provide initial basic monitoring and control training to the Owners personnel to provide them with sufficient knowledge of the BAS installations such that they can use the BAS for the day-by-day monitoring and control of the BAS.

E. The BAS Contractor shall provide advanced supervisor level training on the details of BAS. Provide training related to advanced functions, programming, safety features, integration, database development, network facilities, etc.

F. The advanced BAS training shall, at minimum, cover the following topics:

1. BAS hardware details.
2. System software and applications programs.
3. CCP and DCP controller software development and installation.
4. Graphics and applications program development.
5. Calibration and functional testing of the BAS.
6. Trouble shooting and replacement of faulty components at CCP, DCP and UC’s.

G. Provide field maintenance and troubleshooting training for the Owner's Maintenance staff on the operation, calibration, troubleshooting, maintenance and repair of BAS field devices including, but not limited to, all instrumentation, valves and valve actuators, dampers and damper actuators, thermostats, etc.

H. Training sessions shall be designed on the basis of experience and knowledge of the attendees scheduled to participate and shall differentiate between the requirements of supervisory, operations and maintenance personnel. The training shall be specific to the project and shall cover, at minimum, the following:

1. Data base features.
2. Operating sequence programming.
3. Operator interface features.
4. Details related to the BACnet device and data object point mapping, identification naming/numbering, alarm point definitions, etc.
5. Other subjects necessary to ensure that the operators, maintenance and supervisory staffs will be able to operate the BAS without any on-going assistance from any outside party.

I. The CBAS Contractor shall provide Owner Training on the CBAS monitoring and control facilities provided for each project. CBAS training shall be project specific and shall at minimum include the following:

1. Details related to the network interconnection and data communications with the remote BAS.
2. Details related to the point mapping, database development, programming, BACnet BAS device and object identification, point naming, integration, etc.
3. VDU graphics set up and modification.
4. Alarm monitoring, display, annunciation and modification facilities.
The BAS Contractor may provide computer based, self-directed training to accomplish the portions of the SFU training requirements. Provide onsite training for details specific to the particular BAS installation project (i.e. device locations, sequences of operation, safety devices, life safety system interlocks, maintenance procedures, etc.). Provide site training for any new products, equipment, devices, and software.

2.5. **BAS Documentation Requirements**

A. The BAS Specifications shall specify requirements for CBAS and BAS documentation to be provided as part of the work of all CBAS/BAS projects.

B. A complete draft set of engineered system graphics shall be submitted prior to the start of commissioning for review and approval of the BAS manager. The submittal shall clearly identify:

1. All building floor plans,
2. All mechanical system graphics,
3. A schematic graphic detailing an overview of the hydronic systems and air systems contained within the building,
4. All individual mechanical equipment graphics (E.G.: VAV boxes, fan terminal units, etc.),
5. All system operating parameter tables, tables shall include:
   a. All unitary equipment (e.g.: heat pumps, etc.),
   b. All terminal equipment (e.g.: VAV boxes, radiation zones, etc.),
   c. All third party BACnet interface device object values (chillers, boilers, VFD BACnet object variables that may need to be referenced rarely).
   i. BACnet object values that are pertinent to daily operating requirements shall be displayed on the mechanical system graphic as well as in the object table.
6. All interlinking between the graphics, and third party documents, (PDF files, spreadsheets, etc.) referenced through graphical links.
7. All third party documents that will be graphically linked to the graphics package.

C. The following information shall be included on the cover page for each shop drawing and equipment documentation submittal:

1. Project name.
2. Date.
3. Submittal number and resubmittal number as appropriate.
4. Name and address of Architect/Consultant.
5. Name and address of Owner.
6. Name and address of BAS Contractor.
7. Name and address of supplier or vendor if appropriate.
8. Name of manufacturer.

D. Shop drawings shall be CAD generated, minimum plot size of 11 x 17 inches; refer to SFU Facilities Services Record Submission Requirements for details. Drawings shall include diagrams, mounting instructions, installation procedures, equipment details and software descriptions for all aspects of the system to be installed. At minimum, the shop drawings shall include:

1. BAS topology/network architecture schematic(s).
2. Installation drawings and schedules.
4. CCP, DCP, UC and other panel layouts, including floor plan location and interconnection drawings.
5. Field instrumentation locations on floor plan drawings.
6. Schematic of systems indicating instrumentation locations.
7. Installation details.
8. Schedule of cabling including details of proposed cable types.
9. Composite drawings of all motor starter terminal strips and damper terminal strips indicating all wiring by all contractors on the motor terminal strip.

E. Equipment submittals shall include design, performance and installation details for all aspects of the system to be installed. Equipment submittals shall be in hardcover binders with a table of contents and indexing tabs. At minimum, the equipment documentation submittals shall include:

1. Equipment technical data sheets with mounting and installation details.
2. The documentation shall include comprehensive and complete details of the Automation Level data communications, data objects, and devices including address, associated controller type, etc. as required and for the interface to the CBAS. Provide Protocol Implementation Statements (PICS) for all devices.
3. Details of networks/communications equipment, cabling and protocols proposed.
4. Software specifications and descriptions including operating sequences.
5. Field sensor and instrumentation specification sheets.
6. Damper and actuator specification sheets.
7. Valves and valve actuator specification sheets.

F. Provide record documentation in manuals as indicated below:

1. Specifications, maintenance requirements and installation requirements for all hardware components.
2. Record drawings and schedules of the completed installation including location of devices, mounting details, and cabling details.
3. Field Instrumentation and End Device Hardware Manuals
5. Maintenance Manuals.
6. Control Drawings.
7. Other supporting documentation.

G. BAS O&M manuals will exist in Mechanical O&M, no separate standalone copies will be accepted.

H. Provide Operators’ and Supervisors’ Manuals with, at minimum, the following information:

1. Details of all features and functions available to the Operators.
2. Details of all alarm, diagnostic, error and other messages. Detail the Operator action to be taken for each instance.
3. Detail special programs provided and provide a complete programming instruction manual. Detail operation of all software applications.
4. Detailed listing of the database for all installed devices.
5. Details of all data base management functions and features.
6. All details and descriptions shall be in a step-by-step format such that an Operator/Manager would be able to undertake the respective actions solely on the basis of information provided in the manuals and drawings.

I. Provide hardware manuals that shall include, at minimum, the following:

1. Specifications, maintenance requirements and installation requirements for all hardware components.
2. Record drawings and schedules of the completed installation including location of devices, mounting details, and cabling details.
3. Operating sequences and interlocks.
4. Names and addresses of spare parts suppliers.
J. Provide field instrumentation and end device manuals that shall include, at minimum, the following:

1. Control Drawings
   a. Description of the point identification tag format used.
   b. All applicable point termination diagrams i.e. typical wiring and termination of all field devices, controllers and networks.
   c. Riser Diagram with equipment listed on opposing page - see specimen in Appendix 1.
   d. Network architecture diagram.
   e. System drawing for each mechanical and electrical system with equipment list and sequences of operation on opposing page for easy reference.

2. Control drawings shall be record drawings for the completed installation including the following:
   a. Location reference to mechanical drawing number and adjacent grid line number for instrumentation.
   b. Location of conduit, tubing and wiring.
   c. Details of process interface unit termination.
   d. Details of BAS controlled valves, dampers and actuators including normal position (open or closed), operating spring/voltage/current ranges and use of pilot positioners.

3. Sequences of operation and interlocks shall be provided on the "as-built" drawings such that a single drawing will enable easy cross-reference to the sequences and associated field equipment, instrumentation and interlocks.

K. Provide Software documentation manuals that shall include, at minimum, the following:

1. System programming supervisor manuals.
2. Complete programming instruction and reference details.
3. Application software program information.
4. Sequences of operation program flowcharts provided in plastic sleeves within the manual.
5. Control Sequence
   a. Full description to support all BAS monitored and controlled systems and controllers. Provide in plastic sleeves within the manuals. Printout of control language statements, complete with detailed comment lines to enable the Owner to undertake changes to sequences without vendor support. Comment lines shall be provided at the beginning of each program to identify the use and function of all variables.

6. Point Reports
   a. Log of all point identification names and descriptors.

7. Printout of the BAS point database for all installed and calculated points.
8. Other relevant software information.

L. Provide maintenance manuals that shall include, at minimum, the following topics:

1. Maintenance, calibration and installation details for all instrumentation, valves, dampers and actuators furnished under this Contract.
2. Maintenance instructions for all BAS hardware equipment including but not limited to CCP, DCP, UC, distributed DDC controllers, modems, printers, ROW, etc.

M. Provide one sharp, clean photocopy of each new or revised drawing, schedule or prepared instruction sheet to the Owner for microfilming. Maximum size for any sheet is 11 x 17 inches. Drawings shall be on 11" x 17" sheets. The title block of each drawing shall have provision for a SFU project number and SFU drawing number.
N. Documentation shall be neatly typed or printed on 8 1/2 x 11 inch heavy bond or offset book paper. Page quality must be such as to ensure good microfilm reproduction.

O. Provide a copy of each as-built system drawing in 8½" x 11" drawing format and laminated in plastic. A set of laminated "as-built" drawings shall be provided at each CCP and DCP controller location. Laminated as-builds for VAV terminal unit controllers shall be provided at the CCP they are connected to. Each set of laminated "as-built" drawings shall be held together by a metal ring through a grommet hole in the top left hand corner of each drawing. The ring shall be attached to approximately 3 metres of light duty chain, which shall in turn be securely fastened to the intercom mounting board at the same location as the associated CCP. A hook shall be provided in the intercom mounting board on which to hang the drawings by the metal ring.

P. Manuals shall be provided in hard covered loose leaf binders with index pages and indexing tabs. Binders are to be as manufactured by ACCO Canadian Company Limited, or approved equal, as follows:

   1. 1 and 2 inch binders shall be According "Customizer" Binder 11 x 8 1/2 inch Beige, types 13401 and 13403 respectively.

Q. Manuals shall be updated whenever the Contractor makes changes to the Work.

R. Comply with and additional project requirements for documentation.

S. Record drawings shall be CAD generated and shall include, at minimum, the following:

   1. Details required by the shop drawings.
   2. Final locations and point ID for each monitored and controlled device.

T. Provide one (1) complete set of all record documentation in printed hardcopy and one (1) complete set of all record documentation in .pdf electronic computer data file format.

U. All BAS and CBAS Record Documentation shall be provided in electronic .pdf file format on a CD or DVD.

2.6. BAS Installation Commissioning and Testing

A. BAS specifications shall clearly specify the requirements for Contractor testing and commissioning of the BAS including test documentation and requirements for testing and demonstration with other project commissioning personnel and the BAS design consultant.

B. All commissioning shall be completed using the graphics generated for the user interface, and the graphics shall be verified at the same time that point end-to-end checks and programmed sequences of operation verifications are completed.

   1. Hardware and graphics commissioning shall take place simultaneously.
   2. Should the initial end-to-end checks be completed without the use of the graphics, the end-to-end checks must be completed again to confirm the point layout indicated on the graphics is consistent with the point locations in the field.

C. The BAS Contractor shall conduct full end-to-end testing and commissioning of the BAS installations and the overall monitoring and control of the building systems. BAS Contractor testing shall include the monitoring and supervisory control and data communications with the associated campus NDS.

D. The BAS Contractor shall undertake joint testing of the BAS integration with the CBAS with the CBAS Integration Contractor. The BAS Specifications shall specify requirements for the joint BAS/CBAS Contractor Testing and Commissioning.
E. The BAS Contractor shall perform a complete and detailed operational check of each BAS component. Tests shall be documented on Contractor Commission Record Sheets. The Owner, Consultant and Engineer shall undertake such random testing as the Owner, Consultant and Engineer considers necessary to verify the acceptability of the components.

F. Point to point checks shall be proven from the field device/interface operation to the controller/outstation and from the controller to the presentation of the point on the graphics. The results from the point-to-point tests shall be submitted for approval.

G. Point to point checks shall verify (at minimum) the following:
   1. Correct location of the field device for the application.
   2. Correct installation of the control device/interface with reference to the manufacturer’s literature and check that sufficient access has been provided for maintenance.
   3. That the control device has the correct range for the application, that the range is correctly entered in the controller and is correctly engineered on the operator's terminal.
   4. Correct operation of the controls device/interface, including any associated alarm and alarm text.
   5. Correct installation of each valve and damper actuator, and ensure that each valve and damper actuator is stroked correctly when checked against the BAS output.
   6. Calibration of the control device.
   7. Labels provided on the control devices and mechanical equipment is correct.

H. Systems testing shall commence once all component testing has been successfully undertaken and approved by the Consultant.

I. System testing shall be undertaken by the BAS Contractor and the BAS Contractor shall complete and submit the BAS Contractor Commission Record Sheets. The following shall be demonstrated as a minimum with the presence of the commissioning authority:
   1. Each and every point on the system including calibration checks and the stroking of actuators.
   2. All dynamic graphics comply with the mechanical and control specifications.
   3. All system programs comply with the specification under the normal modes of operation, emergency power, building fire detected and fireman's override operating modes.
   4. All system alarms comply with the specification.
   5. System stability.
   6. Dynamic tests to prove control stability and those environmental conditions are being maintained.

J. The Consultant’s verification tests shall be performed by the BAS Contractor and shall be witnessed by the Consultant who shall complete the Consultant’s portion of the system performance verification test sheets as each test is successfully undertaken. Additionally, the commissioning authority should be present for testing. The BAS Contractor shall remedy any deficiencies that are observed during the system performance verification tests and shall be re-tested as required to demonstrate satisfactory performance and compliance with the specifications.

K. Integrated BAS/CBAS joint systems tests shall be undertaken to demonstrate that the interaction between the individual building BAS and the CBAS meets the SFU requirements. The BAS Contractor shall participate in joint verification of the integrated systems and cooperate with the Owner in the demonstration of the integrated systems.
L. The BAS Specifications shall specify the requirements for the BAS/CBAS integration joint systems verification. The BAS/CBAS Integrated System Verification shall include the following minimum requirements:

1. Test all BAS monitored and controlled field devices, BAS data points and all BAS input and output points. CBAS monitored data point values shall be verified against actual field device position/state and compared to BAS values to ensure both BAS and CBAS values are the same.
2. CBAS override control of all BAS output points and control data points shall be verified.
3. BAS network and controller device status and data communications status are accurately monitored at the CMBS. Alarms for failed controllers and failed data communications are annunciated.
4. BAS data values displayed on dynamic system graphics or in tabular data format at the CBAS are functional and accurate.
5. CBAS operator control of BAS control output points and control data points are functional via the dynamic graphic interface.
6. CBAS facilities for operator adjustment of alarm definition parameters and thresholds, set point adjustment, control parameter adjustments, point trend initiation and modification to trends, etc. are fully functional.
7. The CBAS performance requirements for the monitoring and control of BAS data and field devices meet the SFU requirements.
8. BAS device addressing and identification definitions are compatible and identical and the addressing scheme meets with SFU requirements.
9. All BACnet controllers addressing shall conform to the SFU schedule for BACnet device addressing.
10. Point naming used is compatible and conformal with the SFU requirements.

M. Test results shall be documented using test sheets. The test sheets shall be prepared in an appropriate format for the various categories of component and system to be tested. It is the responsibility of the BAS Contractor to provide test verification sheets for each component and system that accurately reflect the sequences of operation and appropriate data for the components and systems.

N. All test documentation shall be maintained in electronic format and in hard copy.
3 BAS DESIGN GUIDELINES

3.1 General BAS Design Requirements

A. BAS installations at SFU buildings shall be turnkey installations operating fully standalone.

B. All BAS shall conform to the most recent revision of the ANSI/ASHRAE Standard 135 including all issued addenda, at minimum, at the Management data communication network level as defined within these guidelines. All BAS devices shall be native BACnet compliant at the Automation data communication network level.

C. The CBAS shall be compliant with the requirements defined for a BACnet Operator Workstation Device (B-OWS). The CBAS shall provide centralized operator interface for monitoring and supervisory control of the individual building BAS.

D. The SFU Campus BAS (CBAS) shall remotely monitor the individual building BAS and shall have supervisory control of building BAS facilities using BACnet over IP data communications. The CBAS Contractor shall, as part of a separate contract, provide point capture, mapping and configuration of the BAS into the CBAS. The BAS Contractor shall provide assistance and cooperation in the integration of the BAS into the CBAS. Prior to acceptance of the BAS at the individual building project, the BAS Contractor shall prove that all specified points are available to the CBAS Contractor for the integration to the CBAS and shall provide all project documentation.

E. The BAS Specifications for each building BAS project shall specify the requirement for the BAS Contractor/Manufacturer to provide all hardware and software required for the CBAS to communicate with the BAS via BACnet IP on the SFU campus WAN. Facilities to be provided shall include any manufacturer specific software tools required for programming, point mapping, configuration, etc. of building BAS data points.

F. All BAS installations shall have a network data server computer with associated BAS manufacturer application software installed and running located in the BAS MACC room in the University Services Building. The NDS shall be rack mounted in standard 19 inch rack equipment. The NDS shall be provided by the associated BAS Contractor complete with all manufacture specific BAS operator interface software for programming, database development, data archiving and storage, and controller program backup and restore facilities. NDS mounting rack shall be provided by SFU. The NDS shall be provided with functionality detailed in these documents. The dedicated NDS shall communicate with the individual building BAS’s over the SFU Management Level WAN. Data communications shall be BACnet/IP. Any BAS installation provided for a SFU building shall have a NDS dedicated to BAS equipment and installations of the same manufacturer. The manufacturer specific NDS shall be installed on site and communicating with the campus WAN prior to any proposed building installation of products from any BAS manufacturer.

G. SFU building BAS installations shall be specified to include all project design, documentation, training, installation work, software, database and logic programming, WAN interconnection, testing, commissioning, warranty, project management and trade coordination work as required for a fully functional, standalone, turnkey BAS. The individual building BAS installation

Contractor work shall include coordination and documentation work for the integration of the BAS into the CBAS via BACnet data interface by other contract. Installations shall in no way negatively affect existing BAS installations and existing campus BAS performance.
H. BAS installations shall be provided which incorporate BAS equipment and network facilities in compliance with the requirements identified in these guidelines. The BAS designer shall specify detailed BAS equipment requirements and BAS network architecture requirements in the BAS Design Specifications. BAS equipment and data communication network specifications shall incorporate good BAS engineering, design, and application practices and shall incorporate the SFU BAS Design Guideline requirements.

I. BAS online editing is necessary for all controllers that serve critical equipment (to be determined by project team) which cannot be shut down without a maintenance shutdown notice.

J. BAS installations in SFU buildings shall incorporate the following minimum requirements:

1. Equipment shall be approved components as manufactured by one of the SFU approved BAS Manufacturers and shall be in compliance with the SFU BAS Design Guidelines.

2. Management and Automation Level communication LAN's shall be provided to ensure the following:

3. The failure of a DCP shall not affect the operation of other operating DCP. UC’s supervised by the failed DCP shall continue to function and shall control associated equipment according to specified failure routines. Where information in the failed DCP is used by other DCP’s, UC’s, buildings, routines, etc. the non-availability of the information shall be alarmed and alternate control strategies shall be automatically initiated.

4. The failure of an UC shall not affect the operation of other operating UC or DCP.

5. All BAS monitored and controlled points associated with an individual HVAC System or equipment shall be terminated in the same UC or DCP. It is not acceptable for BAS monitored and controlled points associated with an individual system to be terminated at separate distributed DCP’s or UC’s. All required logic programming and point database facilities associated with an individual building system shall reside in the same UC or DCP to which the system input/output points are terminated. It is not acceptable for logic programming and database facilities required for BAS monitoring and control of a building system to reside in a DCP or UC other than to which the system input/output points are terminated in.

6. UC’s controlling space terminal units (e.g. VAV terminal units, fan powered terminal units, etc.) shall reside on the same automation LAN as the UC that is controlling the associated air handling unit. If an AHU is controlled directly by a DCP, the UC’s controlling space terminal units shall be supervised by that DCP.

3.2. BAS Contractor and System Qualifications

A. BAS’s to be provided for any SFU building installations shall be products as manufactured by one of the following manufacturers:

1. Schneider Electric
2. Delta Controls

B. BAS standalone building installations shall be provided by one of the following SFU approved BAS installation contractors who shall install products of one of the above approved manufacturers:

1. Houle Electric Ltd.
2. ESC Automation
C. BAS installations shall be provided by BAS Contractors who meet the following requirements:

1. Must have been in operation in the BAS industry in the City of Burnaby area for a minimum of 10 years.
2. Employ qualified staff in the Burnaby area capable of undertaking a complete BAS installation project and to provide routine and emergency maintenance on all elements of the BAS.
3. Have successful project experience on similar projects for a minimum period of five (5) years.
4. Have local service and support facilities for the total BAS. BAS Contractor shall have service and support facilities available to SFU 24 hours per day, 7 days per week.
5. Have local, or access to, supplies of BAS components with a maximum delivery period of 24 hours.

D. All new control points shall be connected to the closest existing or new Infinity Andover or Delta Control panel, and are to be fully compatible with the existing installed central monitoring and control facilities, network communications facilities, and with other SFU building BAS installations.

E. All BAS DCP’s, UC’s, OIW’s where applicable, and other BAS Manufacturer specific equipment within a building shall be manufactured by the same manufacturer. All HVAC and building services monitoring and control shall be provided by BAS facilities from one of the approved SFU BAS manufacturers. In applications where HVAC system controls within an existing building are being retrofitted and BAS facilities of any of the approved BAS manufacturers exist within the building, BAS facilities shall be provided by the manufacturer of the BAS equipment already installed. The retrofitted BAS installation shall be provided to interconnect the new renovation work into the existing building and campus BAS facilities.

F. BAS DDC controllers shall be products manufactured by a company that is an active Corporate Member of the BACnet Manufacturers Association (BMA).

G. All BAS products proposed for installation on a SFU project shall have been previously demonstrated to SFU Building Operations satisfaction and approved by SFU Building Operations prior to being listed as an approved bidder. Any BAS product/equipment for which there is not a significant existing installation on campus of products from the same manufacturer that is successfully integrated with the CBAS shall be fully demonstrated to SFU’s satisfaction and approved by SFU Building Operations prior to being considered as an approved product.

3.3. **BAS Network Architecture and Communications Requirements**

A. The CBAS and the individual building BAS systems shall be based on multiple tier/level data communication networks utilizing different network communications technologies. The CBAS and the individual building BAS system architecture shall comprise of three layers as defined within these documents.

B. BAS design specifications shall detail the data communications network facilities to be provided and the contracting party responsible for providing the work.

C. The CBAS/BAS architecture shall comprise the following network layers:
1. Management Level (by CBAS and BAS Contracts):
   a. A Wide Area Network (the SFU Campus WAN) shall provide a means of interoperable communication between the CBAS and the individual building BAS using BACnet/IP. This WAN is hereafter referred to as the Management Level Network. The Management Level Network shall provide a means by which the building systems throughout the SFU facilities can exchange data in the form of BACnet data objects. The Management Level Network shall be BACnet/IP over Ethernet and shall be such that an operator with the required access level shall be able to undertake monitoring and control functions for any of the integrated BAS buildings.
   b. It shall be the responsibility of each BAS building contractor, to ensure that all BAS system data is available at the Management Level Network. The intent is that the CBAS shall be able to automatically read this data from the network using the BACnet automatic “find new objects” features. Each BAS building system contractor shall provide comprehensive and complete documentation regarding the installed BACnet devices, device address, controller type, databases and other pertinent information to the Owner and to the CBAS contractor. BAS Specifications shall specify the inform
   c. Each BAS system shall have a dedicated NDS installed at the SFU MACC. The NDS shall be dedicated to campus building BAS’s of the same manufacturer product. The NDS shall have terminal service capabilities with “Thin Client” operator interface or shall employ “web services” technology such as Microsoft .Net technology with web browser based operator interface. The NDS shall communicate with the individual building BAS’s over the BAS Management Level via BACnet/IP. The NDS shall have manufacturer specific application software for operator interface. The NDS shall be configured for archiving and data storage of all associated BAS controllers and devices and for manufacturer specific controller programming, trouble shooting, data entry, configuration software tools, etc. It is not intended that the NDS be configured as the central operator monitoring and control workstation.
   d. The NDS shall have Terminal Service capabilities with Thin Client operator interface, or equivalent, such that all applications software resides at the terminal servers and the entire SFU facilities are covered by a single software license regardless of the number of Personal Computers that are accessing NDS via the Management Level Network at any point in time.
   e. The existing SBT Apogee with BACnet Option server computer and application software shall be the operator interface for supervisory monitoring and control of the building BAS systems. The SBT Apogee Server computer, application software and associated management level WAN facilities shall be the Campus Building Automation System (CBAS).
   f. The CBAS shall be in conformance with the requirements and functionality detailed in ANSI/ASHRAE Standard 135 (BACnet) for a BACnet Operator Workstation (B-AWS). The CBAS shall have terminal service capabilities with “Thin Client” operator interface. The CBAS shall communicate with the individual building BAS’s over the BAS Management Level via BACnet/IP. CBAS applications software shall run on the existing SBT Apogee NDS server computer installed at the SFU MACC. The CBAS workstations, including the Portable Operator Workstations (POT), shall be Thin Clients operating through a Virtual Private Network (VPN). It shall be possible to add access from a remote location by modem and/or via the Web.
   g. The Operator Interface Workstations (OIW) that serve the CBAS and BAS shall be resident on the Management Level Network, not the BAS Automation Level. If an OIW is required within a remote building, the CBAS contractor shall provide it under a separate contract.
   h. The Management Level Network communications, without exception, shall be BACnet/IP. It is intended that there be a single point of interface between a building BAS and the Management Level Network (SFU WAN). If multiple
CCP are required in a building due to Automation Level node quantities or limitations of CCP capabilities, the BAS Contractor shall add the additional CCP as an extension of the Management Level Network within the school. The BAS Contractor shall provide Management Level network facilities within individual buildings.

i. The demarcation point between the CBAS and the building BAS shall be the BAS CCP connection to the WAN data outlet within the building. The BAS Contractor shall make the final terminations with supervision from SFU.

2. Automation Level (by the BAS Contract):
   a. The Communication Control Panels (CCP) shall be part of the BAS. CCP shall be software programmable and shall incorporate BACnet/IP to BACnet/MS/TP routers between the Management Level Network and the BACnet controllers on the Automation Level Network.
   b. The Automation Level shall primarily include the DDC controllers that interface with the field sensors and final control elements. It is anticipated that there will be two types of DDC controller within the CBAS architecture:
      I. Distributed Controlpanels (DCP).
      II. Unitary Controllers (UC).
   c. DCP controllers shall be fully programmable controllers and shall have an I/O capability to handle major types of equipment such as air handling units, roof top units, chiller plants, heating plants, etc. The DCP shall be BACnet Building Controller (B-BC) type controllers and shall be interfaced with the Management Level Network via the CCP. DCP may incorporate CCP functionality and reside at the Management network level.
   d. UC shall be application specific or fully programmable controllers and shall be suitable for the monitoring and control of specific types of smaller equipment such as VAV terminal units and Fan Coil Units. UC shall be BACnet Advanced Application Controller (B-AAC) and/or BACnet Application Specific Controller (B-ASC) type controllers at the Automation Level. These UC shall operate on the same network as the BACnet DCP.
   e. All controllers shall be BACnet compliant. Where testing protocols and certification requirements are developed for standardized BACnet device types, devices must be tested and certified compliant by the BACnet Testing Laboratory (BTL). For BAS standardized devices where testing protocols and certification requirements are not yet finalized, the BAS product manufacturer must demonstrate committed efforts to comply with BACnet Standard requirements for the device and an ongoing commitment to undertake the future testing and certification process. All BAS controllers shall be tested and certified within a reasonable period of time of the testing and certification process being available.
   f. The BAS Automation Level Networks shall be BACnet MS/TP protocol. No other protocols or network architecture shall be used.
   g. Where interface to a third party controller is not BACnet compatible, the interface shall be accomplished through a point-for-point, hardwired interface.

3. Field Level (by BAS Contract):
   a. The Field Level shall include the instrumentation interfaced to the Automation Level DDC controllers such as the temperature, humidity, level, pressure sensors and switches. It shall also include the final control elements such as the valve and damper actuators and the control relays.
4 BAS EQUIPMENT

4.1 Management Level Network

A. Extension of the Management Level Network shall meet, at minimum, the following requirements:

1. Ethernet TCP/IP network. The CCP, OIW, NDS, POT and CBAS shall communicate at 100Mbs or higher communication rates.
2. All data communications shall be BACnet/IP.
3. Cabling shall be Category 6 or higher quality and shall be tested and certified for 1 Gbps data transfer rate.
4. Network equipment, configurations, and data communications shall be fully compatible with the SFU Campus WAN.

B. OPERATOR INTERFACE WORKSTATION (OIW)

1. The OIW shall conform to the BACnet device profile B-AWS.
2. The B-AWS is the advanced operator's window into a BACnet system. It is primarily used to monitor the performance of a system and to modify parameters that affect the operation of a system. It will also be used for BAS system configuration activities that are beyond the scope of the BACnet standard.
3. At minimum the workstation shall be capable of meeting the following requirements of the BACnet standard:
   a. Data Sharing,
      I. Presentation of data (i.e., reports and graphics),
      II. Ability to monitor the value of all BACnet object types, including all required and optional properties,
      III. Ability to modify setpoints and parameters,
   b. Alarm and Event Management
      I. Operator notification and presentation of event information
      II. Alarm acknowledgment by operators
      III. Alarm summarization
      IV. Adjustment of alarm limits
      V. Adjustment of alarm routing
      VI. Creation of new Event Enrollment and Notification Class objects
      VII. Presentation of Event Logs
   c. Scheduling
      I. Modification of calendars and schedules
      II. Display of the start and stop times (schedule) of scheduled devices
      III. Display of calendars
      IV. Creation of new calendars and schedules
   d. Trending
      I. Modification of the parameters of a trend log
      II. Display of trend data
      III. Creation of new Trend Log objects
   e. Device and Network Management
      I. Ability to find other BACnet devices
      II. Ability to find all objects in BACnet devices
      III. Ability to silence a device on the network that is transmitting erroneous data
      IV. Ability to synchronize the time in devices across the BACnet internetwork at the request of the operator
      V. Ability to cause a remote device to reinitialize itself
      VI. Ability to backup and restore the configuration of other devices
      VII. Ability to command half-routers to establish and terminate connections
4. At minimum the workstation shall be capable of meeting the following requirements that fall outside of the BACnet standard:
   a. Operating third party drawing packages such as AUTODESK AutoCad, MICROGRAPHIX Draw, ADOBE Illustrator, or COREL Draw,
   b. Operating third party office suites such as MICROSOFT Office Professional, 
   c. Operating database analysis tool such as SAP Crystal Reports.
   d. Capability to transmit detailed documents, screen captures, reports, trend graphs, alarms, and notifications via email.
      I. Email should be capable of being sent to individuals, and or groups.
      II. The system shall have the capability to generate emails automatically based upon BAS calendar dates and times, system events, or system alarm events.
      III. Emails generated by the BAS systems shall have the capability to send to different people, departments or groups based upon the type of alarm, alarm priority, and the building system generating the email.
   e. Capability to transmit critical alarms to cellular phones via SMS text messaging.
      I. Text messages generated by the BAS systems shall have the capability to send to different people, departments or groups based upon the type of alarm, alarm priority, and the building system generating the text messages.

C. WEB SERVER OPERATOR INTERFACE (WOI)

1. The WIO, at minimum, shall conform to the BACnet device profile B-OWS.
2. The B-OWS is an operator interface with limited capabilities relative to a B-AWS. The B-OWS is used for monitoring and basic control of a system, but differs from a B-AWS in that it does not support configuration activities, nor does it provide advanced troubleshooting capabilities.
3. The B-OWS profile is targeted at the daily operator who needs the ability to monitor basic system status and to perform simple modifications to the operation of the system.
4. At minimum the workstation shall be capable of meeting the following requirements of the BACnet standard:
   a. Data Sharing
      I. Presentation of data (i.e., reports and graphics)
      II. Ability to modify setpoints and parameters
   b. Alarm and Event Management
      I. Operator notification and presentation of event information
      II. Alarm acknowledgment by operators
      III. Alarms summarization
      IV. Adjustment of analog alarm limits
   c. Scheduling
      I. Modification of calendars and schedules
      II. Display of the start and stop times (schedule) of scheduled devices
      III. Display of calendars
   d. Trending
      I. Display of trend data
   e. Device and Network Management
      I. Ability to find other BACnet devices
      II. Ability to synchronize the time in devices across the BACnet internetwork at the request of the operator
5. At minimum the workstation shall be capable of meeting the following requirements that fall outside of the BACnet standard:
   a. **Web Server Capabilities**
      i. Automatically generate WEB pages from graphics that are resident in the Operator Interface Workstation (OIW).
      ii. Serve up universally compatible web pages to the World Wide Web (internet, intranet, extranet) or cloud.
         - Web pages shall be compatible with web browsers operating on remote computers, laptops, tablets, or smartphones.
         - Web pages shall be compatible with web browsers such as Internet Explorer operating on MICROSOFT platforms (Windows, Windows Server, Windows CE), Safari operating on APPLE platforms (OSX and IOS), Dolphin operating on the ANDROID platform, or any universal browsers that are platform independent (Chrome, Firefox, Mozilla).
         - Web pages are to use HTML5 encoding for animation and **not** ADOBE Flash.
      iii. Any changes made to the graphics residing in the OIW will be automatically updated at the web page level.

D. **BMS Historian**

1. Historian must be able to trend log every point for a 2-year period at an interval of 15 minutes.

2. Data must be CSV exportable.

E. **BACnet Operator Display (BOD)**

1. The TOI shall conform to the BACnet device profile B-OD.
2. The B-OD is a basic operator interface with limited capabilities relative to a B-OWS. It is not intended to perform direct digital control. The B-OD profile could be used for wall-mounted LCD devices, displays affixed to BACnet devices; handheld terminals or other very simple user interfaces.
3. At minimum the workstation shall be capable of meeting the following requirements of the BACnet standard:
   a. **Data Sharing**
      i. Presentation of basic data
      ii. Ability to modify setpoints and parameters
   b. **Alarm and Event Management**
      i. Operator notification and presentation of event information
   c. **Scheduling**
      i. No minimum requirements
   d. **Trending**
      i. No minimum requirements
   e. **Device and Network Management**
      i. Ability to find other BACnet devices
4.2. **BAS Automation Level Network**

A. BAS Automation Level LAN shall meet, at minimum, the following requirements:

1. BACnet IP and/or BACnet MS/TP protocol implemented via EIA-485.
   a. Data transfer rate and data throughput as required to meet the alarm annunciation requirements.
2. BACnet IP protocol implemented via Ethernet.
   a. Data transfer rate and data throughput as required to meet the alarm annunciation requirements.

B. The failure of any node on the Automation Level LAN shall in no way affect the operation of the BAS except to inhibit monitoring and control functions at the OIW for that node or any devices served by the failed node.

C. The failure of any node shall not inhibit the communication between remaining nodes.
4.3. Communication Control Panels (CCP)

A. CCP shall be BACnet compliant. CCP shall be software programmable controllers on the Management Level Network and shall be a router between the BACnet/IP Management Level Network and the BACnet/MSTP Automation Level Network.

B. Provide, at minimum, one CCP per building. Additional CCP may be required to accommodate the number of Management and Field Level Controller nodes and network segments.

C. The CCP shall incorporate software as necessary to provide communications on the Management Level Network.

D. The failure of any CCP shall be annunciated as an alarm at the CBAS.

E. Provide a real-time hardware clock at each CCP. The hardware real-time clock shall be used to synchronize all other hardware and software clocks in the local building BAS.

F. CCP shall record and store device change of state data, BAS event/transaction and alarm data, and trend data in memory within the CCP and shall automatically upload the data to the CBAS and NDS. In the event that the CBAS and/or NDS is not available, the CCP shall store the data in memory within the controller and automatically upload the data once the CBAS/NDS resume communications. CCP shall have memory facilities to hold 7 days of historic data of normal typical transactions and for 7 days of historic trend data for monitored point values at 15 minute samples.

G. CCP panels shall comply with the BACnet Building Control (B-BC) device profile. A B-BC is a general-purpose, field-programmable device capable of carrying out a variety of building automation and control tasks. The panel shall have the following capabilities:

1. Data Sharing
   a. Ability to provide the values of any of its BACnet objects,
   b. Ability to retrieve the values of BACnet objects from other devices,
   c. Ability to allow modification of some or all of its BACnet objects by another device,
   d. Ability to modify some BACnet objects in other devices.

2. Alarm and Event Management
   a. Generation of alarm / event notifications and the ability to direct them to recipients,
   b. Maintain a list of unacknowledged alarms / events,
   c. Notifying other recipients that the acknowledgment has been received,
   d. Adjustment of alarm / event parameters.

3. Scheduling
   a. Ability to schedule output actions, both in the local device and in other devices, both binary and analog, based on date and time.

4. Trending
   a. Collection and delivery of (time, value) pairs.

5. Device and Network Management
   a. Ability to respond to queries about its status,
   b. Ability to respond to requests for information about any of its objects,
   c. Ability to respond to communication control messages,
   d. Ability to synchronize its internal clock upon request,
   e. Ability to perform re-initialization upon request,
   f. Ability to upload its configuration and allow it to be subsequently restored,
   g. Ability to command half-routers to establish and terminate connections.
4.4. Distributed Control Panels (DCP)

A. The BAS Contractor shall provide all DCP. DCP shall be software programmable controllers that reside/communicate via BACnet/IP on the Management Level and/or via the BACnet MS/TP Automation Level Network and shall provide an interface via Point Interface Modules (PIM) to the field instrumentation and final control elements.

B. DCP may be used for any equipment monitored and controlled by the BAS. Dedicated DCP shall be used to monitor and control the following equipment:

1. Chilled water system.
2. Cooling towers.
3. Heating water system.
4. Air handling units.

C. The DCP shall control its own communications so that the failure of any one node, including any associated PC workstation or server computer, shall not inhibit communications on the network between the remaining nodes. Provide integral network communication connections.

D. DCP shall be BACnet compliant. DCP shall be BACnet Building Controller (B-BC) type controllers and shall be interfaced with the Management Level Network via the CCP. DCP may be equipped with integral CCP functionality. All controllers shall be BACnet compliant and shall have been tested and certified compliant by the BACnet Testing Laboratory (BTL).

E. DCP panels shall comply with the BACnet Building Control (B-BC) device profile. A B-BC is a general-purpose, field-programmable device capable of carrying out a variety of building automation and control tasks. The panel shall have the following capabilities:

1. Data Sharing
   a. Ability to provide the values of any of its BACnet objects,
   b. Ability to retrieve the values of BACnet objects from other devices,
   c. Ability to allow modification of some or all of its BACnet objects by another device,
   d. Ability to modify some BACnet objects in other devices.

2. Alarm and Event Management
   a. Generation of alarm / event notifications and the ability to direct them to recipients,
   b. Maintain a list of unacknowledged alarms / events,
   c. Notifying other recipients that the acknowledgment has been received,
   d. Adjustment of alarm / event parameters.

3. Scheduling
   a. Ability to schedule output actions, both in the local device and in other devices, both binary and analog, based on date and time.

4. Trending
   a. Collection and delivery of (time, value) pairs.

5. Device and Network Management
   a. Ability to respond to queries about its status,
   b. Ability to respond to requests for information about any of its objects,
   c. Ability to respond to communication control messages,
   d. Ability to synchronize its internal clock upon request,
   e. Ability to perform re-initialization upon request,
   f. Ability to upload its configuration and allow it to be subsequently restored,
   g. Ability to command half-routers to establish and terminate connections.

6. Data Sharing
   a. Ability to provide the values of any of its BACnet objects,
   b. Ability to retrieve the values of BACnet objects from other devices,
   c. Ability to allow modification of some or all of its BACnet objects by another device,
   d. Ability to modify some BACnet objects in other devices.
7. **Alarm and Event Management**
   a. Generation of alarm / event notifications and the ability to direct them to recipients,
   b. Maintain a list of unacknowledged alarms / events,
   c. Notifying other recipients that the acknowledgment has been received,
   d. Adjustment of alarm / event parameters.

8. **Scheduling**
   a. Ability to schedule output actions, both in the local device and in other devices, both binary and analog, based on date and time.

9. **Trending**
   a. Collection and delivery of (time, value) pairs.

10. **Device and Network Management**
    a. Ability to respond to queries about its status,
    b. Ability to respond to requests for information about any of its objects,
    c. Ability to respond to communication control messages,
    d. Ability to synchronize its internal clock upon request,
    e. Ability to perform re-initialization upon request,
    f. Ability to upload its configuration and allow it to be subsequently restored,
    g. Ability to command half-routers to establish and terminate connections.

F. All applications programs and associated operating sequences shall reside at the DCP.

G. Provide each DCP with a battery back-up for the protection of volatile memory for a minimum of 72 hours.

H. Provide a real-time software or hardware clock at each DCP. The software clock shall have a battery back-up of at least 72 hours.

I. Interfaces to field instrumentation and final control elements shall have Point Interface Modules (PIM) that will:
   1. Enable the DCP to receive signals from the digital and analog instrumentation.
   2. Enable the DCP to output control signals to the final control elements.

J. Analog I/O PIM shall have a minimum 12 bit analog-to-digital conversion and shall interface to the entire signal types listed in the Point Schedules.

K. Control shall be based on either three term algorithms, i.e. proportional plus integral plus derivative, or two term algorithms, i.e. proportional plus integral, unless specified otherwise.

L. Provide with each controller the BACnet configuration information including BIBB, address, controller configuration type, etc. to integrate the controller into the CBAS.

M. The failure of a DCP shall not affect the operation of other operating DCP. UC’s supervised by the failed DCP shall continue to function and shall control associated equipment according to specified failure routines. Where information in the failed DCP is used by other DCP’s, UC’s, buildings, routines, etc. the non-availability of the information shall be alarmed and alternate control strategies shall be automatically initiated.
4.5. **Unitary Controllers (UC)**

A. The BAS Contractor shall provide all Unitary Controllers (UC). UC shall be fully programmable or applications specific controllers with pre-packaged operating sequences maintained in EEPROM or flash RAM.

B. The UC shall be a node on one of the Automation Level LANs and shall control its own communications so that the failure of any one node shall not inhibit communications on the network between the remaining nodes.

C. UC shall be BACnet Advanced Application Controller (B-AAC) and/or BACnet Application Specific Controller (B-ASC) type controllers incorporated at the Automation Level. These UC shall operate on the same network as the BACnet DCP. All controllers shall be BACnet compliant and shall have been tested and certified compliant by the BACnet Testing Laboratory (BTL).

D. UC shall be totally independent of other LAN nodes for their monitoring and control functions.

E. Provide each UC with a battery back-up or EEPROM for the protection of volatile memory for a minimum of 72 hours. Batteries shall be rated for a seven year life.

F. All associated applications programs shall reside at the UC. UC shall not require communication to any other panel for normal operating sequences other than time scheduled base commands.

G. Control shall be based on either three term algorithms, i.e. proportional plus integral plus derivative, or two term algorithms, i.e. proportional plus integral, unless specified otherwise.

H. Provide with each controller the BACnet configuration information including BIBB, address, controller configuration type, etc. to integrate the controller into the CBAS.

I. UC’s that serve equipment, (such as a unit ventilator), that requires a degree of custom programming to achieve the specified sequence of operation shall be a BACnet Advanced Application Controller (B-AAC). The B-AAC shall have the following capabilities:

1. **Data Sharing**
   a. Ability to provide values for any of its BACnet objects upon request,
   b. Ability to allow modification of some or all of its BACnet objects by another BACnet device.

2. **Alarm and Event Management**
   a. Generation of limited alarm and event notifications and the ability to direct them to recipients,
   b. Tracking acknowledgments of alarms from human operators,
   c. Adjustment of alarm parameters.

3. **Scheduling**
   a. Ability to schedule actions in the local device based on date and time.

4. **Trending**
   a. No requirement.

5. **Device and Network Management**
   a. Ability to respond to queries about its status,
   b. Ability to respond to requests for information about any of its objects,
   c. Ability to respond to communication control messages.
J. UC’s that serve equipment, (such as a VAV box, heat pump, or fan coil), that does not require a degree of custom programming to achieve the specified sequence of operation shall be a BACnet Application Specific Controller (B-ASC). The B-ASC shall have the following capabilities:

1. Data Sharing
   a. Ability to provide values for any of its BACnet objects upon request,
   b. Ability to allow modification of some or all of its BACnet objects by another BACnet device.
2. Alarm and Event Management
   a. No requirement.
3. Scheduling
   a. No requirement.
4. Trending
   a. No requirement.
5. Device and Network Management
   a. Ability to respond to queries about its status,
   b. Ability to respond to requests for information about any of its objects,
   c. Ability to respond to communication control messages.

K. Any trending requirements required for data located at the B-AAC or B-ASC level shall be completed at the CCP level.

L. Any alarming functions that may be required for data located at the B-ASC level shall be completed at the CCP level.

M. A dedicated UC shall be provided for the BAS monitoring and control of each individual unitary equipment such as VAV Terminal Units, Fan Coil Units, Unitary Equipment, Rooftop unit, etc. Failure of one UC shall not affect the BAS monitoring and control or operation of other unitary equipment or BAS devices.

4.6. Valves and Dampers

A. Automatic Control Valve General Requirements:

1. The BAS Contractor shall furnish all valves controlled by the BAS as detailed in the mechanical trade documents and as indicated on control drawings. The BAS Contractor shall furnish all shut-off valves for instrumentation. The Mechanical Contractor shall install valves, except those for instrumentation. All other valves such as check valves, relief valves, pressure reducing valves, self-regulating valves, manually operated valves, etc. shall be furnished and installed by the Mechanical Contractor. The BAS Contractor shall provide details of the manufacturer's installation requirements to the Mechanical Contractor. The BAS Contractor shall coordinate the valve body type and pipe connections with the mechanical trade.

B. The BAS Contractor shall refer to the Mechanical plans and drawings and to the control drawings for the design conditions on which to base sizing and ratings of the valves and their actuators.

C. All valves shall be rated appropriately for the fluid, temperature and pressure.

D. Valves of similar types shall be by the same manufacturer.

E. Valves shall have the manufacturer's name and the pressure rating clearly marked on the outside of the body. Where this is not possible manufacturer's name and valve pressure rating shall be engraved on a minimum 50mm (2 inch) diameter stainless steel tag that shall be attached to the valve by a chain in such a manner that it cannot be unintentionally removed.
F. Valves 13mm to 50mm (0.5 inch to 2 inches) shall have screwed ends. Valves 63mm (2.5 inches) and larger shall have flanged ends. Flanged valves shall be furnished complete with companion flanges, gaskets and bolting materials. Flanges, gaskets and bolting materials shall meet the appropriate ANSI requirements.

G. Valves shall be suitable for continuous throttling.

H. Valve schedules shall be submitted for review and shall clearly show the following for each valve:
   1. Associated system.
   2. Manufacturer and model number.
   3. Valve size and line size.
   4. Flowrate, flow coefficient (CV) - and pressure drop at design conditions or
   5. Valve authority, flowrate and pressure drop across the valve at design conditions and pressure drop across the associated mechanical equipment, e.g., coil, heat exchanger, etc., at design conditions.

I. Valve configuration (e.g. two way, three way, butterfly).
   2. Leakage rate.
   3. Maximum pressure shut-off capability.
   4. Actuator manufacturer and model number.
   5. Valve body pressure and temperature rating.

J. Where necessary to achieve the required performance and pressure drop a control valve may be sized up to two nominal sizes below line size.

K. Valve bodies shall be cast iron, carbon steel, stainless steel or bronze subject to requirements for valve body pressure and temperature rating and suitability of material for application. Valve trim for steam service shall be stainless steel.

L. For all valves larger than one and a half inch (1 ½ inch) valve seats shall be replaceable. Valve seats shall be metal, ceramic filled PTFE or equivalent and must assure tight seating.

M. The BAS Contractor shall certify that the materials of construction are appropriate for the application. In particular, valves used for the control of glycol solutions shall have a trim that is suitable for a glycol solution.

N. Two-Way Control Valves
   1. The BAS Contractor shall provide two-way globe control valves as indicated on the mechanical trade documents.
   2. Pressure drop shall not exceed 35 kPa and shall conform to the following requirements:
      a. Valves shall be selected such that the valve authority (N) shall not be less than 0.5 as defined by the relationship:
         \[ N = \frac{P1}{P1 + P2} \]
      b. where \( P1 = \) pressure drop across the fully open valve, and \( P2 = \) pressure drop across the remainder of the circuit (e.g. a coil, isolation valves, strainers, etc.)
3. Valve shall be capable of tight shut-off when operating at system pressure with the system pump operating at shut-off head. Leakage rate shall not exceed 0.01% of the rated valve capacity.

4. Valve shall be straight pattern type. Angle valves shall only be furnished where the piping configuration does not permit the use of a straight valve.

5. Valves shall be single seat globe type. Double seat valves shall not be furnished.

6. Two-port valves when used to control heating or cooling coil water flow shall have an equal percentage or modified parabolic characteristic. Two-port valves when used in liquid applications systems not detailed above shall have a linear / linear characteristic.

7. Ball type valves may be permitted for valves less than 2 inches. Proposed ball valves must be designed for modulating control service. BAS Consultant to specify requirements.

O. Three-way Control Valves

1. The BAS Contractor shall provide three-way control valves as indicated on the mechanical trade documents.

2. Pressure drop shall not exceed 35 kPa and shall conform to the following requirements:
   a. Valves shall be selected such that the valve authority (N) shall not be less than 0.5 for diverting valves and 0.3 for mixing valves as defined by the relationship: $N = P_1/(P_1 + P_2)$
   b. $P_1$ = pressure drop across the fully open valve
   c. $P_2$ = pressure drop across the remainder of the circuit (e.g. a coil)

3. Three-way control valves shall be of the mixing or diverting pattern type as indicated in the mechanical documents. The inner valve shall have a V-port parabolic or linear plug and stainless steel trim. Valves shall have metal-to-metal stainless steel seats to assure tight seating.

4. Mixing valves shall be capable of tight shut-off between each inlet port and the outlet port and diverting valves shall be capable of tight shut-off between each outlet port and the inlet port when operating at system pressure.

P. Valves for Instrumentation

1. Instrumentation, such as pressure sensors and flow rate monitors, which is provided for the monitoring of parameters associated with liquid in pipes or tanks, shall be removable and replaceable without the requirement to shut down a pump and without the requirement to drain the pipe or tank and without causing liquid to leak from the pipe or tank. To facilitate this, the BAS Contractor shall furnish valves for installation by the mechanical trade.

2. Instrumentation that is mounted external to the pipe or tank and which is connected to the pipe or tank by one or more sampling lines shall have a manual two-way on/off valve in each sampling line meeting the following requirements:
   a. Ball type valve
   b. Valve body shall be 316 stainless steel
   c. Ball and stem shall be 316 stainless steel
   d. Zeroleakage.
   e. Rated for 7000 kPa or for a pressure 50% greater than the system working pressure, whichever is the greater.
   f. Rated for a minimum of 50 °C (90 °F.) greater than the highest fluid temperature.
   g. Brass or stainless steel trim.
   h. Valve seats shall be metal, reinforced TFE or equivalent and must assure tight seating.
   i. Valve shall be Whitey 40 Series or 80 Series or approved equal it meets the requirements detailed above.

3. Valves for insertion flow meters shall be full port gate valves sized for the flow meter in accordance with the flow meter manufacturer’s instructions. If the flow meter manufacturer offers the valve as an accessory then it shall be purchased by the BAS SFU contractor from the insertion flow meter manufacturer and shall be installed by the
mechanical trade in accordance with the insertion flow meter manufacturer’s instructions. The valve shall meet the pressure and temperature requirements detailed for the control valves and shall have zero leakage at the system maximum pressure.

Q. Valve Actuators - Electric

1. The BAS Contractor shall provide electric actuators for valves that are furnished by the BAS Contractor. Pneumatic type actuators are not acceptable.
2. Actuator shall be motor driven type. Valve stem position shall be adjustable in increments of one (1) percent or less of full stem travel.
3. Actuator shall have an integral self-locking gear train, mechanical travel stops and adjustable travel limit switches with electrically isolated contacts.
4. Actuator gear assembly shall be made of hard-anodized aluminum or steel or material of equivalent durability. No plastic components shall be acceptable. Disassembly of the gears shall not be required to remove the motor.
5. Actuator shall be rated for continuous duty and have an input voltage of 120 vac/60 Hz, or 24 V.
6. Actuators on valves located in mechanical rooms or outdoors shall have covers of aluminum or a material of equivalent strength and shall have captive bolts to eliminate loss of bolts when removing the cover from the base. Housings for valves located in a plenum and used for terminal unit or fan coil unit heating/cooling coils, may be constructed of reinforced plastic. Materials of construction for all actuator components shall be non-corroding.
7. Actuator motor shall be fully accessible for ease of maintenance.
8. Actuator shall be sized to meet the shut-off requirements when operating at the maximum system differential pressure and with the installed system pump operating at shut-off head.
9. Actuator shall control against system maximum working pressures.
10. Actuator shall fail as indicated on the control drawings that form part of these contract documents. Provide spring return to de-energized position on loss of power or loss of control signal if so required by the sequences of operation.
11. Actuator shall accept control signals compatible with the BAS analogue or digital output subsystem as appropriate. The valve stem position shall be linearly related to the control signal.
12. Actuator shall have visual mechanical position indication, showing output shaft and valve position.
13. Actuator shall operate the valve from the fully closed to the fully open position and vice versa in less than two minutes.
14. Actuator shall be constructed to withstand high shock and vibration without operations failure. Materials of construction shall be non-corroding.
15. Actuator shall be equipped with an integral position potentiometer to indicate the stem position of the valve where required by the control sequences. All valve actuators shall have integral end position indicators.
16. Actuator and valve shall be mounted and installed only in the location/orientation approved by the manufacturer. Installation drawings shall clearly indicate the valve location.
17. Actuator shall have a manual declutch lever to enable manual operation of the valve. It shall be possible for an operator to manually modulate valves located in mechanical rooms in the event of loss of power. The operator shall be able to manually modulate the valves without having to climb a ladder or other non-permanent structure. It shall be ensured that the valve installation is such that the valve cannot declutch under the influence of gravity and/or vibration.
R. DAMPERS - GENERAL

1. The BAS Contractor shall furnish automatic dampers (CD) as indicated in the Mechanical trade documents and in the Field Termination Schedules for installation by the Division 23 Mechanical Contractor.

2. The BAS Contractor shall provide actuators for all automatic dampers furnished as part of the BAS contract and for all dampers provided by the air handling unit manufacturers, unless otherwise specified. The BAS Contractor shall provide all required actuator mountings, installation, drive arms, linkages and damper end switches. The BAS Contractor shall provide electric damper actuators as specified within the BAS specifications, in the Mechanical trade documents and as detailed in the field termination schedules.

3. Multiple section two position dampers shall be controlled by one BAS output unless indicated otherwise within the Field Termination Schedules or Sequences of Operation.

4. Multiple section modulating dampers shall be controlled in sequence unless indicated otherwise within the Field Termination Schedules or Sequences of Operation.

5. Individual sections shall not be larger than 1.67 sq. m (18 square feet). Each section shall have a separate actuator. Wherever possible the use of Jackshaft extensions shall be avoided for controlling multiple damper sections. Jackshaft connection of damper sections may be permissible where required to mount damper actuators outside of the duct for applications with hazardous exhaust air flow, etc.

6. Actuators shall be mounted to allow complete access for maintenance and removal. Wherever possible provide damper actuators mounted on the exterior of the duct/damper section. The installation of actuators within air streams will be permitted only where damper configurations and site conditions require. Obtain approval for proposed installations of actuators within ductwork, plenums, airstreams, etc. Furnish access doors where required to allow access to the actuators.

7. Dampers and actuators shall be configured for normal and failure positions as indicated in the operating sequences and as indicated in the Division 23 Mechanical Drawings and Specifications.

8. The BAS Contractor shall provide actuators sized in accordance with manufacturers recommendations and industry standards for accurate and stable control of airflow in each application.

9. The BAS Contractor shall provide damper and actuator installations to comply with the acoustical requirements for the project. Noise generated from dampers and actuators in air streams shall not be detectable in occupied building spaces.

10. The BAS Contractor shall furnish manufacturers’ installation details to the Division 23 Mechanical Contractor. Provide details of all multiple section damper installations. Provide schematic diagrams for all multiple section damper installations indicating damper section dimensions, mounting configurations, linkages, actuator mounting locations, structural bracing/reinforcement, etc.

11. The BAS Contractor shall submit damper schedules that include, at minimum, the following for each damper:
   a. Associated mechanical system.
   b. Damper manufacturer and model number.
   c. Actuator manufacturer and model number.
   d. Mechanical drawing reference.
   e. Damper size for each section.
   f. Parallel or opposed blade configuration.
   g. Ratio of anticipated air stream velocity to the manufacturer’s maximum recommended velocity rating.

S. CONTROL DAMPERS (CD)

1. The BAS Contractor shall furnish CD as detailed in the mechanical drawings.

2. Modulating dampers shall be opposed blade type unless specified otherwise. Two position dampers shall be parallel or opposed blade type.

3. The maximum leakage rate for outside air isolation CD shall not exceed 30 litres per sq.
148 m. of overall damper face area at a differential pressure of 1kPa (equivalent to 6 cfm per square foot at 4 inches W.C.). The maximum leakage rate for all other CD shall not exceed 50 litres per sq. m. of overall damper face area at a differential pressure of 1kPa (equivalent to 10 cfm per square foot at 4 inches W.C.). Provide dampers tested and certified for leakage performance in accordance with AMCA Standard 500.

4. The BAS Contractor shall provide integral damper position indicator switches as required by the operating sequences and where required for interlocking to motors. Damper position switches shall be provided to indicate actual damper blade position. Damper position indication based on damper linkage position or damper drive shaft position is not acceptable.

5. Frames:
   a. 16 gauge welded galvanized steel channel, or
   b. 3.2 mm (0.125 inch) thick formed aluminum channel.
   c. Corner bracing of frames of height or width larger than 1m. (3.28 ft.).
   d. Channel dimensions shall be a minimum of 125 mm by 25 mm (5 inch by 1 inch).
   e. Constructed for flanged ductwork connection. Provide damper frames with flanges suitable for installation in interconnected ductwork or plenums.
   f. Sized to match the duct dimension including lining materials.

6. Blades:
   a. Material of construction shall be:
      I. 21 gauge galvanized steel, with four (4) breaks, or
      II. 22 gauge double galvanized sheets, with four (4) breaks in each sheet.
         Sheets shall be spot welded together, or
      III. 14 gauge airfoil shaped double skin galvanized steel, or
      IV. 16 gauge airfoil shaped double skin-extruded aluminum.
   b. 200 mm (8 inch) maximum width for galvanized steel.
   c. 150 mm (6 inch) maximum width for aluminum.
   d. 1.5 m (60 inch) maximum blade length.
   e. Replaceable edge seals made of one of the following:
      I. Neoprene.
      II. Vinyl.
      III. Polyurethane.
      IV. Silicone rubber.
      V. Synthetic elastomer.
   f. Side seals shall be one of the following:
      I. Continuous spring stainless steel strip.
      II. Synthetic elastomer.
      III. Flexible aluminum compression type.
   g. Sections shall be installed such that blades are horizontal except where specifically noted otherwise. Vertically mounted damper blades shall have suitably rated thrust bearings.

7. Axles:
   a. Materials of construction shall be:
      I. 13 mm (0.5 inch) round zinc plated steel, or
      II. 13 mm (0.5 inch) hexagonal zinc plated steel, or
   b. Axles shall be fastened to the blades with bolts through the axle, rivets or welds.
   c. Bearings shall be one of the following:
      I. Oil impregnated sintered bronze, or
      II. Stainless steel.
   d. Extend axle beyond the frame as necessary to match up with actuator.

8. Dampers shall be Ruskin, Nailor, Prefco, Siemens Building Technologies, Johnson Controls, Inc. or approved equal.
V. DAMPER ACTUATORS FOR Control Dampers (CD)

1. Unless otherwise specified the BAS Contractor shall provide electric damper actuators for all CD. Electric actuators shall meet, at minimum, the following requirements:
   
a. Stroke by the rotating motion of a reversible, overload-protected synchronous motor. Actuators shall be directly coupled to damper drive blades with no intermediate linkages or shall be rotary type actuators directly coupled to the damper drive shaft.
   
b. Protected against overload by an integral magnetic clutch or stall protection by non-overloading impedance protected motor.
   
c. 120 Vac + or - 10% 60 Hz or 24 Vac power supply.
   
d. One actuator for each damper section. Provide additional actuators to ensure sufficient torque to meet the specified close off leakage requirements. Damper actuators shall not be stacked. Multiple actuators “stacked” on a single damper drive shaft will not be accepted.
   
e. Actuators shall be motorized/driven in both the open and closed directions. Where required by the sequences of operation, actuators shall have a spring return to the de-energized position upon loss of power. Damper normal and failure positions shall be as identified within the sequences of operation.
   
f. BAS controlled actuators for modulating automatic dampers shall be controlled by a 0-10 Vdc, or 4-20mA signal. Provide actuators that are fully compatible with the BAS analog output subsystem. BAS controlled actuators for two position dampers shall be controlled by 24Vac, 24Vdc or single-phase 120 Vac power switched by the BAS.
   
g. Complete with mounting brackets suitable for extended shaft mounting or direct damper drive shaft mounting.
   
h. Stroke dampers from fully closed to fully open in accordance with the following:

<table>
<thead>
<tr>
<th>Service</th>
<th>Timing Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Two position normal service</td>
<td>75 seconds</td>
</tr>
<tr>
<td>Modulating normal service</td>
<td>120 seconds</td>
</tr>
<tr>
<td>Emergency service (stair pressurization,)</td>
<td>15 seconds</td>
</tr>
</tbody>
</table>

   i. Rated for operation at ambient temperatures of minus 40 °C. to 50 °C. (-40 ° F. to 122 ° F.).
   
j. Complete with damper/actuator stroke position indicator.
   
k. Manual drive release mechanism and manual positioning mechanism.

2. Actuators shall be quiet in operation such that noise from actuator operation is not detectable in any occupied spaces.

3. Actuators shall be Belimo, Honeywell, Nailor, Siemens Building Technologies, Johnson Controls Inc. or approved equal.

4. Motorized controls shall have a 5 year warranty.
W. DAMPER HARDWIRED INTERLOCKS

1. The BAS Contractor shall provide all required hardwired interlocks between fans, intake and discharge dampers, emergency generators, etc. and any motor actuated damper as identified within the BAS specifications or the Mechanical Drawings, whether or not furnished under this Section unless the fan is furnished with interlock by fan manufacturer.

2. The BAS Contractor shall provide all wiring as required for the control and interlocking of automatic dampers. The BAS Contractor shall provide control signal and power supply wiring between any damper monitored and/or controlled by the BAS regardless of whether the BAS Contractor has furnished the damper/actuator assembly. The BAS Contractor shall also provide power supply and control signal wiring between damper actuators and interlocked motor control circuits, thermostats, duct pressure limit switches, safeties, etc.

3. Power for air handling unit automatic control dampers shall be obtained from the associated air handling unit supply fan motor control circuit. The BAS Contractor shall coordinate actuator power supply wiring and fire alarm system override control of dampers with the Electrical Trade.

4. Where dampers are specified to be hard wire interlocked with electric fan motors the BAS Contractor shall provide the damper position switches and all required wiring and interconnection. Provide the damper end switch(s) hard wire interlocked to achieve the operational requirements as specified in the Field Termination Schedules and the sequences of operation in the BAS specifications, and as indicated in the Division 23 Drawings and Specifications. Provide damper end switches hard wire interlocked to prevent fan motor operation in both the hand and auto position of hand/off/auto motor control circuit.
4.7. **BAS Field Devices And Instrumentation**

A. This section details the minimum requirements for BAS field devices and instrumentation to be provided for SFU BAS projects. Specifications for SFU BAS projects shall detail BAS field device hardware and installation requirements.

B. The BAS specifications shall instruct the BAS Contractor to provide the field devices and all wiring, installations, interconnections, power supplies, signal conditioning equipment, field point interface equipment, etc. as required for accurate and fully functional BAS monitoring and control of the device.

C. BAS field device requirements shall be identified in the BAS project specifications. The BAS Consultant shall identify BAS monitoring and control requirements in the specifications via BAS Field Termination Schedules and BAS Systems Schematics. Individual BAS points identified in the Field Termination Schedules shall cross reference corresponding devices indicated on the associated BAS System Schematic. The BAS System Schematic and Field Termination Schedules shall be clearly titled and numbered. All required control requirements, interfaces and hard wire interlock requirements shall be identified in the Field Termination Schedules and in the BAS System Schematics.

D. All BAS components, including equipment, instrumentation, field devices, etc., shall be cUL, ULC, UL, listed, and CSA certified where applicable and shall bear the appropriate labelling. No BAS component shall be provided which contains asbestos, PBC’s, or other hazardous materials.

E. BAS Field Devices and Instrumentation shall be provided in compliance with the following minimum requirements.

1. **Temperature Sensors**
   a. Platinum or Nickel RTD type sensors.
   b. Platinum RTD type temperature sensors in compliance with the following:
      I. 100 ohm Platinum at 0 °C. (Coefficient of resistivity of 0.00385 ohms/ohm/°C.).
      II. 1000 ohm Platinum at 0 °C. (Coefficient of resistivity of 0.00385 ohms/ohm/°C.).
   c. Nickel RTD sensors shall be 1000 ohm.
   d. If the RTD is 100 ohm Pt, provide a transmitter located at the RTD.
   e. If the RTD is 1,000 ohm Pt or Nickel, provide a transmitter at the RTD:
      I. If the I/O subsystem at the UC or DCP cannot interface directly to an RTD.
      II. If the distance between the RTD and the associated UC or DCP exceeds 50m (160 feet).
   f. Transmitter output shall be 4 to 20mA proportional to temperature and shall cover a temperature range as indicated in this Section. The analog-to-analog conversion of the transmitter shall be such that the monitored temperature is reported by the BAS within the accuracy requirements detailed for the individual temperature sensors. Provide temperature transmitters as an integral component of the field mounted temperature sensor or installed at the location of the temperature sensor.
   g. The end-to-end accuracy for all BAS monitored temperature sensors shall be ± 0.5 °C.
   h. An exception to the above is that positive temperature coefficient thermistor type temperature sensors are acceptable for space temperature sensing associated with terminal units (e.g. VAV terminal units, reheat coils, etc.)
2. Provide outside air temperature sensors in compliance with the following additional requirements:
   a. Ventilated white PVC sun shield.
   b. Wall mount weather proof enclosure with conduit fitting.
   c. In compliance with requirements listed above.
   d. Operating temperature range of -50 °C. to +50 °C.

3. Provide duct temperature sensors in compliance with the following additional requirements:
   a. In compliance with requirements listed above.
   b. Single point type sensor probe. Sensor probe length shall be no less than 1/3 of duct width or diameter.
   c. Complete with duct mounting facilities and conduit fittings.
   d. Operating temperature range of 0 °C. to 65 °C.

4. Provide duct averaging type temperature sensors in compliance with the following additional requirements:
   a. In compliance with requirements listed above. Duct averaging probe materials may be stainless steel, copper or aluminum.
   b. Probe length of 3.66m (12 feet) minimum or 3.25m per sq.m. (one linear foot per square foot) of duct cross-sectional area, whichever is greater.
   c. Duct mounted moisture/waterproof housing with conduit fitting.
   d. Suitable supports at all bends and at intermediate points to prevent movement in the air stream.
   e. Operating temperature range of -5 °C. to 50 °C.

5. Provide space temperature sensors in compliance with the following additional requirements:
   a. In compliance with requirements listed above.
   b. Suitably finished wall mounted enclosure with discrete manufacturer logos and markings only. Space temperature sensors shall have displays which at minimum display current temperature and setpoint. Room temperature sensor shall also have an occupancy button which will allow the room to be placed in occupied mode for an adjustable time period.
   c. Mounted at locations approved by SFU and the BAS Design Consultant. For new construction projects the space temperature sensor locations shall be identified in the mechanical plans.
   d. Provide protective enclosures for all sensors mounted in mechanical and electrical rooms, janitor closets, etc. Enclosure to be ventilated type to ensure sensor accuracy.
   e. Operating temperature range of 0 °C. to 50 °C.
   f. Button or plate type sensors where required to suit the architectural finish is public areas.
   g. Sensors associated with UC’s for control of Terminal Units shall comply with the following:
      I. Provide limited space temperature setpoint adjustment facilities on room sensors when the sensor serves a single office or personal space.
      II. No setpoint adjustment facilities on sensors mounted in areas accessible to the public, in common office or shared areas, and for sensors that serve more than one occupied office or space.
6. Provide thermowell temperature sensors in compliance with the following additional requirements:
   a. In compliance with requirements listed above.
   b. Stainless steel probe. Probe length shall be at minimum 20% of the pipe width.
   c. Moisture/waterproof housing with conduit fitting.
   d. Provide complete with Brass or Stainless Steel thermowell.
   e. Provide complete with thermal transfer compound inside thermal well.
   f. Sensors required for the determination of temperature differential shall be matched with a maximum variation over the entire temperature range of 0.1 °C.
   g. Operating temperature range to suit application.

7. Where required, provide temperature transmitters in accordance with the requirements identified above and in compliance with the following requirements:
   a. Two or three wire RTD input as required to achieve specified performance requirements.
   b. Factory calibrated.
   c. 4-20 mA output signal.
   d. Accuracy of +/- 0.1 % of span.
   e. Complete with integral zero and span adjustment.
   f. Complete with mounting enclosure.
   g. Compatible with the analog inputs at the DCP and UC.

8. Low Temperature Detection Device (AHU Air Service)
   a. Minimum 6.1 m (20 feet) vapor tension element, which shall serpentine the inlet face on all coils. Provide additional sensors, wired in series, to provide 3.25 m per sq.m. (One linear foot per square foot) of coil surface area.
   b. Hardwire interlock device to shut down fans and position mixing dampers to the full recirculation position. Refer to sequences of operation. Provide device hardwire interlocked such that AHU fan will shut down when HOA switch is in Hand or Auto position.
   d. Setpoint shall be adjustable in the range of, at minimum, 0 °C. to 7 °C. (32 °F. to 45 °F.). Provide a scale with temperature setting clearly displayed.
   e. SPDT switch contacts. Switch contacts shall be rated for duty.
   f. Provide suitable supports.
   g. Provide complete with auxiliary contacts for monitoring by the BAS.

9. Relative Humidity Sensors
   a. Overall accuracy of +/- 3 % reading from 0 to 95 % RH unless the individual application requires higher accuracy.
   b. Operating temperature range of - 20 °C. to 80 °C.
   c. Long term stability with less than 1 % drift per year.
   d. Sensitivity of 0.5 % RH.
   e. Complete with built in transmitter for 4-20 mA output proportional to RH to the BAS. Sensor to be fully compatible with BAS.
   f. Humidity sensor shall be replaceable.
   g. Provide complete with RH sensor calibration tool and all required connection cables.

10. Provide outdoor air relative humidity sensors in compliance with the following additional requirements:
    a. Non-corroding outdoor shield to minimize wind effects and solar heating.
    b. Wall mount weather proof enclosure with conduit fitting.
11. Provide duct mount relative humidity sensors in compliance with the following additional requirements:
   a. Duct mount moisture resistant enclosure with conduit fitting.
   b. 8 inch probe length.
   c. Operating temperature range of 0 °C to 50 °C (32 °F to 122 °F).
   d. Sensor shall be suitable for operation in moving air streams as required to suit application.

12. Provide space relative humidity sensors in compliance with the following additional requirements:
   a. Suitably finished wall mounted enclosure with discrete manufacturer logos markings only. Enclosure shall not have temperature or RH indication devices.
   b. Mounted at locations approved by SFU and the BAS Design Consultant. For new construction projects the RH sensor locations shall be identified in the mechanical plans.
   c. Provide protective enclosures for all sensors mounted in mechanical and electrical rooms, janitor closets, etc. Enclosure to be ventilated type to ensure sensor accuracy.

13. Combination Relative Humidity and Temperature Sensors
   a. Where there is a requirement for the monitoring of both relative humidity and temperature at the same location, the BAS contractor may provide a combination relative humidity sensor and temperature sensor. The individual sensors must each meet the specifications detailed above.

14. Combination Dewpoint and Dry Bulb Temperature Transmitter
   a. Complete with mounting accessories and enclosures for interior or exterior wall or duct mounting.
   b. Stainless steel probe with NEMA 4 transmitter housing. Outside air sensor shall have a solar shield.
   c. Two wire, 4-20 mA output proportional to minimum dewpoint temperature range of -40 °C to +63 °C.
   d. Two wire, 4-20 mA output proportional to minimum dry bulb temperature range of -23 °C to +79 °C.
   e. Probe shall be a minimum of 200mm for duct application.
   f. BAS shall report the monitored dry bulb temperature with an accuracy of ± 0.5 °C.

15. BAS shall report the monitored dewpoint temperature with an accuracy of ± °C at 50% RH and dry bulb temperature of -25 °C to +65 °C.
   a. If it meets the above requirements, provide Honeywell HyCal model HYD840, Honeywell HyCal HYDMP2 Moisture Pro or approved equal.

16. Latching Type Control Relays
   a. Pickup rating, time and hold rating as required for individual applications.
   b. Rated for a minimum of ten (10) million mechanical operations and a minimum of 500,000 electrical operations.
   c. Provide complete isolation between the control circuit and the BAS digital output.
   d. Located in the DCP, UC or other local enclosures.
   e. Malfunction of a BAS component shall cause the controlled output to fail to the positions identified in the failure procedure.
17. Momentary Type Control Relays
   a. Coil ratings of 120 VAC, 50 mA or 10-30 VAC/VDC, 40 mA as suitable for the application. 
   b. Provide complete isolation between the control circuit and the BAS digital output.
   c. Located in the DCP, UC or other local enclosures.
   d. 10 amp contact rating.
   e. LED status indication.
   f. If it meets the above requirements, provide Core Components, Model CVR or approved equal.

18. Duct Static Pressure Transmitter
   a. Input pressure range to suit each individual application.
   b. 4-20 mA output signal proportional to pressure input range.
   c. ± 5% accuracy.
   d. Operating temperature range of -7 °C to 49 °C. (20 °F to 120 °F.)
   e. Easily accessible, integral non-interacting zero and span adjustment.
   f. Minimum over pressure input protection of five times rated input.
   g. If it meets the above requirements, provide MODUS, Model T40, Mamac series PR272, Setra or approved equal.

19. Space Static Pressure Transmitter
   a. Input range to suit application. Typically input range of -0.25 to +0.25 inches w.g.
   b. 4-20 mA output proportional to pressure input range.
   c. ± 5% accuracy of range.
   d. Temperature range of 0 °C to 38 °C. (32 °F to 100 °F.)
   e. Easily accessible, integral non-interacting zero and span adjustment.
   f. Over pressure input protection of five times rated input.
   g. Exterior static pressure references shall be monitored via a static pressure sensor dampening pot. Coordinate exact mounting locations of exterior static pressure reference points. Dampening pot shall be manufactured by Dwyer, Model A-306 or approved equal.
   h. If it meets the above requirements, provide MODUS, Model T40, Johnson Controls DPT2641, Mamac series PR272 series, Setra or approved equal.

20. Air Flowrate Sensor - Duct Mounted
   a. Multipoint flow cross or grid measuring device.
   b. Complete with transducer. Input pressure range of pressure transducer shall be appropriate for application. Coordinate with Division 23 Contractor.
   c. Bulkhead fittings to allow sensor tubing to be connected or removed without removing ductwork.
   d. Internal materials of the transducer suitable for continuous contact with air.
   e. Sensing grid shall be constructed of stainless steel.
   f. Integral signal integrator to minimize primary signal noise from the output signal.
   g. Output signal of 4-20 mA proportional to input pressure.
   h. Temperature range of -18 °C to 60 °C. (0 °F to 140 °F.)
   i. ± 5% accuracy of measured value.
j. Transducer to be provided complete with easily accessible, integral non-interacting zero and span adjustment.

21. Air Flowrate Sensor - Fan Inlet
   a. Multipoint flow cross or grid measuring device mounted at the inlet of the fan.
   b. Complete with transducer. Input range appropriate to application. Coordinate with Division 23 Contractor.
   c. Bulkhead fittings to allow sensor tubing to be connected or removed without removing the device from the fan.
   d. Internal materials of the transducer suitable for continuous contact with air.
   e. Sensing grid shall be constructed of stainless steel.
   f. Integral signal integrator to minimize primary signal noise from the output signal.
   g. Output signal of 4-20 mA proportional to input pressure.
   h. Temperature range of -18 °C. to 60 °C. (0 °F. to 140 °F.)
   i. Combined sensor and transducer accuracy of ± 3% of measured value.
   j. Transducer to be provided complete with easily accessible, integral non-interacting zero and span adjustment.

22. Current Sensing Transformer and Relay Combination - Electric Motor Status Monitoring Service
   a. Rated for the applicable load.
   b. SPDT Status Indication relay contacts. Status indication relay shall have an accessible trip adjustment over its complete operating range. Provide LED indication of relay status.
   c. Long term drift shall not exceed 5% of full range per 6 months.
   d. Current transformer and relay shall have over current and over voltage protection. Transformer and relay may be combined into a single unit or can be separate units.
   e. Transformer core shall be sized for the application.
   f. Accuracy-± 2% of reading from 10% to 100% of full scale range, ± 2% full scale from 0 to 10% of full scale range.
   g. Temperature range of -15 °C. to 60 °C. (5 °F. to 140 °F.).
   h. If it meets the above requirements, provide Hawkeye, Kele and Associates model (S)CS1150A, Electromatic SM115, Cymatic 850 Series or approved equal.
   i. Relay portion shall not be installed in within the MCC tubs. Relay portion shall be installed in local field panel enclosure, in the DCP/UC enclosure, or in the wiring channel between MCC tubs. Provide device securely mounted with screw type wire terminations. Device shall be mounted for easy access.

23. Water Differential Pressure Sensor
   a. Cast aluminum NEMA 1 enclosure.
   b. Complete with transducer with output of 4-20 mA proportional to the pressure sensed.
   c. Over pressure protection of five times the rated input.
   d. Easily accessible, integral non-interacting zero and span adjustment.
   e. Operating range to suit application.
   f. Accuracy of ± 2% of full scale reading.
   g. Valved tappings shall be installed by the Division 23 Contractor. Furnish the valves to the Division 23 Contractor. Provide differential pressure transducer installation complete with a 3-valve manifold mounted within a suitable enclosure. Installation shall allow the transducer to be isolated for service.
   h. If it meets the above requirements, provide Setra, Model 228-1, Veris Industries
Alta Labs PW series, Mamac series PR-282, modus or approved equal.

24. Differential Pressure Switch - Air Service - Duct Static Pressure Limit Devices
   a. UL, cUL, CSA listed and approved.
   b. SPDT or two SPST switches rated for 10 amps minimum at 120 Vac.
   c. Adjustable setpoint with a setpoint range to suit the application.
   d. 1/4 inch compression fittings suitable for copper sensing tubing.
   e. Temperature range of -18 °C. to 71 °C. (0 °F. to 160 °F.).
   g. Provide sensing inputs complete with signal dampening facilities to prevent nuisance tripping where required.
   h. If it meets the above requirements, provide Kele Model AFS-460, Dwyer, or approved equal.

25. Differential Pressure Switch - Air Service - Filter Status Indication
   a. UL, cUL, CSA listed and approved.
   b. SPDT or two SPST switches rated for 10 amps minimum at 120 Vac.
   c. Adjustable setpoint with a setpoint range to suit the application.
   d. 1/4 inch compression fittings suitable for copper sensing tubing.
   e. Operating range to suit application.
   f. Automatic reset
   g. If it meets the above requirements, provide devices as manufactured by Cleveland Controls, Inc. (Model AFS-222) Dwyer, or approved equal.

26. Differential Pressure Switch - Water Service
   a. UL, cUL, CSA listed and approved.
   b. SPDT or two SPST switches rated for 10 amps minimum at 120 Vac.
   c. Adjustable setpoint with a setpoint range to suit the application.
   d. 1/4 inch compression fittings suitable for copper sensing tubing.
   e. Operating temperature and pressure range to suit application.
   f. Durable Nema 4 rated enclosure.
   g. Provide sensing inputs complete with signal dampening facilities to prevent nuisance tripping where required.
   h. Suitable for continuous contact with the sensed fluid and rated for operating temperature.
   i. Repeatability of +/- 1% of span.
   j. Over pressure input protection to a minimum of five (5) times rated input.
   k. If it meets the above requirements, provide devices as manufactured by Dwyer, Penn, Delta-Pro or approved equal.

27. Water Pressure Sensor
   a. Input range of 0 to 200 psi.
   b. Complete with transducer with 4-20 mA output signal proportional to water pressure.
   c. 0.5% accuracy over entire sensing range.
   d. Temperature range of 0 °C. to 38 °C. (32 °F to 100 °F.).
   e. Transducer with easily accessible, integral non-interacting zero and span adjustment.
   f. Over pressure input protection of two times rated input.
   g. NEMA-4 rated fittings.
   h. Stainless steel wetted parts.
   i. Burst pressure of 5 times rated input
   j. Long-term stability of .25 percent of full scale.
k. If it meets the above requirements, provide Precise Sensor, Fisher/Rosemount, or approved equal.
l. Stainless Steel wetted parts suitable for continuous contact with the sensed medium.

28. Liquid Level Float Switch
   a. Polypropylene float, PVC cable, hermetically sealed mercury switch.
   b. 13 amp running current @ 120 VAC, 11 amp current @ 240 VAC.
   c. SPDT switch contacts. Switch contacts shall be selected to suit required sensing/control action.
   d. Operating temperature of 0 °C to 71 °C (32 °F to 160 °F).
   e. Operating pressure of 26 psi.
   f. If it meets the above requirements, provide MagneTek, 7010 Series, Scientific Technologies product or W.E. Anderson product, or approved equal.

29. Liquid Level Controller
   b. Type E-4 holder with rod electrodes.
   c. Pressure tight.
   d. Temperature range of 93 °C to 232 °C (200 °F to 450 °F).
   e. Pressure range of 2000 psi @ 93 °C (200 °F), and 400 psi @ 232 °C (450 °F).
   f. Provide suitable stilling well as required.
   g. If it meets the above requirements, provide MagneTek, 6012 Series or approved equal.

30. Continuous Liquid Level Sensor (Float Type)
   a. Corrosion resistant, 316 stainless steel.
   b. Solid state float actuated sensor.
   c. Complete with transducer with 4 to 20 mA signal output proportional to sensed level.
   d. Temperature range of 32 °F to 125 °F.
   e. Pressure range of 0 to 500 psia.
   f. If it meets the above requirements, provide MagneTek, 7025 Series, product or approved equal.

31. Air Quality Sensor
   a. Measurement of volatile organic compounds (VOC) containing, at minimum, the following gases:
      I. Methane
      II. Ethylene
      III. Hydrogen
      IV. Carbon Monoxide
      V. Carbon Dioxide
      VI. Ammonia
   b. Ventilated cover, Circuit board covered by a polycarbonate housing.
   c. 135 mA max current, 4 K OHMS min. load resistance, 24 VAC + 10%-50% or 24DC. (Min. 12V, Max 24V) power supply.
   d. Rate or rise circuit to filter out short term disturbances and provide a stable output.
   e. Temperature range of 0 °C to 60 °C (32 °F to 140 °F).
   f. Mounting and enclosure suitable for duct air or space air monitoring as
specified.
g. If it meets the above requirements, provide G-Controls, Model AQS/D or approved equal.

32. Carbon Dioxide Sensor
   a. Negligible temperature and humidity effect on accuracy.
   b. Complete with transducer with selectable 4-20 mA or 0-10 VDC output signal proportional to carbon dioxide concentration.
   c. 0 - 2000 ppm CO₂ sensing range.
   d. Manufacturer 5 year or longer calibration interval guarantee.
   e. Accuracy: ± 3% of reading or ± 50 ppm, whichever is the more stringent requirement over 15 °C to 32 °C temperature range. Accuracy of +/- 5 % or 100 ppm of reading whichever is the more stringent requirement over 0 °C to 50 °C temperature range.
   f. Annual Drift not to exceed +/- 10 ppm.
   g. Operating temperature of 0 °C to 50 °C.
   h. Complete with auxiliary relay contacts for alarm indication.
   i. For space monitoring applications provide with a white enclosure with no manufacturer Logo or LED indication. Provide complete with blank display cover.
   j. For duct sensing applications provide sensor complete with aspiration box and air stream sensor.
   k. If it meets the above requirements, provide Engelhard 8000 Series or approved equal.
   l. Nondispersive Infrared technology based sensor.

33. Damper Position Switch
   a. Mechanically actuated electrical switch.
   b. Provide damper end switch which indicates actual damper blade position. Damper position switches which are actuated by damper crankshaft or actuator position will not be accepted.
   c. Contacts shall be rated for the electrical load to be switched. Provide auxiliary contacts as required.

F. Install sensors in accordance with the manufacturers’ recommendations to sense the variables specified.

G. Mount sensors securely. Mountings shall be suitable for the environment within which the sensor operates.

H. Install sensors as required to properly sense the controlled medium. Sensor locations shall be such that access to the instruments can be obtained for service and removal.

I. Sensors mounted on water lines shall have isolation valves that shall enable the sensor to be easily removed without the need to drain any lines or portions of lines.
5 BAS SOFTWARE, DATABASE AND PROGRAMMING REQUIREMENTS

5.1 General

A. The BAS NDS shall be provided complete with fully functional, advanced, BAS Application Software and Database facilities in compliance with the SFU requirements. The building BAS Contractor shall provide all required programming, database development, and data communication configuration work required to incorporate new campus building BAS installations.

5.2 System Requirements

A. The NDS computer shall provide the capabilities for automatically archiving controller programming and database, receiving and archiving all operator transactions, trending and archiving of defined BAS data, etc.

B. The NDS and associated application specific BAS Software shall be provided with programming and configuration facilities to allow BAS operators to undertake BAS administration functions including the following:

1. Add/delete/modify data points and input/output points.
2. Configure controller data communications.
3. Add or modify automatic sequence of operations programs, database, etc.
4. Change control system data parameters.
5. Modify setpoints, etc.
6. Restore/download programming and database parameters to BAS controllers.

C. BAS installations shall be provided in a completed state fully ready for integration to the CBAS including all data point definition, addressing, naming, network configuration/connection, documentation, commissioning and training.

D. The BAS Contractor shall include, at minimum, two days of work in the BAS installation to work with the CBAS Contractor for the integration of the BAS into the CBAS beyond any time required to make all system data available at the CCP connection to the WAN. The building BAS designer shall assess each installation and specify additional scope of work and time requirements for the BAS Contractor integration work required based on project size and complexity.

E. BAS installations shall be in compliance with the following requirements and shall provide the following functionality:

1. All BAS and CBAS controllers and operator interface workstations shall be devices that are conformal with the BACnet standardized device types described in Annex L of the current ASHRAE Standard 135. BAS devices shall, at minimum, support the BIBB’s (defined in Annex K of ASHRAE Standard 135) and the associated functionality that are defined as a functional requirement for the device in Annex L of the ASHRAE Standard 135.
2. All BAS controllers, regardless of their device type, shall communicate on the BAS and CBAS networks and shall be “visible” to the CBAS and BAS networks.
3. BAS data shall comply with the BACnet data object property requirements and, at minimum, shall support the properties defined in ASHRAE Standard 135 as “required”.
4. All physical BAS monitored input points (binary and analog type) shall be readable and available for monitoring at the CBAS and by other BAS controllers.
5. All physical BAS controlled output points (binary and analog type) shall be readable and available for monitoring at the CBAS and by other BAS controllers and shall be writeable and shall be capable of being controlled/positioned by the CBAS and by other BAS controllers.
6. All software data points and control system parameters critical to the supervisory monitoring and control of the building systems shall be available for monitoring at the CBAS and by other BAS controllers and/or shall be writeable and shall be capable of being controlled/positioned by the CBAS and by other BAS controllers. Provide the following typical software data points and control parameters with the defined functionality, at minimum.

F. The BAS Specifications shall identify additional points and functionality where required.

1. System enable virtual points.
2. Virtual or “logical” software points.
3. Equipment and System operation Calendar/Time Schedule points and parameters.
5. Post Power Failure System Enable/Disable points.
6. Control loop setpoints and PID loop values.
7. Alarm setpoints and alarm limit parameters.
8. Define and modify alarm states and alarm limit threshold values for any monitored analog and digital input points and for analog output values.

G. Modification of the controlled output points shall be via operator interface at the CBAS dynamic graphical interface facilities and shall not require BAS manufacturer proprietary software or special configuration software files.

H. Performance times shall be as follows:

1. Data values updated in dynamic report or graphical display reports within maximum interval of 5 seconds.
2. Defined high priority or critical alarms annunciacted within 3 seconds of its sensed occurrence.
3. CBAS Operator command outputs and data point modifications shall be executed within 5 seconds of the command initiation at the CBAS workstation or other remote BAS device.
4. Failed BAS/CBAS data communications or controller device on the Management Data Communications Level or the Automation Data Communications Level within ten (10) seconds.

I. All BAS standard and proprietary data objects from any BAS connected device shall be available for monitoring on the BAS and CBAS. Values for all BACnet defined required property values, supported optional properties and proprietary properties shall be available to the BAS and CBAS for monitoring and display and control where applicable.

J. The BAS Specifications for each building BAS project shall specify the requirement for the BAS Contractor/Manufacturer to provide all hardware and software required for the CBAS to communicate with the BAS via BACnet IP on the SFU campus WAN. Facilities to be provided shall include any manufacturer specific software tools required for programming, point mapping, configuration, etc. of building BAS data points.

K. Trending: The BAS contractor shall setup and configure system trending as follows:

1. In general, all DDC system points shall be trended and each trend log point shall be minimum 200 samples. Trend logs shall be set up to meet the following requirements:
a. Storage:
   I. Trend log sample frequency shall be setup to have the trend log information display meaningful data that can be used to Trend logs must reside in the controller of the points being trended.
   II. All trend logs shall be archived to the trend archival system.

b. Sample Frequency:
   I. Sample frequencies shall be configured to gather meaningful data required to analyze system performance, confirm loop tuning, and aid system troubleshooting.
   II. Control points and loops that have a slow dynamic response shall have lower sample frequencies (E.g.: outdoor air temperature, radiant slab heating, etc.).
   III. Control points and loops that have a faster dynamic response shall have higher sample frequencies (E.g.: mixed air temperature, water differential pressure, etc.).
   IV. Trend logs used to verify loop tuning shall be set at the fastest possible sample frequency for the duration of the loop tuning interval.
   V. Loop tuning trend logs shall have a high enough sample frequency to accurately describe the loop response to rapid changes in set point or input variables.
   VI. The trend logs shall be archived and the trend sample frequency set to an interval used for day-to-day operation.

2. Trended Points:
   a. All physical input and out points.
   b. All setpoint values (this is to include loop setpoints, high and low limit setpoints, and all room setpoints).

3. Trend Log Grouping:
   a. Trend logs shall be grouped to display the performance of the various control loops required to control the system.
   b. Trend groups shall be accessible directly from the graphics.
   c. Trend logs shall contain all input variable, all controlled variables, and all setpoint for the system being trended. For example:
      I. A terminal reheat room temperature control trend would contain the following points:
         i. Room Temperature
         ii. Active Room Setpoint
         iii. Occupancy Status
         iv. Heating Valve Output
      II. Where a system is too complex to display all of the required trend variables in one trend log, the system will be broken down to its functional components and each component shall be trended. For example, a zone being controlled by variable air volume boxes with terminal reheat, CO2, and occupancy would need more than one trend log.
         i. Trend Log A would contain the variable associated with the heating component:
            ♦ Room Temperature
            ♦ Active Room Setpoint
            ♦ Occupancy Status
            ♦ Heating Valve Output
            ♦ Primary Air Supply Temperature
            ♦ VAV supply air temperature (downstream of the reheat coil)
            ♦ VAV Supply Air Volume
            ♦ VAV Damper Position
         ii. Trend Log B would contain variables associated with the ventilation component:
            ♦ CO2 Level
            ♦ Active CO2 setpoint
4. Where variable trends are repeated in each functional component of the system, repeat the trending in each trend log to ensure that the trend log is clear and complete, (E.g.: occupancy status, VAV Supply Air Volume, VAV Damper Position are repeated in the above example).

L. Data Archiving: The BAS contractor shall install, configure and program the DAU. The DAU shall be configured as follows:
   1. Every physical point shall be archived,
   2. Every software variable that is used for day to day operations shall be archived,
   3. The archival time period shall be set for five (5) years.
      a. The DUA device or system shall automatically prune all data that has aged beyond the five year time limit.
   4. All alarms shall be archived. Alarms shall be archived to include the following information:
      a. All alarms shall include the following identification;
         DCC Network Descriptor acronym
      b. Expanded DDC Network Descriptor,
      c. Date
      d. Time
      e. Point Name
      f. Expanded Point Descriptor
      g. Alarm Type (e.g.: Operating, Maintenance, Critical, Emergency, etc.)
      h. Alarm Status
         i. Automatic Control Priority (Overridden Value, Automatic Control, Disabled, failed, etc.)
      j. Actual point monitored input / controlled output value.
      k. Alarm Setpoint
      l. Alarm Message.

5.3. SOFTWARE

A. An operator with BAS configuration software shall be able to define a minimum time delay between successive starts of equipment so that disturbances created on the building electrical system are minimized in frequency and amplitude.

B. An operator with BAS configuration software shall be able to define the minimum time delay between the stopping of a piece of equipment and its subsequent restart. This time delay shall be in effect for motors in the BAS software control mode and for motors in the BAS manual control mode.

C. The BAS shall not override any hardwired interlocks such as those provided at motor starters for overload protection, damper interlock, pressure interlock, etc. and those provided to facilitate control by the Fire Alarm System regardless of the BAS output control mode.

D. Unless stated to the contrary, the modulation of final control elements by the BAS in the BAS software control mode shall be based on a Proportional-Integral (PI) or Proportional-Integral-Derivative (PID) control algorithm. The control constants for the PID algorithm shall be definable by the operator. If self-tuning algorithms are provided, it shall still be possible for the operator to manually tune the control loops. The software shall incorporate facilities to enable the bumpless transfer of a modulating output from BAS manual control to BAS software control and vice versa and the prevention of integral wind-up. PID algorithms shall maintain the system operation within the desired tolerance around the setpoint.
E. Provide dynamic graphical trending software at the CBAS that emulates, at minimum, a three point strip chart recorder. This program shall concurrently display three or more plots of variables in a graphical format. The graphs shall be plotted as the values are sampled in a similar fashion to a chart recorder and when the plot reaches the right hand side of the X-axis, the X-axis shall scroll to the left so as to accommodate newly sampled data.

F. Provide an energy monitoring software facility in both the CBAS and BAS NDS to monitor and report electrical energy usage and instantaneous energy demand. This feature shall also store data for recall via the historical data trend package.

G. Provide run time totalizing software facilities at both the CBAS and BAS NDS that will accumulate the operating times for motors and unitary equipment as selected by the operator using an interactive procedure. Any piece of equipment that has its status monitored by the BAS shall be selectable for inclusion in this feature. It shall be possible to concurrently monitor the accumulated operating time for every item of equipment monitored and/or controlled by the BAS. Historical trend data shall be stored in a non-proprietary database such as Microsoft SQL Server in the BAS NDS.

H. Provide demand limiting and duty cycle programs that will duty cycle equipment usage in a manner that conserves energy. The cycling of equipment shall be initiated by one of the following means:
   1. Operator defined schedule.
   2. Peak electric demand control software program.

I. The proportion of ON time to OFF time in a single cycle shall either be assigned by the operator using an interactive procedure or the operator may elect to have a variable ON/OFF ratio based on other criteria.

J. Provide a scheduling program that will enable the BAS to automatically schedule an item of equipment on and off (occupied) and on and off (unoccupied) based on time to allow, for example, the AHU to operate with the outside air dampers closed during non-occupied time periods, etc. The operator shall be able to assign a minimum of four start and four stop times to each piece of equipment for each day of the week and for holidays. These schedules shall only be in effect for a piece of equipment when it is in the BAS software control mode. Equipment and space time occupancy time schedules shall be available for display and operator adjustable via the CBAS. The scheduling feature shall conform to the CBAS scheduling interface.

K. Provide equipment fail restart software that will restart equipment shut down as the result of a fire alarm system following the return to normal conditions or a power fail condition.

L. Provide a night setback software program that shall:
   1. Start HVAC equipment after normal hours of scheduled operation to maintain building after hour setpoints, while reducing energy consumption.
   2. Night setback temperatures for heating shall be initially set at 13 °C to activate the heating equipment and 15.5 °C to stop the heating equipment. Once activated, the units involved shall operate as specified in the respective sequence of operation.

M. Coordinate the operation of this program with the requirements for terminal unit controls.
   1. Night setup temperatures for cooling shall be initially set at 32 °C to activate the cooling equipment and 29 °C to stop the cooling equipment. Once activated, the units involved shall operate as specified in the respective sequence of operation. Coordinate the operation of this program with the requirements for terminal unit controls.
   2. This feature shall be provided for all HVAC equipment under control of the BAS. The operator shall be able to enable/disable this function on a unit by unit basis.

N. Provide facilities for alarm notification via both the building BAS NDS and the CBAS via e-mail messaging, wireless text messaging and SNMP.
### 5.4. SFU BAS POINT NAMING CONVENTIONS REQUIREMENTS

A. All point naming conventions shall be reviewed and accepted by the SFU Facilities prior to be implemented.

B. Each point name shall consist of the following components:
   1. Abbreviated building name
   2. Equipment type as per table below.

<table>
<thead>
<tr>
<th>System</th>
<th>Point</th>
<th>Function</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>VAV</td>
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<td></td>
<td>Variable Air Volume System</td>
</tr>
<tr>
<td>AHU</td>
<td></td>
<td></td>
<td>Air Handling Unit</td>
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<tr>
<td>BLR</td>
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<td>Boiler System</td>
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<td>Heating System</td>
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<td></td>
<td>Preheat Coil Valve</td>
</tr>
<tr>
<td>DX</td>
<td></td>
<td></td>
<td>Direct Expansion Valve</td>
</tr>
<tr>
<td>CCP</td>
<td></td>
<td></td>
<td>Cooling Coil Pump</td>
</tr>
<tr>
<td>HCP</td>
<td></td>
<td></td>
<td>Heating Coil Pump</td>
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<tr>
<td>PCP</td>
<td></td>
<td></td>
<td>Preheat Coil Pump</td>
</tr>
<tr>
<td>ECP</td>
<td></td>
<td></td>
<td>Evaporative Cooling Pump</td>
</tr>
<tr>
<td>System</td>
<td>Point</td>
<td>Function</td>
<td>Description</td>
</tr>
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<tr>
<td>FRZ</td>
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<td>Room Temperature</td>
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<td>Status</td>
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<td>MODE</td>
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<td>PG</td>
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<td>Program</td>
<td></td>
</tr>
<tr>
<td>AL</td>
<td></td>
<td>Alarm</td>
<td></td>
</tr>
</tbody>
</table>

3. Number of instance.

5.5. **SFU BAS CONTROLLER AND DEVICE ADDRESSING AND NAMING CONVENTION REQUIREMENTS**

A. All IP addresses are to be provided by SFU personnel once the necessary IT infrastructure is in place.
   1. In the event of new building construction this infrastructure will not be in place until the building is near completion.

B. BACnet device addressing is to be managed by the controls contractor and should be coordinated with SFU Facilities.

C. SFU personnel are to provide BACnet device addresses for devices outside of the assigned vendor address ranges.

D. SFU personnel must be provided any necessary tools to change the BACnet device address on any devices installed.
6 CBAS SOFTWARE, DATABASE AND PROGRAMMING REQUIREMENTS

6.1. INTEGRATION OF STANDALONE BUILDING BAS INTO THE CAMPUS BAS

A. The CBAS Contractor shall provide the mapping, storage, and reporting of the building BAS monitoring and control objects into the CBAS and the preparation of data presentation for the CBAS Management Level Network. Two separate CBAS system are currently in place, Delta Controls System and Andover system. The BAS Contractor shall provide to the Owner and to the CBAS Contractor, all necessary documentation, BIBB information, device addressing, etc. as required for the integration of the BAS monitoring and control functions into the corresponding CBAS.

B. The CBAS Contractor shall integrate all trend logging and trend log archiving set up in the building BAS into the CBAS.

6.2. ALARM MANAGEMENT AND ANNUNCIATION

A. Alarms shall be generated by the BAS and shall be annunciated at the CBAS upon the occurrence of one of the following events:

1. Failure of a CCP, DCP, UC, or any other BAS hardware components.
2. Failure of communications or devices on the Automation Level Network.
3. A monitored status indicates a discrepancy between the actual and the required value.
4. A monitored value does not meet criteria established by the operator.
5. The deviation of a variable from setpoint exceeds operator established criteria.
6. The output to a final control element is outside operator established criteria.
7. A digital input is in the state defined by the operator as indicating an alarm condition.
8. Software failures and errors shall be diagnosed and annunciated by the BAS.

B. Provide configuration of alarming for all monitored and controlled points. BAS Specifications shall detail all required alarm states, values and limits.

C. BAS alarms shall be assigned priority levels as follows:

1. Critical Alarms:
   These alarms are assigned by 2 criteria: 1) alarm leads to dangers and/or life threatening conditions. 2) occupants specify they want to be notified immediately when a certain alarm condition occurs. The following list is not all inclusive but lists the typical critical alarms.

   a. Natural gas alarm
   b. Freon gas alarm
   c. Carbon monoxide alarm
   d. Hydrogen sulfide alarm
   e. Exhaust fan pressure failure
   f. Fume hood exhaust fan failure
   g. Cooling unit failure serving critical area (server room, refrigeration etc.)
   h. High temperature water in mechanical systems
   i. Freezing of water lines

2. Non-critical alarms
   Remaining alarms are non-critical alarms.

D. Defined BAS alarm events shall be communicated by the BAS to the CBAS. Defined alarms shall be annunciated at the CBAS workstation. Alarms shall be retained in the CBAS alarm summary.
E. All alarms shall include the following identification:

1. DCC Network Descriptor acronym
2. Expanded DDC Network Descriptor,
3. Date
4. Time
5. Point Name
6. Expanded Point Descriptor
7. Alarm Type (e.g.: Operating, Maintenance, Critical, Emergency, etc.)
8. Alarm Status
9. Automatic Control Priority (Overridden Value, Automatic Control, Disabled, failed, etc.)
10. Actual point monitored input / controlled output value.
11. Alarm Setpoint

F. The alarm log shall have the capability to be sorted or filtered on any or all of the following values:

1. DCC Network Descriptor acronym
2. Alarm Message.
3. Time
4. Date
5. Point Name
6. Alarm Type (e.g.: Operating, Maintenance, Critical, Emergency, etc.)
7. Automatic Control Priority (Overridden Value, Automatic Control, Disabled, failed, etc.)
8. Alarm Status

6.3. CBAS/BAS ALARM HANDLING ARCHIVING REQUIREMENTS

A. The CBAS shall allow access of BAS alarms related to each system (Delta or Andover).

B. The CBAS shall maintain a historical alarm log that encompasses all alarms for a predefined period.

C. The historical alarm log shall be searchable and have the capability to be sorted or filtered on any or all of the following values:

1. DCC Network Descriptor acronym
2. Alarm Message.
3. Time
4. Date
5. Point Name
6. Alarm Type (e.g.: Operating, Maintenance, Critical, Emergency, etc.)
7. Automatic Control Priority (Overridden Value, Automatic Control, Disabled, failed, etc.)
8. Alarm Status

D. The database sorting and filtering keys shall be a minimum of three levels deep.

6.4. TESTING AND COMMISSIONING REQUIREMENTS

A. Integrated BAS/CBAS joint systems tests shall be undertaken to demonstrate that the interaction between the individual building BAS and the CBAS meets the SFU requirements. The BAS Contractor shall participate in joint verification of the integrated systems and cooperate with the Owner in the demonstration of the integrated systems.

B. The BAS Specifications shall specify the requirements for the BAS/CBAS integration joint systems verification in the BAS and CBAS Specifications and/or Contract Documents. The BAS/CBAS Integrated System Verification shall include the following minimum requirements:
1. Test all BAS monitored and controlled field devices, BAS data points and all BAS input and output points. CBAS monitored data point values shall be verified against actual field device position/state and compared to BAS values to ensure both BAS and CBAS values are the same.

2. CBAS override control of all BAS output points and control data points shall be verified.

3. BAS network and controller device status and data communications status are accurately monitored at the CMBS. Alarms for failed controllers and failed data communications are annunciated.

4. BAS data values displayed on dynamic system graphics or in tabular data format at the CBAS are functional and accurate.

5. CBAS operator control of BAS control output points and control data points is functional via the dynamic graphic interface.

6. CBAS facilities for operator adjustment of alarm definition parameters and thresholds, setpoint adjustment, control parameter adjustments, point trend initiation and modification to trends, etc. are fully functional.

7. The CBAS performance requirements for the monitoring and control of BAS data and field devices meet the SFU requirements.

8. BAS device addressing and identification definitions are compatible and identical and the addressing scheme meets with SFU requirements.

9. Point naming used is compatible and conformal with the SFU requirements.

C. Test results shall be documented using test sheets. The test sheets shall be prepared in an appropriate format for the various categories of component and system to be tested. It is the responsibility of the BAS Contractor to provide test verification sheets for each component and system that accurately reflect the sequences of operation and appropriate data for the components and systems.

D. All test documentation shall be maintained in electronic format and in hard copy.
7 GUIDELINES FOR APPLICATION OF BAS TO TYPICAL HVAC SYSTEMS

7.1. BAS Sequences of Operation, Field Termination Schedules, and System Schematic Diagrams

A. This section of the SFU BAS Design Guidelines identifies BAS monitoring and control requirements for typical building HVAC Systems and includes "sequences of operation" for typical building systems. BAS design specifications for all SFU BAS projects shall include BAS Sequences of Operation detailing the BAS monitoring and automatic control logic programming requirements. BAS Sequences of Operation to be provided in BAS Design Specifications shall be in the same format as the sequences of operation identified within these guidelines.

B. BAS Design Specifications for SFU BAS projects shall detail BAS monitoring and control requirements in Field Termination Schedules and System Schematic Diagrams. Field Termination Schedules and System Schematic Diagrams shall be provided for all BAS monitored and controlled equipment and systems. The Field Termination Schedules and System Schematics shall be provided for each building system and logical group of monitored and controlled equipment. The Field Termination Schedules and System Schematics shall clearly identify BAS monitoring and control requirements and shall be labelled and cross reference the associated sequences of operation. Examples of Field Termination Schedules and System Schematic Diagrams are included in Appendix A1 of these guidelines. Field Termination Schedules and System Schematic Diagrams provided in SFU project BAS Design Specifications shall be based on the same format as indicated within these documents.

C. Sequences of Operation for typical SFU building HVAC systems are identified within this section. Refer to Appendix A1 of these guidelines for the associated building system Field Termination Schedule and System Schematic Diagrams.

D. BAS automatic control of building systems and equipment shall not override life safety or equipment protection overrides. The BAS Design Consultant shall specify automatic control interface requirements.

7.2. BAS Component and Building Equipment Failure Requirements

A. The BAS Design Specifications shall clearly specify building system/equipment control requirements in the event of failure of BAS components and in the event of failure of building equipment. The following are general minimum component/equipment failure requirements.

B. DCP/UC Controller Failure
   a. associated BAS controlled electric motors/equipment off.
   b. AHU mixing dampers to full recirculation position.
   c. steam control valves closed.
   d. hot water control valves open.
   e. cooling coil control valves closed.
   f. fan/pump speeds set to minimum position.
   g. fan/pump volume flow rate control devices (e.g. inlet vanes, etc.) set to no-load position.
   h. isolation dampers closed.
   i. exhaust dampers and outside air dampers closed.

   1. BAS Analog Input Sensor Failure
      a. Associated BAS control output retained in last commanded state. If an alternative sensor can be utilized for satisfactory control the BAS shall incorporate automatic control logic to implement the revised control.
      b. Failure of information only type BAS input points shall be annunciated alarms.
2. Controlled Electric Motor/ Equipment Failure
   a. Anytime the status of BAS controlled equipment is different than the associated BAS controlled output status the equipment shall be considered as “failed” and shall be shut down by the BAS. The associated BAS controlled system shall also be shut down. **Project Design Specifications shall specify the post failure equipment restart requirements.**
   b. Where building systems/equipment are shut down by the by the fire alarm system in an alarm condition or are shut down as the result of a building power failure, the BAS shall restart the failed equipment/systems in an orderly and pre-defined manner following **the cleaning of the Fire Alarm or return to normal power.** The BAS Design Specifications shall specify the post fire alarm equipment restart and the post power failure equipment restart requirements.
   c. All BAS component failures shall be annunciated as an alarm at the defined BAS main central computer facility.

3. If a BAS controlled motor or equipment fails to start as defined in the sequences of operation, the failure shall be annunciated as an alarm and the associated system shut down.

7.3. BAS Automatic Sequenced Control of AHU Mixing Dampers and Valves
   A. Designated air handling units require the BAS to control heating and cooling coil control valves and mixing dampers in sequence. BAS facilities shall be provided as follows for air handling units with sequenced control of the heating coil valves, cooling coil valves, and the mixing dampers:
      
      1. The mixing dampers (return air, outside air and exhaust air (where applicable)) shall be modulated in unison to maintain the supply air temperature setpoint. If the supply air temperature setpoint cannot be maintained then the heating coil control valve or the cooling coil control valve shall be modulated in sequence with the mixing dampers to maintain the supply air temperature setpoint. If heating is required the dampers shall be in the minimum outside air position and the heating coil control valve shall be modulated to maintain the supply air temperature setpoint. If cooling is required and the outside air temperature is less than the return air temperature and greater than the supply air temperature setpoint, the outside air dampers shall be fully open and the chilled water cooling coil valve shall be modulated to maintain the supply air temperature. When the outside air temperature is greater than the supply air temperature setpoint and greater than the return air temperature the mixing damper shall be in the minimum outside air position and the chilled water cooling coil control valve shall be modulated to maintain the supply air temperature. When the outside air temperature is less than the supply air temperature setpoint and greater than the return air temperature the mixing damper shall be overriden when necessary to satisfy minimum outside air requirements.

7.4. General BAS Monitoring and Control Requirements
   A. All BAS alarm limit values and setpoints shall be on-line adjustable by a BAS Operator with the appropriate password access level.
   B. All BAS Operator monitoring and control functions shall be provided with the appropriate password access control.
C. A single BAS software control point shall be provided for each BAS controlled system to enable/disable automatic start-up and control of the entire system. BAS controlled systems shall be capable of being started/stopped either by automatic BAS control or via online Operator command.

7.5. Post Fire Alarm Equipment Restart

A. Fire Alarm Systems in buildings will override BAS control of designated equipment in an alarm condition. The BAS shall monitor a set of contacts output from the fire alarm system for status indication of a building fire alarm. The BAS Controls Contractor shall coordinate building equipment that is shut down by the Fire Alarm System.

B. Upon detection of air handling unit shutdown the BAS shall close associated valves and stop associated pumps.

C. Alarms shall be annunciated by the BAS to indicate the equipment failure/shut down and the building fire alarm condition. The BAS shall not annunciate nuisance alarms for monitored input points on systems shut down by the BAS or fire alarm system (e.g. high supply air temperature, low duct static pressure, etc.).

D. Equipment shut down by the fire alarm system will be completed through hardwired connections. The BAS will automatically start equipment once fire alarm is cleared – all buildings monitor status of fire alarm signal sent to BAS.

E. The restart sequence shall provide an orderly start-up of the motors for each individual system with time delay between restarts of individual systems. Start of systems shall be according to normal system start up sequences. Only those motors which should be operational in accordance with the Occupancy Schedule or application software programming requirements shall be restarted.

7.6. Post Building Power Failure Equipment Restart

A. Power failures in buildings will result in building equipment shutting down. The BAS shall monitor building electrical distribution equipment status for indication of a building power failure condition. Some building equipment will be serviced with emergency power and UPS power supplies. The BAS Controls Contractor shall coordinate building equipment that is serviced with emergency and UPS power supplies.

B. Post Building Power Failure Equipment Restart facilities shall be provided to ensure the controlled and orderly startup of building equipment following a power failure. The Post Building Power Failure Equipment Restart facilities shall be provided based on the requirements identified above for the Post Fire Alarm Equipment Restart.

7.7. Air Handling Unit Optimum Start and Stop Programs

A. Air handling system shall be started by the BAS according to defined Occupancy Operating Schedules. These schedules exclude the time required for optimum start periods. Heating shall start in order to provide a minimum space temperature in all rooms of 20 °C by the
beginning of assigned Occupancy Period with the mixing dampers in the "full recirculation" position. Cooling shall start in order to provide a maximum space temperature in all rooms of 22 °C. by the beginning of the assigned Occupancy Period with the mixing dampers in the "full recirculation" position. The system shall stop at the end of the assigned Occupancy Period and return to the state described in B. above.

7.8. **After-hours Equipment Operation**

A. Designated air handling systems shall be off during Unoccupied Periods if all space temperatures are above 15 °C. If any space temperature falls below 15 °C. the system shall be started and operate with the mixing dampers in the full recirculation position, the heating pump on and the heating coil valve fully open to flow through the coil. The system shall return to the off position as described in B. above when all space temperatures are above 16 °C.

7.9. **Air Handling Unit Supply Air Temperature Reset Schedules**

A. The BAS typically controls air handling unit equipment to maintain supply air temperature conditions from air handling units. Typical SFU building air handling units may be provided with facilities to automatically reset the supply air temperature setpoint. SFU air handling unit supply air temperature setpoints are reset based on criteria specific to each application. The BAS designer shall specify setpoint reset facilities to suit the specific application and shall coordinate the reset schedules and setpoint values with SFU, the Architect and the associated mechanical engineer.

B. The following are a number of BAS air handling unit control applications and associated supply air temperature reset schedule schemes that may be applied:

1. Constant Volume Air Handling Unit, No BAS secondary controls, adequate BAS space temperature sensors.
   
   a. BAS to average space temperature values and reset supply air temperature based on an Average space temperature schedule.

<table>
<thead>
<tr>
<th>Average Space Temperature</th>
<th>Supply Air Temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 °C.</td>
<td>?? °C.</td>
</tr>
<tr>
<td>24 °C.</td>
<td>?? °C.</td>
</tr>
</tbody>
</table>

2. Constant Volume Air Handling Unit, No BAS secondary controls, insufficient space temperature monitoring.

   a. BAS to reset supply air temperature based on return air temperature reset schedule.

<table>
<thead>
<tr>
<th>Return Air Temperature</th>
<th>Supply Air Temperature Setpoint</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 °C.</td>
<td>?? °C.</td>
</tr>
<tr>
<td>24 °C.</td>
<td>?? °C.</td>
</tr>
</tbody>
</table>

3. Constant or Variable Air Volume Air Handling Unit with BAS secondary controls.

   a. BAS to control to design supply air temperature setpoint. BAS to adjust supply air temperature setpoint to maintain the zone with the greatest demand for cooling as determined by terminal unit damper positions and terminal unit reheat coil control valve positions.
7.10. **Mixed Air Calculations and Mixing Damper Minimum Outside Air Positioning**

A. BAS mixed air calculation facilities shall be provided to dynamically calculate the percentage of outside air flow rate entering air handling units with mixing damper sections (outside air damper, return air damper and exhaust air where applicable). The dynamic mixed air calculations shall be based on the relationship between BAS monitored values for outside air temperature, mixed air temperature, and return air temperature.

B. The BAS shall override normal BAS minimum outside air damper position control to maintain specified outside air flow requirements based on the dynamic mixed air calculations. The BAS shall implement control strategies to override normal mixing damper control to maintain specified minimum outside air requirements only when the outside air temperature is less than the return air temperature by 10 °C or more. The BAS shall also limit mixing damper control to prevent the mixed air temperature from falling below 6 °C. Mixing damper settings shall be verified during the Warranty period following a seasonal change.

7.11. **Typical Sequence of Operation - Constant Volume Air Handling Unit (AH1)**

A. System Off - When the system is off:

1. The return fan shall be off.
2. The supply fan shall be off.
3. The heating coil pump shall be off if outdoor air temperature is above 15 °C. and shall remain on whenever the outside air temperature is below 15 °C.
4. The mixing dampers shall be in the full recirculation position.
5. The cooling coil control valve shall be closed.
6. The heating coil control valve shall be closed to flow through the coil.
7. The steam humidifier control valve shall be closed.
8. System control loops shall be disabled.

B. The Occupancy operating schedule for this system is:

C. System Start-up: On system start-up:

1. Return fan shall be started with the mixing dampers in the full recirculation position.
2. Following proof of return fan operation and a time delay, initially set at one (1) minute, the supply fan shall be started.
3. Upon proof of supply fan operation and following a time delay initially set at two (2) minutes the mixing dampers shall be positioned in the minimum outside air position and the control loops shall be enabled.

D. System Operation:

1. The mixing dampers (outside air damper, return air damper and exhaust air damper) shall be modulated in unison via single analog output MDC.
2. The mixing dampers shall be modulated in sequence with the heating coil control valve and the cooling coil control valve to maintain the supply air temperature setpoint. The supply air temperature setpoint shall be reset according to (BAS DESIGNER TO IDENTIFY RESET REQUIREMENTS).
3. Override control of the mixing damper positions shall be provided based on dynamic mixed air calculations.
4. The heating coil pump shall be started/stopped by the BAS based on the heating coil control valve position. The pump shall be started on a requirement for heat prior to the heating valve be modulated open and shall be stopped when the valve has been modulated closed. Minimum run times and minimum off times shall be provided to prevent pump cycling.

5. The BAS shall enable the steam humidifier control on a requirement for humidification if
cooling is not required. The BAS shall open the humidifier two-position steam control valve whenever humidification is required, the associated air handling unit supply fan is in operation, and the cooling coil control valve is closed. Upon opening the two-position steam control valve the BAS shall enable automatic modulating control of the humidifier steam control valve. The BAS shall modulate the humidifier steam control valves to maintain the zone relative humidity setpoint. The zone relative humidity shall be the average of the values of the space relative humidity sensors in a zone. The zone relative humidity setpoint shall be reset according to the following outside air temperature/space relative humidity reset schedule:

<table>
<thead>
<tr>
<th>Outside Air Temperature</th>
<th>Space Relative Humidity Setpoint</th>
</tr>
</thead>
<tbody>
<tr>
<td>-10 °C</td>
<td>35%</td>
</tr>
<tr>
<td>25 °C</td>
<td>50%</td>
</tr>
</tbody>
</table>

E. The BAS shall monitor the supply air relative humidity. The BAS shall limit the humidifier steam control valve position to maintain the supply air relative humidity to no greater than 80%. An alarm shall be generated and the associated steam control valve shall be closed if the supply air relative humidity remains above 85% for longer than ten minutes.

F. System Shut Down:

1. System shut down shall be initiated by automatically by the BAS according to Occupancy Schedule requirements, by manual Operator command, or via hardwired interlocks.
2. On system shut down the BAS shall return the system to the state described for System Off.
3. The BAS shall shut down supply fan, position the mixing dampers to the full recirculation position and generate an appropriate alarm message on detection of a supply or mixed air temperature of less than 5 °C. The return fan shall remain on. This BAS software shutdown sequence shall be disabled during the first ten (10) minutes following system start-up.

G. Hardwire Interlocks

1. The low temperature detection device shall be hardwire interlocked to shut down the supply fan and position the mixing dampers to the full recirculation position whenever a duct air temperature of 5 °C or lower is sensed. The return fan shall remain in operation. Device shall be manual reset. The BAS shall monitor the status of the low temperature detection device and shall annunciate an alarm in a low temperature condition.

2. Provide a hardwired supply air relative humidity high limit controller to override BAS control of the humidifier steam valve in a high supply air relative humidity condition initially set at 90% RH. The humidification control valve shall be closed until supply air relative humidity has dropped 20% below alarm value. Provide the hardwired supply air R.H. high limit controller complete with an auxiliary set of dry contacts for alarm monitoring by the BAS.
7.12. **Typical Sequence of Operation - Constant Volume Air Handling Unit - hardwire interlocked RF**

A. **System Off - When the system is off:**
   1. The return fan shall be off.
   2. The supply fan shall be off.
   3. The heating coil pump shall be off if outdoor air temperature is above 15 °C. and shall remain on whenever the outside air temperature is below 15 °C.
   4. The mixing dampers shall be in the full recirculation position.
   5. The cooling coil control valve shall be closed.
   6. The heating coil control valve shall be closed to flow through the coil.
   7. The steam humidifier control valve shall be closed.
   8. System control loops shall be disabled.

B. The Occupancy operating schedule for this system is:

C. **System Start-up: On system start-up:**
   1. Supply fan shall be started with the mixing dampers in the full recirculation position.
   2. The return fan shall be hardwire interlocked to start/stop with the associated air handling unit supply fan. The return fan shall be on when the supply fan is on and shall be off when the supply fan is off.
   3. Upon proof of supply fan operation and following a time delay initially set at two (2) minutes the mixing dampers shall be positioned in the minimum outside air position and the control loops shall be enabled.

D. **System Operation:**
   1. The mixing dampers (outside air damper, return air damper and exhaust air damper) shall be modulated in unison via single analog output MDC.
   2. The mixing dampers shall be modulated in sequence with the heating coil control valve and the cooling coil control valve to maintain the supply air temperature setpoint. The supply air temperature setpoint shall be reset according to (BAS DESIGNER TO IDENTIFYRESET REQUIREMENTS).
   3. Override control of the mixing damper positions shall be provided based on dynamic mixed air calculations.
   4. The heating coil pump shall be started/stopped by the BAS based on the heating coil control valve position. The pump shall be started on a requirement for heat prior to the heating valve being modulated open and shall be stopped when the valve has been modulated closed. Minimum run times and minimum off times shall be provided to prevent pump cycling.

   5. The BAS shall enable the steam humidifier control on a requirement for humidification if cooling is not required. The BAS shall open the humidifier two-position steam control
valve whenever humidification is required, the associated air handling unit supply fan is in operation, and the cooling coil control valve is closed. Upon opening the two-position steam control valve the BAS shall enable automatic modulating control of the humidifier steam valve. The BAS shall modulate the humidifier steam control valve to maintain the zone relative humidity setpoint. The zone relative humidity shall be the average of the values of the space relative humidity sensors in a zone. The zone relative humidity setpoint shall be reset according to the following outside air temperature/space relative humidity reset schedule:

<table>
<thead>
<tr>
<th>Outside Air Temperature</th>
<th>Space Relative Humidity Setpoint</th>
</tr>
</thead>
<tbody>
<tr>
<td>-10 °C</td>
<td>35%</td>
</tr>
<tr>
<td>25 °C</td>
<td>50%</td>
</tr>
</tbody>
</table>

E. The BAS shall monitor the supply air relative humidity. The BAS shall limit the humidifier steam control valve position to maintain the supply air relative humidity to no greater than 80%. An alarm shall be generated and the associated steam control valve shall be closed if the supply air relative humidity remains above 85% for longer than ten minutes.

F. System Shut Down:

1. System shut down shall be initiated by automatically by the BAS according to Occupancy Schedule requirements, by manual Operator command, or via hardwired interlocks.
2. On system shut down the BAS shall return the system to the state described for System Off.
3. The BAS shall shut down supply fan, position the mixing dampers to the full recirculation position and generate an appropriate alarm message on detection of a supply or mixed air temperature of less than 5 °C. This BAS software shutdown sequence shall be disabled during the first ten (10) minutes following system start-up.

G. Hardwire Interlocks

1. The low temperature detection device shall be hardwire interlocked to shut down the supply fan and position the mixing dampers to the full recirculation position whenever a duct air temperature of 5 °C. or lower is sensed. The return fan shall remain in operation. The BAS shall monitor the status of the low temperature detection device and shall annunciate an alarm in a low temperature condition.
2. Provide a hardwired supply air relative humidity high limit controller to override BAS control of the humidifier steam valve in a high supply air relative humidity condition initially set at 90% RH. The humidification control valve shall be closed until supply air relative humidity has dropped 20% below alarm value. Provide the hardwired supply air R.H. high limit controller complete with an auxiliary set of dry contacts for alarm monitoring by the BAS.
7.13. Typical Sequence of Operation - Variable Volume Air Handling Unit

A. System Off - When the system is off:

1. The return fan shall be off.
2. The supply fan shall be off.
3. The heating coil pump shall be off if outdoor air temperature is above 15 °C. and shall remain on whenever the outside air temperature is below 15 °C.
4. The mixing dampers shall be in the full recirculation position.
5. The cooling coil control valve shall be closed.
6. The heating coil control valve shall be closed to flow through the coil.
7. The steam humidifier control valve shall be closed.
8. VSD’s shall be set to the minimum speed.
9. System control loops shall be disabled.

B. The Occupancy operating schedule for this system is:

C. System Start-up: On system start-up:

1. Return fan shall be started at minimum speed with the mixing dampers in the full recirculation position.
2. Following proof of return fan operation and a time delay, initially set at ten seconds, the supply fan shall be started in minimum speed.
3. Upon proof of supply fan operation, and following a time delay, initially set at ten seconds, the supply and return fan speeds shall be ramped to the 40% air volume position and the supply and return fan automatic variable speed controls shall be enabled. The fan variable speed drive outputs shall be ramped up over a 300 second time period from the minimum 40% air volume position until the ramp output equals the associated duct static pressure control loop output at which time the control outputs shall be released to automatic BAS control.
4. Upon proof of supply fan operation and following a time delay, initially set at two (2) minutes, the mixing dampers shall be positioned in the minimum outside air position and the control loops shall be enabled.

D. System Operation:

1. The BAS shall modulate the supply air fan speed to maintain the supply air static pressure setpoint. Supply air static pressure high limit software facilities shall be provided to limit the supply fan speed to prevent excessively high supply air static pressures. The supply air static pressure setpoint shall be Operator adjustable and initially set by the mechanical engineer. The return fan speed shall be modulated to maintain an Operator definable percentage difference between the supply and return air volume flowrates. Initially the return air volume flowrate shall be maintained at 10% less than the supply air volume flowrate.
2. The mixing dampers (outside air damper, return air damper and exhaust air damper) shall be modulated in unison via single analog output MDC.
3. The mixing dampers shall be modulated in sequence with the heating coil control valve and the cooling coil control valve to maintain the supply air temperature setpoint. The supply air temperature setpoint shall be reset according to (BAS DESIGNER TO IDENTIFY RESET REQUIREMENTS).
4. Override control of the mixing damper positions shall be provided based on dynamic mixed air calculations.
5. The heating coil pump shall be started/stopped by the BAS based on the heating coil control valve position. The pump shall be started on a requirement for heat prior to the heating valve being modulated open and shall be stopped when the valve has been modulated closed. Minimum run times and minimum off times shall be provided to prevent pump cycling.
6. The BAS shall enable the steam humidifier control on a requirement for humidification if cooling is not required. The BAS shall open the humidifier two-position steam control valve whenever humidification is required, the associated air handling unit supply fan is in operation, and the cooling coil control valve is closed. Upon opening the two-position steam control valve the BAS shall enable automatic modulating control of the humidifier steam control valve. The BAS shall modulate the humidifier steam control valve to maintain the zone relative humidity setpoint. The zone relative humidity shall be the average of the values of the space relative humidity sensors in a zone. The zone relative humidity setpoint shall be reset according to the following outside air temperature/space relative humidity reset schedule:

<table>
<thead>
<tr>
<th>Outside Air Temperature</th>
<th>Space Relative Humidity Setpoint</th>
</tr>
</thead>
<tbody>
<tr>
<td>-10 ° C</td>
<td>35%</td>
</tr>
<tr>
<td>25 ° C</td>
<td>50%</td>
</tr>
</tbody>
</table>

E. The BAS shall monitor the supply air relative humidity. The BAS shall limit the humidifier steam control valve position to maintain the supply air relative humidity to no greater than 80%. An alarm shall be generated and the associated steam control valve shall be closed if the supply air relative humidity remains above 85% for longer than ten minutes.

F. System Shut Down:
1. System shut down shall be initiated by automatically by the BAS according to Occupancy Schedule requirements, by manual Operator command, or via hardwired interlocks.
2. On system shut down the BAS shall ramp down the supply and return fan speeds and return the system to the state described for System Off.
3. The BAS shall shut down supply fan, position the mixing dampers to the full recirculation position and generate an appropriate alarm message on detection of a supply or mixed air temperature of less than 5 ° C. The return fan shall remain on and shall be set to an operator adjustable speed, initially set at 65 % air volume. This BAS software shutdown sequence shall be disabled during the first ten (10) minutes following system start-up.

G. Hardwire Interlocks
1. The low temperature detection device shall be hardwire interlocked to shut down the supply fan and position the mixing dampers to the full recirculation position whenever a duct air temperature of 5 ° C or lower is sensed. The return fan shall remain in operation and shall be set to an operator adjustable speed, initially set at 65 % air volume. Device shall be manual reset. The BAS shall monitor the status of the low temperature detection device and shall annunciate an alarm in a low temperature condition.
2. Provide a hardwired supply air relative humidity high limit controller to override BAS control of the humidifier steam valve in a high supply air relative humidity condition initially set at 90% RH. The humidification control valve shall be closed until supply air relative humidity has dropped 20% below alarm value. Provide the hardwired supply air R.H. high limit controller complete with an auxiliary set of dry contacts for alarm monitoring by the BAS.
3. Provide duct static pressure high limit devices in the supply and return air ducts to shut down the associated fans and the air handling unit system in a high duct static pressure condition. Devices shall be manually reset.
7.14. Typical Sequence of Operation - VAV Outside Air AHU

A. System Off - When the system is off:

1. The exhaust fan shall be off.
2. The supply fan shall be off.
3. The heating coil pump shall be off if outdoor air temperature is above 15 °C. and shall remain on whenever the outside air temperature is below 15 °C.
4. The outside air dampers and the exhaust air dampers shall be fully closed.
5. The cooling coil control valve shall be closed.
6. The heating coil control valve shall be closed to flow through the coil.
7. The steam humidifier control valves shall be closed.
8. VSD’s shall be set to the minimum speed.
9. System control loops shall be disabled.

B. The Occupancy operating schedule for this system is:

C. System Start-up: On system start-up:

1. The BAS shall output a start command to the supply fan variable speed drive motor control circuit. The supply fan shall be started in minimum speed. Provide the damper actuator(s) on the outside air dampers hardware interlocked with the supply fan such that the dampers are commanded fully open on a start command and are closed when the supply fan is commanded off. Provide damper end switches on the outside air damper sections hardware interlocked with the supply fan motor control circuit such that the supply fan cannot operate unless the dampers are in the fully open position. Provide the end switches hardware interlocked into both the hand and auto legs of the hand/off/auto motor control circuit to prevent fan operation without the dampers fully open.

2. Following proof of supply fan operation and a time delay, initially set at thirty seconds, the BAS shall output a start command to the exhaust fan variable speed drive motor control circuit. The exhaust fan shall be started in minimum speed. Provide the damper actuator(s) on the exhaust air dampers hardware interlocked with the exhaust fan such that the dampers are commanded fully open on a start command and are closed when the exhaust fan is commanded off. Provide damper end switches on the exhaust air damper sections hardware interlocked with the exhaust fan motor control circuit such that the exhaust fan cannot operate unless the dampers are in the fully open position. Provide the end switches hardware interlocked into both the hand and auto legs of the hand/off/auto motor control circuit to prevent fan operation without the dampers fully open.

3. Upon proof of supply fan operation, and following a time delay initially set at ten seconds, the supply fan speed shall be ramped to the 40% air volume position and the supply fan automatic variable speed controls shall be enabled. The fan variable speed drive outputs shall be ramped over a 300 second time period from the minimum 40% air volume position until the ramp output equals the associated duct static pressure control loop output at which time the control output shall be released to automatic BAS control.

4. Upon proof of exhaust fan operation, and following a time delay initially set at ten seconds, the exhaust fan speed shall be ramped to the 40% air volume position and the exhaust fan automatic variable speed controls shall be enabled. The fan variable speed drive outputs shall be ramped over a 300 second time period from the minimum 40% air volume position until the ramp output equals the associated duct static pressure control loop output at which time the control output shall be released to automatic BAS control.

5. Upon proof of supply and exhaust fan operation the remaining automatic control loops shall be enabled.

6. On a system start-up if the outside air temperature is less than 6 °C., the BAS shall position the heating coil control valve to the 30 % open position sixty seconds prior to
issuing the supply fan start command. Valve control shall be released when automatic controls are enabled.

D. System Operation:

1. The BAS shall modulate the supply air fan speed to maintain the supply air static pressure setpoint. Supply air static pressure high limit software facilities shall be provided to limit the supply fan speed to prevent excessively high static pressures. The supply air static pressure setpoint shall be Operator adjustable and initially set by the mechanical engineer.
   a. The exhaust fan speed shall be modulated to maintain the exhaust air static pressure setpoint. Exhaust air static pressure low limit software facilities shall be provided to limit the exhaust fan speed to prevent excessively low static pressures. The exhaust air static pressure setpoint shall be Operator adjustable and initially set by the mechanical engineer.
   b. The heating coil control valve and the cooling coil control valve shall be modulated in sequence to maintain the supply air temperature setpoint. The supply air temperature setpoint shall be reset according to (BAS DESIGNER TO IDENTIFY RESET REQUIREMENTS).
   c. The heating coil pump shall be started/stopped by the BAS based on the heating coil control valve position. The pump shall be started on a requirement for heat prior to the heating valve being modulated open and shall be stopped when the valve has been modulated closed. Minimum run times and minimum off times shall be provided to prevent pump cycling.
   d. The BAS shall enable the steam humidifier control on a requirement for humidification if cooling is not required. The BAS shall open the humidifier two-position steam control valve whenever humidification is required, the associated air handling unit supply fan is in operation, and the cooling coil control valve is closed. Upon opening the two-position steam control valve the BAS shall enable automatic modulating control of the humidifier steam control valve. The BAS shall modulate the humidifier steam control valve to maintain the zone relative humidity setpoint. The zone relative humidity shall be the average of the values of the space relative humidity sensors in a zone. The zone relative humidity setpoint shall be reset according to the following outside air temperature/space relative humidity reset schedule:

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<td>50%</td>
</tr>
</tbody>
</table>

F. The BAS shall monitor the supply air relative humidity. The BAS shall limit the humidifier steam control valve position to maintain the supply air relative humidity to no greater than 80%. An alarm shall be generated and the associated steam control valve shall be closed if the supply air relative humidity remains above 85% for longer than ten minutes.
G. System Shut Down:

1. System shut down shall be initiated automatically by the BAS according to Occupancy Schedule requirements, by manual Operator command, or via hardwired interlocks.
2. On system shut down the BAS shall ramp down the supply and exhaust fan speeds and return the system to the state described for System Off.
3. The BAS shall shut down the supply fan and the exhaust fan and generate an appropriate alarm message on detection of a supply air temperature of less than 5 °C. This BAS software shutdown sequence shall be disabled during the first ten (10) minutes following system start-up.

H. Hardwire Interlocks

1. The low temperature detection device shall be hardwire interlocked to shut down the supply fan and close the outside air dampers whenever a duct air temperature of 5 °C or lower is sensed. The BAS shall shut down the exhaust fan and close the exhaust air dampers when a low temperature condition is sensed. Device shall be manual reset. The BAS shall monitor the status of the low temperature detection device and shall annunciate an alarm in a low temperature condition.

2. Provide a hardwired supply air relative humidity high limit controller to override BAS control of the humidifier steam valve in a high supply air relative humidity condition initially set at 90% RH. The humidification control valve shall be closed until supply air relative humidity has dropped 20% below alarm value. Provide the hardwired supply air R.H. high limit controller complete with an auxiliary set of dry contacts for alarm monitoring by the BAS.

3. Provide static pressure high limit devices in the supply air duct hardwire interlocked to shut down the associated fan and the air handling unit system in a high static pressure condition. Provide duct static pressure low limit devices in the exhaust air ducts to shut down the associated fan and the air handling unit system in a low duct static pressure condition. Devices shall be manually reset.

4. Provide outside air and exhaust air damper actuators hardwire interlocked with the associated fan motor control circuit as indicated above.

5. Provide damper end switches on the outside air and exhaust air dampers hardwire interlocked with the associated fan motor control circuit as indicated above.
7.15. Typical Sequence of Operation - Make-up Air AHU

A. System Off - When the system is off:
   1. The supply fan shall be off.
   2. The heating coil pump shall be off if outdoor air temperature is above 15 °C. and shall remain on whenever the outside air temperature is below 15 °C.
   3. The outside air dampers shall be fully closed.
   4. The heating coil control valve shall be closed to flow through the coil.
   5. System control loops shall be disabled.

B. The Occupancy operating schedule for this system is:

C. System Start-up: On system start-up:
   1. The BAS shall output a start command to the supply fan motor control circuit. Provide the damper actuator(s) on the outside air dampers hardwire interlocked with the supply fan such that the dampers are commanded fully open on a start command and are closed when the supply fan is commanded off. Provide damper end switches on the outside air damper sections hardwire interlocked with the supply fan motor control circuit such that the supply fan cannot operate unless the dampers are in the fully open position. Provide the end switches hardwire interlocked into both the hand and auto legs of the hand/off/auto motor control circuit to prevent fan operation without the dampers fully open.
   2. Upon proof of supply fan operation, the automatic controls shall be enabled.
   3. On a system start-up if the outside air temperature is less than 6 °C., the BAS shall position the heating coil control valve to the 30 % open position sixty seconds prior to issuing the supply fan start command. Valve control shall be released when automatic controls are enabled.

D. System Operation:
   1. The heating coil control valve shall be modulated to maintain the supply air temperature setpoint. The supply air temperature setpoint shall be reset according to (BAS DESIGNER TO IDENTIFY RESET REQUIREMENTS).
   2. The heating coil pump shall be started/stopped by the BAS based on the heating coil control valve position. The pump shall be started on a requirement for heat prior to the heating valve being modulated open and shall be stopped when the valve has been modulated closed. Minimum run times and minimum off times shall be provided to prevent pump cycling.

E. System Shut Down:
   1. System shut down shall be initiated automatically by the BAS according to Occupancy Schedule requirements, by manual Operator command, or via hardwired interlocks.
   2. On system shut down the BAS shall return the system to the state described for System Off.
   3. The BAS shall shut down the supply fan and generate an appropriate alarm message on detection of a supply air temperature of less than 5 °C. This BAS software shutdown sequence shall be disabled during the first ten (10) minutes following system start-up.
F. **Hardwire Interlocks**

1. The low temperature detection device shall be hardwire interlocked to shut down the supply fan and close the outside air dampers whenever a duct air temperature of 5 °C or lower is sensed. Device shall be manual reset. The BAS shall monitor the status of the low temperature detection device and shall annunciate an alarm in a low temperature condition.

2. Provide outside air damper actuators hardwire interlocked with the associated fan motor control circuit as indicated above.

3. Provide damper end switches on the outside air dampers hardwire interlocked with the associated fan motor control circuit as indicated above.

### 7.16. **Typical Sequence of Operation - Rooftop Self Contained AC Unit**

A. **System Off - When the system is off:**
   1. The fan shall be off and the unit shut down.

B. **The Occupancy operating schedule for this system is:**

C. **System Start-up: On system start-up:**
   2. The BAS shall output a system enable command to the self-contained ac unit electronic controller. Wire to terminations at the electronic controller.

D. **System Operation:**
   1. Once enabled by the BAS the ac unit shall be controlled by the standalone integral ac unit controller as provided by the ac unit manufacturer.
   2. The BAS shall monitor the status of the ac unit and shall monitor an ac unit common fault alarm from the ac unit controller. Wire to terminations at the ac unit controller.

E. **System Shut Down:**
   1. System shut down shall be initiated automatically by the BAS according to Occupancy Schedule requirements, by manual Operator command, or via hardwired interlocks.
   2. On system shut down the BAS shall return the system to the state described for System Off.
   3. The BAS shall shut down the supply fan and the exhaust fan and generate an appropriate alarm message on detection of a supply air temperature of less than 5 °C.
   
   C. This BAS software shutdown sequence shall be disabled during the first ten (10) minutes following system start-up.

F. **Hardwire Interlocks**

1. Hardwire interlocks may be required. BAS Designer to coordinate requirements for any hardwire interlocks, BAS wiring terminations and interfaces, etc.
7.17. Chilled Water (CW) and Condenser Water (CSR) Systems

A. System Off - When the system is off:
   1. The chilled water pumps shall be off.
   2. The chillers shall be commanded off.
   3. The condenser water pumps shall be off.
   4. The cooling tower fans shall be off.
   5. All control loops shall be disabled.

B. The Occupancy operating schedule for this system is:
   1. This system shall be enabled either by an operator manually entered command at the BAS or automatically by the BAS based on time schedule or demand by the AHU’s.
   2. Provide two BAS operator modes of control, “BAS Manual” and “BAS Automatic”. Selection of operating mode shall be by manual Operator selection. When in the BAS Manual mode start up and shut down of the chilled water and condenser water systems shall be by manual Operator BAS command only. When in the BAS Automatic Mode, start up and shut down of the chilled water and condenser water systems shall be automatically controlled by the BAS as defined in the following sequences of operation.
   3. When in the BAS Automatic mode the chilled water and condenser water system shall be on whenever there is a demand for cooling by the associated air handling units as determined by cooling coils control valve positions. System shall be off if all valves are closed and shall be started when any valve is open more than 10%. Provide minimum run time of four (4) hours and minimum off time of two (2) hours. The system shall be on during occupied periods whenever the outside air temperature is above 20 ° C. regardless of cooling coil valve position.

C. System Start-up: On system start-up:
   1. BAS shall start the designated "duty" chilled water pump. BAS shall automatically designate "duty" or "standby" status to chilled water pumps based on pump totalized run time. Duty pump designation shall be assigned to the pump with the least accumulated run time at time of system start-up. If duty pump fails to start or is disabled the BAS shall start the standby pump.
   2. Upon proof of chilled water pump operation the BAS shall start the designated “duty” condenser water pump. BAS shall automatically designate “duty” or “standby” status to condenser water pumps based on pump totalized run time. Duty pump designation shall be assigned to the pump with the least accumulated run time at time of system start-up. If duty pump fails to start or is disabled the BAS shall start the standby pump.
   3. Following proof of chilled water and condenser water pumps, and following an Operator adjustable time delay initially set at thirty seconds, if there is not a condenser water low level alarm the BAS shall output an enable command to the chiller control panel provided by the chiller manufacturer. Once enabled by the BAS, control of the chiller shall be by the chiller control panel. The BAS chiller enable/disable control software shall incorporate minimum chiller run times and minimum times between chiller restarts.
   4. BAS Controls Contractor shall furnish flow switches for installation by the Mechanical Contractor in the chilled water supply and return as well as the condenser water supply and return lines and shall hardwire interlock these devices to the chiller control panel to prevent chiller operation without flow detected. Flow switches shall be hardwire interlocked into the hand and auto branches of the hand/off/auto control circuit for the chiller.
   5. BAS shall monitor chiller status and chiller fault alarms from the integral chiller control panel. Coordinate wiring terminations with the chiller manufacturer. Provide all wiring and auxiliary relays required to monitor multiple chiller fault alarms as a common point on the BAS.
6. Upon proof of condenser water pump operation the BAS shall enable the condenser water system controls. Upon proof of condenser water pump operation the BAS shall control the cooling tower fans to maintain the condenser water supply temperature.

D. System Operation:

1. The BAS shall output a modulating control output to the chiller control panel for chilled water supply temperature setpoint reset control. Provide the chilled water supply temperature setpoint reset signal time averaged to adjust the chilled water supply temperature setpoint over a span of 6 °C. The chilled water supply temperature setpoint shall be adjusted based on air handling unit chilled water control valve positions. Coordinate chilled water supply temperature setpoint reset signal requirements with Chiller Manufacturer.

2. (CENTRIFUGAL CHILLER ONLY) The BAS shall output a chiller current demand signal to the chiller control panel to limit the maximum operating capacity of the chiller based on electrical current demand. The current limiting value shall Operator adjustable and shall be manually set.

3. (If Cooling Tower is Equipped with a By-pass) If the outside air temperature is below an operator defined setpoint, the cooling tower bypass valve shall be positioned to bypass flow to the tower sumps.

4. If the outside air temperature is below an operator defined setpoint, the cell isolation valves for all cells shall open and allow flow over the tower without the fan operating. If the condenser water supply temperature setpoint cannot be maintained for an Operator adjustable period of time, initially set at two minutes, then the isolation valves on the operator selected lead tower shall remain open and all other cell isolation valves shall close. The lead fan shall start on low speed. The speed of the operating fan within the cell shall be controlled to maintain the condenser water supply temperature setpoint.

5. If the lead tower cell is operating at low speed and the condenser water supply temperature setpoint cannot be maintained for an operator defined period, then the following staging shall occur, with appropriate time delays to prevent excessive fan starting/stopping:

   a. Stage 2 - First cell high speed.
   b. Stage 3 - Second cell low speed.
   c. Stage 4 - Second cell high speed.
   d. Stage 5 - Third cell low speed.
   e. Stage 6 - Third cell high speed.
   f. etc. as determined by the # of cooling tower cells.

E. The above sequence shall reverse as required to maintain the condenser water supply temperature setpoint. Provide satisfactory time delays between switching fans to low speed from high speed operation. Coordinate cooling tower control requirements with the cooling tower manufacturer.

1. Provide condenser water supply temperature setpoint reset based on wet bulb temperature approach. Coordinate reset schedule and minimum allowable condenser water temperature with the chiller and cooling tower manufacturers/suppliers.
F. System Shut Down:
   1. System shut down shall be initiated automatically by the BAS according to Occupancy Schedule requirements and/or air handling unit cooling requirements, by manual Operator command, or via hardwired interlocks.
   2. The condenser water system shall be shut down by the BAS if none of the chilling units are operating.
   3. On system shut down the BAS shall return the system to the state described for System Off.

G. Hardwire Interlocks
   1. Provide flow switches installed in the chilled water supply and return and the condenser water supply and return lines hardwire interlocked with the chiller control panel as identified above.
   2. Additional hardwire interlocks may be required associated with the chiller and cooling towers. Provide all required hardwire interlock facilities as identified elsewhere in the Division 23 and Division 26 Specifications.

H. Alarm setpoints - The BAS shall generate an alarm:
   1. If the chilled water supply temperature is outside the operator established low and high alarm limits, which shall be initially set at 38 °F. and 42 °F.
   2. If a pump or chiller fails to start or fails in service.
   3. If the condenser water supply temperature is outside the operator established low and high alarm limits, which shall be initially set at 4 °F. around the current setpoint.

I. Setpoints - The setpoints for the system shall be determined as follows:
   1. The condenser water supply temperature setpoint shall be set initially at 85 °F. during normal operation and 40 Def. F. during economizer operation.
   2. The outside air temperature low limit for bypass control shall be 36 °F.
   3. The condenser water supply temperature setpoint during after hours operation shall be 85 °F.
   4. The time delay for cell staging shall be 10 minutes.
   5. The switch over setpoint for staging fans off shall be 5 °F. below setpoint.
   6. The plant condenser water supply temperature setpoint shall be 65 °F.

7.18. Supply Hot Water System (SHW)

A. System Off - When the system is off:
   1. Hot water circulation pumps shall be off.
   2. Steam control valves shall be closed.
   3. Three way mixing valve on the secondary hot water system shall be fully closed to flow through from the hot water supply.
   4. Control loops shall be disabled.

B. The Occupancy operating schedule for this system is:
   1. System shall be started/stopped by the BAS according to the Occupancy Schedule and after hours space temperature control requirements.
   2. Additionally the system shall be on if any air handling unit supply fans or Domestic Hot Water pumps are in operation or as required for afterhours low space temperature control requirements.
3. This system shall be off if all air handling units and pumps are off and the outside air temperature is greater than 21 °C.

C. System Start-up: On system start-up:
   1. BAS shall start the designated "duty" hot water supply pump. BAS shall automatically designate "duty" or "standby" status to the hot water pumps based on pump totalized run time. Duty pump designation shall be assigned to the pump with the least accumulated run time at time of system start-up. If duty pump fails to start or is disabled the BAS shall start the standby pump.
   2. Upon proof of hot water supply pump operation and following an Operator adjustable time delay, initially set at one (1) minute, the control loops shall be enabled.
   3. Provide pump minimum run and off times. Pump minimum run time and minimum off time shall be Operator adjustable and initially set at thirty (30) minutes.

D. System Operation:
   1. The BAS shall modulate the 1/3 - 2/3 steam control valves in sequence to maintain the hot water supply temperature setpoint. The steam control valves shall be sequenced such that the 1/3 capacity valve is modulated fully open first. The 2/3 capacity valve shall be modulated open once the 1/3 valve is fully open and the hot water supply temperature setpoint has not been achieved. The hot water supply temperature setpoint shall be Operator adjustable and shall initially be set at 93 °C.
   2. The BAS shall modulate the secondary radiation water three-way mixing valve to maintain the radiation/reheat hot water supply temperature setpoint. The radiation/reheat hot water supply temperature setpoint shall be reset based on an outside air temperature reset schedule as follow:

   OUTSIDE AIR TEMPERATURE
   -10 °C.
   15 °C.

   HOT WATER SUPPLY SETPOINT
   93 °C.
   60 °C.

E. Provide BAS software point for hot water supply temperature setpoint adjustment. Provide facilities to enabled the Operator to adjust the hot water supply temperature setpoint by +/- 10°C. If the hot water supply temperature is 98 °C. or above, the steam valves shall be closed and an alarm generated.

F. System Shut Down:
   1. System shut down shall be initiated automatically by the BAS according to Occupancy Schedule requirements and/or air handling, space and domestic hot water heating requirements, by manual Operator command, or via hardwired interlocks.
   2. On system shut down the BAS shall return the system to the state described for System Off.

G. Hardwire Interlocks
   1. None identified with this system.
7.19. Domestic Hot Water System

A. System Off - When the system is off:
   1. The domestic hot water circulation pump shall be off.
   2. Control loops shall be disabled.

B. The Occupancy operating schedule for this system is:
   1. The system shall be enabled at an Operator adjustable period of time before the start of the Occupancy Period, initially set at 30 minutes, and shall be disabled at the end of the Occupancy Period.

C. System Start-up: On system start-up:
   1. BAS shall start/stop the domestic hot water recirculation pump to maintain the domestic hot water return temperature at setpoint.

D. System Operation:
   1. Control of the domestic hot water heater shall be via standalone controls. The domestic hot water temperature controls shall remain operational continuously 24 hours per day.
   2. Once enabled to operate by the BAS, the domestic hot water circulation pump shall be cycled on/off to maintain the domestic hot water return temperature at setpoint. The pump shall be started when the domestic hot water return temperature is below setpoint and shall be stopped when below setpoint. Provide deadbands between pump on/off commands. Provide Operator adjustable minimum run and off times initially set at five minutes.

E. System Shut Down:
   1. System shut down shall be initiated automatically by the BAS according to Occupancy Schedule requirements, by manual Operator command, or via hardwired interlocks.
   2. On system shut down the BAS shall return the system to the state described for System Off.

F. Hardwire Interlocks
   1. There are no hardwire interlock requirements associated with this system.

***END OF SECTION***
1.1 GENERAL

1.2 Related SFU Technical Requirements

.1 Section 01 78 39 Project Record Documents
.2 Section 01 78 23 Operation and Maintenance Data
.3 Divisions 26, 27, 28, 33

1.3 Co-ordination Requirements

.1 SFU Facilities
.2 SFU IT

1.4 Description

.1 General requirements for all Division 26.

2.1 MATERIALS AND DESIGN REQUIREMENTS

2.2 General

.1 The Electrical Consultant shall submit to SFU Facilities a design philosophy for the proposed building electrical, communication, and access systems. Major components of the philosophy must be accepted in principle by SFU Facilities before the project can proceed to construction. Consultants are expected to produce designs that meet User needs and allow SFU Facilities to continue to meet those needs in the future in a safe efficient manner.

.2 The contractor is responsible for and keeps one complete set of white prints, including revision drawings in the job site, office.

.3 Construction Power
  .1 SFU provides construction power.
  .2 The connection point and voltage for the construction power are the responsibility of SFU Facilities.
  .3 The Contractor shall pay for all materials and installation of equipment for the provision of temporary construction power.
  .4 Consumption costs are typically not billed. Only excessive consumption will be billed at cost.
  .5 The Contractor must contact SFU IT for coordination and installation of temporary telecommunications cabling.
  .6 Construction power provision complements the provision of temporary IT services in Division 27 as it is provided in much the same way.

.4 The electrical consultant will coordinate and meet needs of SFU.

2.3 General Installation

.1 The installation shall be installed in a manner that is conducive with quality workmanship. Exposed wiring that is visible in common areas shall be installed square and true to other areas and installations. Architectural considerations must be taken into account during the installation.

.2 All work shall be in strict adherence with the latest edition of the Canadian Electrical Code, National Building Code, their amendments, supplements, local bylaws and
conform to SFU standards.

.3 Do not employ inside wiremen on outdoor services where linemen would be normally employed.

.4 Employ at least one journeyman electrician or lineman on all underground services.

.5 All Electrical Rooms shall be designed and installed so that no equipment will be installed behind a door swing or above a door.

.6 Adequate unobstructed wall space shall be provided in all electrical rooms to permit the installation of new (future) equipment and shall not be less than 1 m x wall height (where possible).

.7 The designer shall coordinate with the architect to ensure that all electrical and life safety equipment that is installed shall be readily accessible for maintenance, replacement and repair without the use of tools to remove building finishes.

2.4 Public Safety

.1 The contractor shall install safety barriers over all panels and other equipment where covers have been removed and there exists a possibility of electrical shock to personnel.

.2 “Danger High Voltage” signs shall be displayed wherever there is a possible danger to personnel.

.3 All electrical equipment to be locked out and tagged according to W.C.B. regulations. Tags to have date, time, name (signed and printed) include company and 24 hour phone number. This applies to even low voltage breakers.

2.5 VFD Speed Drive Design and Installation

.1 Drives shall be industrial grade with bypass (AAB drive preferred).

.2 Drives will be installed with a load reactor assembly.

.3 Net Motors will be rated for use with a drive assembly.

.4 Motor overload protection will be provided from the VFD.

.5 Refer to SFU reference document Variable Speed Drive Installation Guidelines for details.

2.6 Identification of Equipment

.1 Apart from light switches, all switches and breakers shall be appropriately identified, notwithstanding, where lighting switches are grouped or arranged so that their function is not obvious, they shall be identified.

.2 All indicating devices, panelboards, starters, controllers, feeder switches etc., shall be identified.
.3 Panelboards shall be provided with the service location, load of each circuit and a circuit directory indicating the usage of each breaker.

.4 All switches, panelboard covers, motor starters, etc. shall be identified with nameplates following SFU Identification and Labeling Standard. Refer to Section 20 00 08.2.

.5 Nameplates for terminal cabinets and junction boxes to indicate system and voltage characteristics.

.6 Nameplates for receptacles and switches mounted on walls shall be mounted near the receptacle or switch, not on the equipment.

2.7 High Voltage Vaults

.1 All high voltage vaults shall have a floor drain and containment curbs.

2.8 Electrical Receptacles for Specific Purposes

.1 Provide duplex electrical receptacles for custodial use at each floor level and near the doorway in each stairwell.

.2 Provide at least one convenience duplex electrical receptacle in each mechanical room, connected to standby power if available. Additional receptacles to be provided in all larger utility rooms.

.3 Provide at least one convenience duplex electrical receptacle in each electrical room, connected to standby power if available. Additional receptacles to be provided in all larger utility rooms.

2.9 Project Record Drawing Requirements

.1 The contractor shall be responsible for and keep one complete set of white prints, including revision drawings at the job site.

.2 The contractor shall deliver to the consultant at "substantial performance" one complete set of white prints, showing by colored lines and suitable notation all work as installed, together with sizes and routes of electrical service lines installed, relocated or adapted under this project. The contractor shall maintain a current record, as the job progresses, of any deviations from contract drawings. Manholes, pulling pits, etc. shall be located at the center lines, by co-ordinates, on a grid system shown on the site plan. Locations and levels shown on plans must be accurate to within 12 mm.

.3 Approval for backfilling of underground services will not be given before SFU Facilities is satisfied that the exact location of the underground service has been surveyed and recorded. The contractor must employ a qualified surveyor to record the horizontal and vertical location of underground services. This survey information is to be shown on the project record drawings and must indicate the location of all buried services, as well as, those capped or exposed by the work of this contract.

.4 Project Record White prints shall be delivered to the consultant at "substantial performance" in accordance with Division 01 General Requirements.
For final Record Drawing submission, refer to Section 01 78 39 Project Record Documents. The standard is 3 hard copies with electronic copy provided.

2.10 Electrical Operating and Maintenance Manuals

For detailed requirements, refer to Section 01 78 23 Operation and Maintenance Data.

2.11 Demolition and Clean Up

Remove all debris from the site as it occurs. Do not allow it to accumulate.

The site shall be left in a clean and tidy condition to the satisfaction of the Engineer before a certificate of acceptance will be issued.

All used and surplus electrical material shall be delivered to a storage area designated by the Engineer.

***END OF SECTION***
1.1 **GENERAL**

1.2 **Related Technical Requirements**

1.2.1 *Division 26, Section 33 71 00 Electrical Utility Transmission and Distribution*

1.2.2 *Divisions 27 and 28*

1.3 **Coordination Requirements:**

1.3.1 SFU Facilities

1.3.2 SFU IT

1.4 **Description**

1.4.1 SFU requirements for the Design Development Documents for *Division 26.*

2.1 **MATERIAL AND DESIGN REQUIREMENTS**

2.2 **General Requirements**

2.2.1 Engaged Consultants supplies the University at the preliminary stage of the building project, a Development Brief which contains information listed below:

2.2.1.1 Preliminary drawings clearly defining scope of work and equipment details.

2.2.1.2 Specifications of all electrical systems and equipment.

2.2.1.3 Power Riser Diagram.

2.2.1.4 One Line Diagram.

2.2.1.5 Fire Alarm Riser Diagram.

2.2.1.6 Building area access routes for service of installed systems.

2.3 **Off Site and Site Services**

2.3.1 Through discussion with SFU Facilities the Design Development Brief shall include:

2.3.1.1 Underground duct system tie-in to existing duct or manhole.

2.3.1.2 Expected peak demand, in KVA.

2.3.1.3 Manhole size and approximate location, drainage provision.

2.3.1.4 Number, size and type of power cables and neutral.

2.3.1.5 Number of ducts in each duct bank.

2.4 **Building Service**

2.4.1 The Design Development Brief shall include the following Building Service information:

2.4.1.1 Size and location of main electrical and sub electrical rooms and distribution centers.

2.4.1.2 Power switching components.

2.4.1.3 Power transformer types and sizes.

2.4.1.4 Secondary voltages.

2.4.1.5 One line diagram including secondary distribution board, sub distribution centers, motor control centers, and risers.
2.5 Other Services

.1 The Design Development Brief shall include the following other information:

.1 Fire alarm and building alarm components and supervisory equipment.
.2 Communication rooms size and location.
.3 Other services to be provided such as clocks, bells, telephone/data outlets, TV outlets, closed circuit television system, P/A system, emergency lighting and standby generator.
.4 Type of interior, exterior lighting fixtures and poles.

2.6 Construction Power

.1 The Consultant obtains from SFU Facilities, the location and voltage level for construction power.

.2 The Design Development Brief shall include the following construction power information:

.1 The Consultant provides in his design, a drawing showing the basic equipment and wiring for the service.

.3 Construction power consumption and all associated equipment and installation material and labour shall be paid for by the project.

***END OF SECTION***
1.1 **GENERAL**

1.2 **Related Technical Requirements**

.1 *Division 26*

1.3 **Coordination Requirements**

.1 SFU Facilities

2.1 **MATERIAL AND DESIGN REQUIREMENTS**

.1 Wiring exposed to excessive vibration (i.e. generators) shall be copper and type SIS.

.2 Load side wiring of variable frequency drives (VFD) shall not share raceways or junction boxes with other VFD’s or loads.

.3 Components used to fasten, mount or secure electrical equipment and cables outdoors or in other corrosive locations shall be suitable and rated for such.

***END OF SECTION***
1.1 GENERAL

1.2 Coordination Requirements

.1 SFU Facilities

1.3 Description

.1 The Burnaby campus is fed at 64,000 volts from two separate power lines from two different BC Hydro substations as a transmission customer. Poles carry both lines up the same right of way on the east side of the mountain. Each line feeds a 64-12 kV transformer in the substation yard. BC Hydro can switch both transformers to one line if necessary. The substation building contains 12 kV switchgear that routes three sets of main and backup power feeds to 3 “receiving substations” (nodes) on campus via underground ducted high voltage cables. These nodes are located at TC, TASC1 and Saywell Hall. All 12 kV power outside of buildings is run through underground concrete encased cable ducts. Over 100 manhole duct chambers connect these duct sections to carry high voltage and data cables between buildings. There is no overhead power wiring on campus.

.2 The original receiving substation at TC fed power to all buildings on campus. The two new receiving substations in TASC 1 and Saywell Hall are designed to gradually connect to and power many of the buildings currently fed from TC. This will reduce reliance on that location and its single point of failure issues. New underground cable ducts have been constructed to enable this re-configuration. When this is complete, the following groups of buildings will be fed as shown:

Saywell Hall- Blusson, Saywell, Education, RC Brown, AQ, Maggie Benston/ Theatre, new SUB and the Library; the Water Tower building may also be fed from here in the near future
TASC 1- SSB, TASC 1, TASC 2, Facilities, ASB, Kinesiology, Physics, Biology and Chemistry
TC- Gym, TC, West Mall and the Residence buildings

.3 The 69 kV transformers are designed as N+1. The campus load will reach the capacity of one transformer in the next few years. Prior to that a third 69 kV transformer will be installed at the substation yard. A new 12 kV switchgear lineup in the substation building will have to be added at that time.

.4 Several buildings are fed directly from BC Hydro at the distribution rate, not through the campus grid. These include Discovery 1 and 2, Animal Care and the Water Tower building. The proposed Corix biomass heating plant will be fed directly from BC Hydro.

.5 Building substation
From each of the 3 receiving substations, a main and a backup set of power cables run to a group of buildings. At or near each building there is a pair of junction boxes (JB’s) where main and backup power is tapped off, then daisy chains to the next building JB’s.

.6 In this way each building receives two 12 kV power feeds. This passes through disconnect switches (load breaks) and 12 kV breakers in the electrical vault. Key interlocks are used for both load breaks and 12 kV breakers to ensure only one source at a time can be connected to
The transformer. Breakers are not draw-out type. The main or backup power feed (via the 12 kV breaker) connects to the main transformer, which transforms it down to 480 volts (also 208 volts in some buildings). For the most part, the 480 volt distribution powers motors and larger electrical equipment as well as most lighting (277 volts). There are a few buildings that use 347/600 volts for distribution, but these are being converted to 277/480 volt over time.

The main 12 kV breakers can be operated locally or remotely. To deal with power problems or to isolate components for maintenance, the buildings can be switched from the main to the standby power feed. A “mimic board” at the TC 011 electrical room connects to many of the building substations for remote monitoring and control of the 12 kV breakers. A second mimic board was installed in the TASC 1 vault, and will be connected to most of the remaining building substations in the near future.

Most buildings convert 480 volts to 120/208 volts for plug loads and some lighting. These transformers range from 30 to 225 kVA in most cases. The oldest ones are gradually being replaced with “PowerSmith” high efficiency transformers, model series 80 R. This is also the standard transformer for new installations or renovations due to its high quality and superior part load energy efficiency.

2.1 MATERIAL AND DESIGN REQUIREMENTS

All new buildings shall be supplied from the underground 12 KV distribution system, with a few exceptions.

Power to new small buildings may be fed at 480 Volts from a nearby building, with approval of SFU Facilities.

Refer to Standard Drawing No. E1-1 for details on for the supply feeders into each building. Any deviation from the standard details must be reviewed and approved by SFU Facilities prior to construction.

Note that a ground of equivalent size (in general a 4/0) shall be installed to each building switch room. This ground conductor shall tie into the existing ground system and also be connected to an accessible ground bus on which all equipment and service grounds are to be terminated. Provisions shall be made for at least two spare connecting points for additional grounding, other than for the Telephone Company, fire alarm, etc.

Some buildings may have individual PF correction capacitor banks; all new projects must be reviewed for suitability with existing systems.

Each building substation must have surge suppression.

Before handover, a coordination study as well as power systems commissioning must have been successfully completed.

All transfer switches must be make-before-break type.

***END OF SECTION***
1.1 GENERAL

1.2 Coordination Requirements

1.3 Description

2.1 MATERIAL AND DESIGN REQUIREMENTS

2.2 General

.1 The engaged consultant shall provide short circuit analysis and protective device coordination studies as prepared by the equipment manufacturer for all electrical protective devices to verify each device can safely withstand and interrupt the available fault currents to which they are applied.

.2 Utility information shall be provided, upon request, to the consultant or equipment manufacturer by SFU Facilities.

.3 Coordination information shall be shown on a graphical chart in log-log format for all applicable low voltage devices and for all devices used for Medium Voltage protection. All device settings shall be indicated either on the chart or accompanying the chart.

.4 The maximum allowable Arc Flash Hazard category for any part within Medium Voltage unit substations will be advised by SFU consultant LEX Engineering on a case by case basis.

.5 The engaged consultant shall provide an Arc Flash hazard analysis for all applicable components of the project’s electrical distribution system per CSA Standard Z462.

.6 The engaged consultant shall ensure that every effort is given to minimize the Arc Flash Hazard category while maintaining selective device coordination.

.7 The Arc Flash hazard analysis shall clearly indicate the Incident Energy, Arc Flash protection boundary and Hazard Category for each applicable device.

.8 All documentation shall be in colour and provided in soft copy PDF format. Scanned copies shall not be permitted.

.9 All applicable equipment shall have Arc Flash Hazard labels affixed as required in Section 26 10 00 Secondary Power Distribution.

.10 All ground fault protection devices must be readily accessible for monthly testing as per code requirements.

***END OF SECTION***
1.1 **GENERAL**

1.2 **Coordination Requirements**

.1 SFU Facilities

2.1 **MATERIALS AND DESIGN REQUIREMENTS**

2.2 **Performance Standards**

.1 High Voltage Cable shall comply with the requirements of the most recent edition of:
   .2 CSA C68.3.

2.3 **Cable Specifications**

<table>
<thead>
<tr>
<th>Rated Voltage (single conductor)</th>
<th>15 KV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wire Gauge</td>
<td>500 kcmil</td>
</tr>
<tr>
<td>Insulation</td>
<td>220 mil ethylene-propylene (EPR) insulation (133%), suitable for continuous operation at 105°C conductor temperature, emergency conditions at 140°C and 250°C for short circuit conditions.</td>
</tr>
<tr>
<td>Shield</td>
<td>Copper tape shield</td>
</tr>
<tr>
<td>Cable Tray</td>
<td>CSA FT4 Rated</td>
</tr>
</tbody>
</table>

2.4 **Applicable Manufacturers**

.1 Aetna Insulated Wire Company.
.2 Phillips Cable.
.3 Prysmian Cable.
.4 Alcatel.
.5 Okonite
.6 Southwire
.7 All substitutes shall be pre-approved by SFU Facilities.

2.5 **SFU Underground Duct System Consideration**

.1 All cables will be pulled into underground duct systems constructed to SFU Standards.

.2 The duct system is not waterproof and the cables may be immersed in water for long periods of time.

.3 Ducts are to be constructed as per SFU Standard Drawings E2-1, E2-2 and E2-3.

2.6 **Ground Wires**

.1 Grounding conductors shall be installed to SFU standards and as required by the Code. Specify wire size 4/0 and 500 kCM.

2.7 **High Voltage Cable Termination**

.1 High voltage cable terminations shall be Elastimold #K656 BLR 600 amp series only, unless
otherwise specified.

.2 Termination cable kit shall match conductor insulation diameter for 500 kCM or 4/0 conductors.

.3 Refer to SFU Standards Drawing # E4-2.

2.8 Interruption of Services

.1 Shut down for any 12 KV circuits must be requested 4 weeks in advance of the actual shutdown date.

.2 At any time no more than one 12 KV circuit can be shut down.

2.9 Manhole Access

.1 Permission to access any utility manhole must be coordinated and approved by SFU Facilities. A Manhole Entry Permit must be approved before entry.

.2 Entry into any manhole must be made in the company of SFU Facilities.

2.10 Safety Standards

.1 All work within a utility manhole shall comply with WorkSafeBC confined space access requirements.

2.11 Labeling

.1 Feeder labels to be installed around feeders at cable heads, stress cones, manholes, pull pits, etc.

.2 Feeders revised from existing circuit arrangements shall be relabeled at all “downstream” locations such as manholes, pull pits and building switchgear.

2.12 Testing

.1 Tests to be performed using qualified personnel. Provide necessary instruments and equipment.

.2 Perform Hi-pot testing of cable at a voltage level not exceeding cable rating on the original reel at the SFU site. Failure to comply will void the factory warranty and the installation will be at the Contractor’s risk.

.3 Check phase rotation and identify each phase conductor of each feeder.

.4 Check insulation resistance after each splice and/or termination to ensure that the cable system is ready for acceptance testing.

.5 Acceptance Testing

.1 Ensure terminations and accessory equipment is disconnected including ground shields, ground wires, metallic amour and conductors not under test.

.2 SFU Facilities has the option to perform installed cable acceptance tests on all new cable installations.
.3 Review test with the Engineer before proceeding.

.4 Provide Engineer with list of test results showing location at which each test was made, circuit tested and result of each test.

.5 Remove and replace entire length if cable fails to meet the test criteria. Contractor will be responsible for the cable and installation costs to replace damaged cable.

***END OF SECTION***
1.1 **GENERAL**

1.2 **Related Technical Requirements**

.1 *Division 26*

1.3 **Coordination Requirements**

.1 SFU Facilities

1.4 **General**

.1 The University has adopted a series of standards covering various electrical components such as manholes, duct systems, lighting poles, etc.

.2 Wherever applicable, these standards shall be used on University work.

.3 Any electrical civil standard not listed below shall be performed to MMCD and CEC specifications.

1.5 **Index to Standard Electrical Drawings**

AutoCAD files can be found on the Technical Guidelines website under *Division 26*.

<table>
<thead>
<tr>
<th>Drawing No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>E1-1</td>
<td>Single line diagram. Distribution systems 12 KV dual radial feeders typical building supply</td>
</tr>
<tr>
<td>E1-2</td>
<td>Electrical unit substation one line diagram</td>
</tr>
<tr>
<td>E1-3</td>
<td>Electrical unit substation key interlocks</td>
</tr>
<tr>
<td>E1-4</td>
<td>Typical electrical room layout</td>
</tr>
<tr>
<td>E2-1</td>
<td>Standard concrete encased electrical duct</td>
</tr>
<tr>
<td>E2-2</td>
<td>Standard electrical service conduit directly buried</td>
</tr>
<tr>
<td>E2-3</td>
<td>Standard electrical ductbank concrete encased</td>
</tr>
<tr>
<td>E2-4</td>
<td>Electrical ductbank clearances to steam distribution lines</td>
</tr>
<tr>
<td>E3-1</td>
<td>Standard electrical precast manhole</td>
</tr>
<tr>
<td>E3-2</td>
<td>Standard electrical manholes pour in place</td>
</tr>
<tr>
<td>E3-3</td>
<td>Additional reinforcing for pour in place electrical manholes</td>
</tr>
<tr>
<td>E3-4</td>
<td>Standard electrical manhole cover and riser details</td>
</tr>
<tr>
<td>E3-5</td>
<td>Standard electrical manhole sump detail</td>
</tr>
<tr>
<td>E3-6</td>
<td>Typical manhole grounding and details</td>
</tr>
<tr>
<td>Drawing No.</td>
<td>Description</td>
</tr>
<tr>
<td>------------</td>
<td>-------------</td>
</tr>
<tr>
<td>E3-7</td>
<td>Typical manhole separations</td>
</tr>
<tr>
<td>E4-2</td>
<td>Mounting and shield grounding details for splices between 2 (or more) 15 KV 'X' - Link 500 MCM &amp; 4/0 cables</td>
</tr>
<tr>
<td>E4-4</td>
<td>Schneider Electric 7350 ion meter 120/208V, 3 phase, 4 wire system. 3 element wiring connection diagram</td>
</tr>
<tr>
<td>E4-5</td>
<td>Schneider Electric 7350 ion meter 347/600V, 3 phase, 4 wire system. 3 element wiring connection diagram</td>
</tr>
</tbody>
</table>

***END OF SECTION***
1.1 **GENERAL**

1.2 Related Technical Requirements

.1 *Divisions 20 to 28*

1.3 Coordination Requirements

.1 SFU Facilities

1.4 Description

.1 SFU Requirements for Wire and Cables (0-1000 V).

2.1 **MATERIALS AND DESIGN REQUIREMENTS**

.1 Wires shall be copper throughout with 90°C insulation. Minimum wire size shall be #12 AWG except for control wire. Wires #12 AWG and larger shall be stranded.

.2 Power wiring shall be color coded red, blue and black with white for neutral and green for ground.

.3 Color shall be impregnated in the insulation for wire #8 and smaller, and clearly identified with colored vinyl tape at both ends and at all splices for large wire. Heat shrink is also acceptable.

.4 Control wiring shall be clearly identified if AC or DC.

.5 Color coding for motor control wiring shall reflect accepted industry standards, but be sized no smaller than #18.

.6 Wiring installed in underground ducts or conduits shall be copper, 1000V insulation, XLPE.

.7 Electrical wiring shall be installed in Rigid PVC, Rigid Metal, or EMT conduit. Use metallic surface raceway equal to wire mold in finished areas for renovation projects. Where deviation from this rule is necessary, a variation shall be obtained in writing from Technical Services before proceeding with the work. The variance shall apply only to the particular installation for which it is given.

***END OF SECTION***
1.1 **GENERAL**

1.2 Related Technical Requirements

   .1 Divisions 26 and 28
   .2 Division 27 Section 27 05 26 Grounding and Bonding for Communications Systems

1.3 Coordination Requirements

   .1 SFU Facilities

1.4 Description

   .1 SFU requirements for Electrical Grounding.

2.1 **MATERIALS DESIGN REQUIREMENTS**

2.2 Ground Wires

   .1 Grounding conductors shall be installed as required by the Code.
   .2 From the neutral ground position of each transformer, a grounding conductor shall be extended to the ground bus.
   .3 Ground wire for ground electrodes shall be # 4/0 copper.
   .4 All ground wire shall be tested for continuity. Record each continuity test and include in ground system report.

2.3 Ground Wires

   .1 Unit substation and pad mounted transformers shall have a ground grid.

2.4 Ground Rods

   .1 Ground rods shall be 3/4" x 10' copper clad ground rods.

2.5 Ground Fittings

   .1 Ground connections shall be made with compression fittings that are CSA approved for grounding.
   .2 Ground grid connections for buried ground grid splices shall be Cad welded or CSA approved compression connected.

2.6 Telecommunications Bonding

   .1 Please refer to 1.1.2 Section 27 05 26 Grounding and Bonding for Communications Systems for specialized telecommunications bonding requirements.

2.7 Fire Alarm Bonding

   .1 Please refer to Section 28 31 00 Fire Detection and Alarm for specialized Fire Alarm systems bonding/grounding.

***END OF SECTION***
1.1 **GENERAL**

1.2 Related Technical Requirements

1.2.1 Division 26

1.3 **Coordination Requirements**

1.3.1 SFU Facilities

1.4 **Description**

1.4.1 SFU seismic requirements for Electrical Equipment.

2.1 **MATERIALS AND DESIGN REQUIREMENTS**

2.2 **General**

2.2.1 Submit a detailed and sealed report from Structural Engineer of record who shall also ensure the specified restraint system has been installed.

2.2.2 All electrical equipment shall be seismically secured in compliance with BC Building Code.

2.3 **Transformer and Unit Substation Seismic Support**

2.3.1 The Substation Manufacturer shall have a Seismic Engineer design and select, the seismic restraint system to suit post disaster earthquake requirements.

2.3.2 Structural Engineer of record shall ensure the floor is sufficiently thick for the required bolting and that the specified restraint system has been installed.

2.3.3 Supply chemical bolts for securing the transformer.

2.3.4 Submit bolting requirements for all substation cubicles.

2.3.5 Provide flexible braid connections at transformer line and load connections. Cable connections are not acceptable.

***END OF SECTION***
1.1 GENERAL

1.2 Related SFU Technical Requirements

.1 Section 26 05 06 Standard Drawings
.2 SFU Identification and Labeling Standard

1.3 Coordination Requirements

.1 SFU Facilities

2.1 MATERIAL AND DESIGN REQUIREMENTS

2.2 Identification Logic

.1 Identify each system and system component following the "SFU Identification and Labeling Standard" which should be followed from original design inception. Identification to be consistent throughout the project. Should the SFU Identification and Labeling Standard contradict this Section 26 05 53, the Standard will take precedence.

.2 When identifying systems and components in existing buildings, the new items shall be numbered sequentially with existing systems include the zone or building area serviced by each system.

2.3 Labeling Requirements

.1 Feeder labels to be installed around feeders at cable heads, stress cones, manholes, pull pits, etc. Refer to the most up to date SFU Identification and Labeling Standard.

.2 Feeders revised from existing circuit arrangements shall be relabeled at all 'downstream' locations such as manholes, pull pits and building switchgear.

.3 Engraved lamacoid nameplates with the name of the load shall be installed on breakers or switches at the switchgear cubicles and elsewhere where called for on the drawings.

.4 Sizing of lamacoids shall be as per SFU Identification and Labeling Standard

.5 Nameplates shall be securely fastened and screwed or riveted.

.6 Exterior cubicle nameplate dimensions shall be engraved brass 4” x 1 ½” black lettering.

.7 Only fire alarm conduit is required to be distinguished and red in color.

.8 Electrical receptacles are to be labeled with black lettering on clear tape Brady label.

2.4 Labeling General

.1 Labeling convention shall abide by structure listed in the most up to date SFU Identification and Labeling Standard.

.2 Junction Boxes

.1 Junction boxes in visible areas shall be labeled with machine printed material. The label(s) shall consist of Panel #, Cct #(s), FA zone #, etc.
.3 Labels Outside

.1 Labels located outside shall be of the engraved lamacoid type and be affixed with UV or corrosion resistant ties.

.4 Equipment and Devices

.1 All equipment and devices shall be labeled with their tag # first and if this is not available the circuit #, IP address or Zone shall be labeled with machine printed material. Examples of the equipment and devices that shall be labeled:

- Light switches
- Motors / Pumps
- AHU's
- Heaters
- Equipment specific to the area

***END OF SECTION***
1.1 GENERAL

1.2 Related Technical Requirements

.1 Division 26

1.3 Coordination Requirements

.1 SFU Facilities

1.4 Description

.1 SFU requirements for Secondary Power Distribution.

2.1 MATERIALS AND DESIGN REQUIREMENTS

.1 Two secondary voltage levels are acceptable at the University:
   .1 120/208 Volt, 3-Phase 4-Wire Wye System
   .2 277/480, 3 Phase 4-Wire Wye System.

.2 Alternative voltages such as 347/600 are not acceptable unless approval provided by SFU Facilities.

.3 The selection of distribution voltage shall be based on building layout. Conditions such as large distribution loads, high building and large footprint shall be used to determine the preferred secondary distribution.

.4 If a 480V secondary distribution is selected, all motors 3/4 hp and up shall be supplied at this level.

.5 Any building supplied by 208 or 600 Volts shall have entrance switchgear designed and labelled as "Suitable for Service Entrance".

3.1 SECONDARY DISTRIBUTION EQUIPMENT IDENTIFICATION AND LABELING

.1 Secondary distribution equipment, such as Panel Boards, Load Centers and MCCs shall have conspicuously attached a permanent 2” X 4” Hazard Warning Label to meet OHSA and NFPA standards that clearly identifies:
   .1 Incident Energy
   .2 Arc Flash protection boundary
   .3 Hazard Category
   .1 Secondary distribution equipment that is identified as Hazard Category two or higher, the above label shall be 3.5” X 5”

.2 Panel Boards, Load Centers and Transformers shall be labeled and identified in accordance with the most up to date SFU Identification and Labeling Standard in all new buildings, renovation projects and in any major additions to existing buildings.

***END OF SECTION***
1.1 **GENERAL**

1.2 Coordination Requirements

1.3 Description

2.1 **MATERIAL AND DESIGN REQUIREMENTS**

2.2 Primary Bussing

2.3 Surge Arrestors

2.4 Transformer Connection

2.5 Cast Coil Transformer

<table>
<thead>
<tr>
<th>Transformer Size (KVA)</th>
<th>No. Load Losses (Watts)</th>
<th>Load Losses (Watts)</th>
</tr>
</thead>
<tbody>
<tr>
<td>750</td>
<td>2,300</td>
<td>7,500</td>
</tr>
<tr>
<td>1000</td>
<td>2,900</td>
<td>9,000</td>
</tr>
<tr>
<td>1250</td>
<td>3,250</td>
<td>10,100</td>
</tr>
<tr>
<td>1500</td>
<td>3,800</td>
<td>12,100</td>
</tr>
<tr>
<td>2000</td>
<td>5,200</td>
<td>14,300</td>
</tr>
<tr>
<td>3000</td>
<td>5,700</td>
<td>19,500</td>
</tr>
</tbody>
</table>

.5 The transformer shall be a 3 phase core type with cast epoxy coils fiber glass reinforced, type AN with forced air cooling. To provide 50% additional capacity both HV and LV coils shall be cast under a hard vacuum in steel moulds and the cores shall be mitered.
.6 Insulation system shall be Class F (185 °C) but the average winding temperature rise shall be 80 °C maximum, at rated voltage and full load.

.7 Windings shall be copper. Aluminum shall not be used.

.8 Each LV winding shall be equipped with embedded temperature sensors connected to the detection system temperature relay unit with separate output dry contacts for fan operation, remote alarm and tripping corresponding to 80% and 95% and 105% of rated operating temperature.

.9 Provide a digital readout for each phase and constant memory of the highest temperature with readout on demand.

.10 Provide remote contacts for high temperature monitoring wired to outlet box at roof of transformer.

.11 Mount temperature relay unit and thermometer on a hinged panel of a barrier instrument compartment on the side of cubicle. Connect tripping contacts to trip the primary vacuum breaker. Extend 1-NO and 1-NC alarm contact to terminal blocks in a six inch outlet box on the roof of the transformer enclosure.

.12 Power supply for cooling fan shall be supplied from power source in transformer cubicle (secondary connection).

.13 Provide design data and shop drawings for all transformer characteristics for approval by the consultant before proceeding with manufacture.

.14 The core shall be protected against corrosion by a coating of epoxy resin not less than 1 mm thick. All steel parts other than the core shall be hot dip galvanized with a minimum coating thickness of 0.1 mm or epoxy painted.

.15 After manufacture, the transformer shall be partial discharge and sound level tested in addition to standard production tests list in CSA Standard C9 to verify the specified ratings. The partial discharge shall not exceed 15 pico coulombs at a corona extinction voltage of 120% of rated voltage when energized by induction from a three phase, 60 HZ or higher frequency source. A certificate issued by the Testing Engineer shall be provided verifying the results of all factory tests.

.1 Continuous (XXX) KVA rated output.
.2 (XXX) KVA fan cooled rated output.
.3 Insulation Class - F 185 °C maximum winding temperature.
.4 Temperature Rise Design - 80 °C average winding temp rise.
.5 Frequency – 60 Hz.
.6 Rated Primary voltage – 12,480V.
.7 Rated secondary voltage 347/600V or 120/208V.
.8 Connections - delta / grounded Wye.
.9 Impedance 5% min. to 7% max.
.10 Off load taps - 4 - 2 1/2%, 2 FCAN, 2 FCBN.
.11 Basic Impulse Level – 95 KV.
.12 Available fault current rating - 300 MVA sym.
.13 Number of phases is three (3).
.14 Maximum noise level 65 dBA at full load at one meter.

.16 Approved Manufacturers are:
.1 Powersmith. Alternatives will be considered if approved by SFU Facilities.
.17 Provide the Following Features for the Transformer:

.1 Access doors key interlocked with primary circuit breaker.
.2 Engraved transformer nameplates including connections, voltage ratings, impedance, and other data as required by CSA, one on core and coils and one on exterior of enclosure.
.3 On completion of manufacture, but prior to shipment, the following tests shall be performed and results certified by a registered Professional Engineer.
   .1 All CSA C9 tests, including losses.
   .2 Partial discharge test – Factory Test.
   .3 Sound level test – Factory Test.

.18 Three copies of these results shall be forwarded to the Consultant for approval prior to transformer shipment from the factory.

2.6 Transformer Neutral

.1 Transformer secondary neutral shall be solidly grounded to ground bus mounted in transformer cubicle.

.2 Connect grounding bus in transformer cubicle with ground bus in 12 KV switchgear.

2.7 Ground Bus

.1 Provide a ground bus capable of terminating all ground and neutral connections. Allow for 3 spare 4/0 lugs and space for 6 future lugs.

2.8 Ground Fault Protection

.1 Current Transformer
   .1 Ground fault sensor current transformer sized to match requirements of ground fault relay up to full load current rating of transformer.

.2 Ground Fault Relay (51G)
   .1 Provide a secondary over current ground fault relay 50/51M with current pick-up range (0-XXX) amps, 0 - 10 seconds, adjustable definite time, with current transformer sensor in the neutral conductor of the transformer relay. Ground fault conductor shall trip main vacuum breaker.

2.9 Temperature Relay

.1 Transformer temperature relay with 3 temperature sensors, one for each winding. Relay shall have three contact settings to be set at:
   .1 80 °C Alert.
   .2 100 °C Alarm.
   .3 120 °C Trip.

2.10 SFU Facilities Revenue Meter

.1 Revenue grade meter must be used.

.2 Multifunction Meter with Ethernet capability. Refer to Section 26 27 13 Metering.

2.11 Interlocking

.1 Safety interlocks shall be provided as required, equal to Kirk or FPE. Load break switches
shall be interlocked with the transformer tap door and the 12 KV PT access door. Refer to interlocking diagram.

2.12 Vibration Isolation Requirements

.1 Particular attention shall be paid to the installation of the transformer to reduce the noise level in the transformer room.

.2 Supply transformers generating a space average noise level in the transformer room not exceeding 60 decibels measured in any third octave bank between 50 Hz and 1000 Hz based on a 300 KVA transformer.

.3 Other sizes shall meet equivalent noise level with noise correction based on 10 Log KVA re. 300 KVA.

.4 Supply vibration isolation such that the airborne noise isolation provided by the building structure is not limited by structure borne noise transmission. The following are minimum isolation requirements:

   .1 Mount the transformer core on 25 mm deflection spring isolators, including in series neoprene elements with an effective deflection of 2.5 mm, and restraints meeting the National Building Code with respect to seismic requirements.

   .2 For a slab on grade installation, use neoprene isolators sized for a minimum 2.5 mm deflection, with seismic restraints.

   .3 If the transformer core is mounted on separate transverse steel supporting members, independent of the transformer enclosure, size the members for a 140 Hz cantilever resonant frequency under the dead load of the member (0.013 mm dead load cantilever deflection) and the spring stiffness.

   .4 Provide sufficient flexibility in the braided connectors on both the low voltage and high voltage sides of the transformer such that the vibration isolation provided by the spring/neoprene isolator supports is not limited by the braided connectors. If such flexibility is impractical, isolate the cabinets on neoprene isolators with 2.5 mm deflection and isolate the conduit.

   .5 Within the electrical room, provide neoprene hangers with 0.1” static deflection in threaded rod supports for all new conduit, cable trays, etc. Avoid rigid connections to the structure. Avoid any contact of electrical equipment to drywall partitions where transformer rooms are located adjacent to occupied spaces.

.5 Submit shop drawings detailing proposed isolation.

***END OF SECTION***
1.1 GENERAL

1.2 Coordination Requirements

.1 SFU Facilities

1.3 Description

.1 SFU requirements for Substation Transformers.

2.1 MATERIAL AND DESIGN REQUIREMENTS

2.2 Primary Bussing

.1 15 KV primary copper bussing, minimum capacity 600 amps, 300 MVA bracing.

2.3 Surge Arrestors

.1 Provide three 12 KV MCOV distribution class lightning arrestors. Install immediately upstream of transformer primary connection. Ground arrestors directly to ground bus with 4/0 copper.

2.4 Transformer Connection

.1 Flexible copper braid connections at both primary and secondary connections of transformer.

2.5 Cast Coil Transformer

.1 Substation transformer(s) to step down voltage from 12.48 KV to 227/480V or 120/208V shall be cast coil type, Class F insulation.

.2 Cast coil transformer with fan cooling to provide 50% additional load capacity. The transformer cubicle shall contain transformer core and cast coils, fans and controls, temperature measuring assembly, neutral/ground CT, primary and secondary busses and ground bus.

.3 The transformer shall be designed and built in accordance with the current issues of CSA Standard C9 and ANSI Standard C57.12.00.

.4 Losses shall not exceed those specified below and shall be in compliance with or exceed CSA Standard C802 requirements.

<table>
<thead>
<tr>
<th>Transformer Size (KVA)</th>
<th>No. Load Losses (Watts)</th>
<th>Load Losses (Watts)</th>
</tr>
</thead>
<tbody>
<tr>
<td>750</td>
<td>2,300</td>
<td>7,500</td>
</tr>
<tr>
<td>1000</td>
<td>2,900</td>
<td>9,000</td>
</tr>
<tr>
<td>1250</td>
<td>3,250</td>
<td>10,100</td>
</tr>
<tr>
<td>1500</td>
<td>3,800</td>
<td>12,100</td>
</tr>
<tr>
<td>2000</td>
<td>5,200</td>
<td>14,300</td>
</tr>
<tr>
<td>3000</td>
<td>5,700</td>
<td>19,500</td>
</tr>
</tbody>
</table>

.5 The transformer shall be a 3 phase core type with cast epoxy coils fiber glass reinforced, type AN with forced air cooling. To provide 50% additional capacity both HV and LV coils shall be cast under a hard vacuum in steel moulds and the cores shall be mitered.
.6 Insulation system shall be Class F (185 °C) but the average winding temperature rise shall be 80 °C maximum, at rated voltage and full load.

.7 Windings shall be copper. Aluminum shall not be used.

.8 Each LV winding shall be equipped with embedded temperature sensors connected to the detection system temperature relay unit with separate output dry contacts for fan operation, remote alarm and tripping corresponding to 80% and 95% and 105% of rated operating temperature.

.9 Provide a digital readout for each phase and constant memory of the highest temperature with readout on demand.

.10 Provide remote contacts for high temperature monitoring wired to outlet box at roof of transformer.

.11 Mount temperature relay unit and thermometer on a hinged panel of a barrier instrument compartment on the side of cubicle. Connect tripping contacts to trip the primary vacuum breaker. Extend 1-NO and 1-NC alarm contact to terminal blocks in a six inch outlet box on the roof of the transformer enclosure.

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.13 Provide design data and shop drawings for all transformer characteristics for approval by the consultant before proceeding with manufacture.

.14 The core shall be protected against corrosion by a coating of epoxy resin not less than 1 mm thick. All steel parts other than the core shall be hot dip galvanized with a minimum coating thickness of 0.1 mm or epoxy painted.

.15 After manufacture, the transformer shall be partial discharge and sound level tested in addition to standard production tests list in CSA Standard C9 to verify the specified ratings. The partial discharge shall not exceed 15 pico coulombs at a corona extinction voltage of 120% of rated voltage when energized by induction from a three phase, 60 Hz or higher frequency source. A certificate issued by the Testing Engineer shall be provided verifying the results of all factory tests.

.16 Approved Manufacturers are:

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.1 Access doors key interlocked with primary circuit breaker.
.2 Engraved transformer nameplates including connections, voltage ratings, impedance, and other data as required by CSA, one on core and coils and one on exterior of enclosure.
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   .1 All CSA C9 tests, including losses.
   .2 Partial discharge test – Factory Test.
   .3 Sound level test – Factory Test.

.18 Three copies of these results shall be forwarded to the Consultant for approval prior to transformer shipment from the factory.

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.1 Transformer secondary neutral shall be solidly grounded to ground bus mounted in transformer cubicle.

.2 Connect grounding bus in transformer cubicle with ground bus in 12 KV switchgear.

2.7 Ground Bus

.1 Provide a ground bus capable of terminating all ground and neutral connections. Allow for 3 spare 4/0 lugs and space for 6 future lugs.

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.1 Current Transformer
   .1 Ground fault sensor current transformer sized to match requirements of ground fault relay up to full load current rating of transformer.

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   .1 Provide a secondary over current ground fault relay 50/51M with current pick-up range (0-XXX) amps, 0 - 10 seconds, adjustable definite time, with current transformer sensor in the neutral conductor of the transformer relay. Ground fault conductor shall trip main vacuum breaker.

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   .2 100 °C Alarm.
   .3 120 °C Trip.

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.1 Revenue grade meter must be used.

.2 Multifunction Meter with Ethernet capability. Refer to Section 26 27 13 Metering.

2.11 Interlocking

.1 Safety interlocks shall be provided as required, equal to Kirk or FPE. Load break switches
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.1 Mount the transformer core on 25 mm deflection spring isolators, including in series neoprene elements with an effective deflection of 2.5 mm, and restraints meeting the National Building Code with respect to seismic requirements.

.2 For a slab on grade installation, use neoprene isolators sized for a minimum 2.5 mm deflection, with seismic restraints.

.3 If the transformer core is mounted on separate transverse steel supporting members, independent of the transformer enclosure, size the members for a 140 Hz cantilever resonant frequency under the dead load of the member (0.013 mm dead load cantilever deflection) and the spring stiffness.

.4 Provide sufficient flexibility in the braided connectors on both the low voltage and high voltage sides of the transformer such that the vibration isolation provided by the spring/neoprene isolator supports is not limited by the braided connectors. If such flexibility is impractical, isolate the cabinets on neoprene isolators with 2.5 mm deflection and isolate the conduit.

.5 Within the electrical room, provide neoprene hangers with 0.1” static deflection in threaded rod supports for all new conduit, cable trays, etc. Avoid rigid connections to the structure. Avoid any contact of electrical equipment to drywall partitions where transformer rooms are located adjacent to occupied spaces.

.5 Submit shop drawings detailing proposed isolation.

***END OF SECTION***
1.1 GENERAL

1.2 Related Technical Requirements

.1 Division 20, Section 20 00 06 Meters
.2 Division 33, Section 33 10 00 Water Utilities; Section 33 51 00 Natural Gas Distribution

1.3 Coordination Requirements

.1 SFU Facilities

1.4 Description

.1 SFU requirements for Metering.

2.1 MATERIAL AND DESIGN REQUIREMENTS

2.2 General

.1 Switchgear manufacturer shall supply and install Revenue meter to unit sub manufacturer at the project’s cost.

.2 All substations central metering are to be connected via MODBUS to SFU’s SCADA system.

2.3 Revenue Metering

.1 Revenue meter shall be Measurement Canada approved, Schneider Electric Type 7350 ION Multifunction Meter with Ethernet options.

.2 It shall be for use with 3 current transformers and programmed for CT’s to allow for direct readout.

.3 The meter shall be flush mounted @ 54” above finished floor (centre of meter) in a separately barriered instrument compartment in the distribution enclosure. Provide surface mounted on the inside of the door of the metering compartment a 10-pole test block for current and potential circuits.

.1 For 120/208V Systems wire the meter as shown on Drawing E4-4.
.2 For 347/600V Systems wire the meter as shown on Drawing E4-5.

.4 Approved Test Block Manufacturers:

.1 ABB type FT-1.
.2 Sangamo.
.3 Superior #1082F.

2.4 Metering Transformers

.1 Metering transformers shall be provided by the switchgear manufacturer.

.2 Three current transformers (CT’s) shall include revenue metering accuracy of 0.3B0.9, ratio XXX/5 for Schneider Electric 7350 ION multifunction meter. Mount CT’s on transformer secondary bus.

.3 Metering at 600V secondary shall include three voltage transformers, revenue accuracy, 360:120 ratio shall be mounted in a separate barrier instrument compartment.
.4 Substation meters are to be connected via MODBUS to SFU’s SCADA system. 48V DC power is required for this metering.

2.5 Mechanical Meters

.1 Heating water BTU energy meters are directly connected from DDC to SCADA system. For full details refer to Division 20, Section 20 00 06 Meters.

.2 For gas and water meters refer to Division 20, Section 20 00 06 Meters for latest requirements.

3.0 OTHER

.1 A raceway shall be provided between the 7350 ION meter and the nearest communications closet. Provide an IT demarcation box within 3 metres of the 7350 ION meter.

***END OF SECTION***
1.1 **GENERAL**

1.2 Related Technical Requirements

.1 Division 27, Section 27 05 05 Communication Rooms Design Guidelines – 2.6
.2 Division 28, Section 28 31 00 Fire Detection and Alarm

1.3 Coordination Requirements

.1 SFU Facilities and Environmental Health and Safety should be involved with both planning/design stages and commissioning of new generator installations and renewals of existing. This to include tank locations, anti-siphoning, piping, genset enclosures, and transfer switches etc.

.2 SFU IT.

1.4 Description

.1 Generator for emergency and stand-by power.

2.1 **MATERIALS AND DESIGN REQUIREMENTS**

2.2 General Requirements

.1 All buildings are required to have a generator for life safety equipment. (Non-life safety) equipment requiring a generator will be addressed on a case-by-case basis.

.2 When a generator is installed, the following equipment shall be connected to the life safety source.

.1 All active smoke control equipment and controls
.2 Fire Alarm Control Panel
.3 Emergency and exit lighting
.4 Heat Trace wiring
.5 Sprinkler system equipment (dry and pre-action system compressors, excess pressure and fire pumps, heating systems for water service rooms, etc.)
.6 Sanitary sump pumps and storm sump pumps
.7 Main electrical room lighting and least one convenience receptacle

.4 If a generator is installed, then all emergency power shall be supplied from it and battery packs shall not be used other than at the generator/transfer switch location to allow for breakdown maintenance.

.5 In general, fume and bio-hazard hoods should not be supplied from life safety power. Alternate proposals to supply fume and bio-hazard hoods from emergency power may be discussed with SFU Facilities.

.6 In general, elevators not designated as “Elevator for Use by Firefighters” by the BC Building Code should not be powered from generators unless specifically required to be by the BC Building Code. Alternate proposals to supply non-designated elevators from life safety power may be discussed with SFU Facilities.

.7 Emergency generators shall supply only life safety requirements except as otherwise noted or as required by the BC Building Code.
.8 Emergency generators shall be diesel fuel type only.

.9 Emergency generators shall have a minimum 24-hour run time under 100% loading without refueling.

.10 All generators shall be capable of being refueled from ground level. The refueling location shall be accessible for fuel trucks to park within 5 meters.

.11 Confirm positive fuel prime to all fuel pumps.

.12 Fuel level, generator run and generator trouble should be pulled as 3 separate dry contacts for connection from generators.

.13 Critical alarms will be monitored through fire alarm system. See Section 28 31 00 Fire Detection and Alarm for fire alarm system for monitoring of generator and transfer switches.

.14 In buildings where generators are installed a 5-20R receptacle supplied by a dedicated over current device shall be installed immediately below each panel that derives its supply from the life safety distribution.

2.3 Generator Housing and Location

.1 Generators to be primarily located at ground level in separate enclosures. Generators can ONLY be located at roof level if they can be replaced by lifting with a mobile crane.

.2 If located at roof level, locate diesel exhaust away from potential air intakes and open windows. Provide ample vibration isolation and a fuel pumping system to allow for refuelling from ground level.

.3 Generators should be housed in areas which are large enough to allow for maintenance, testing and repair, and remove and replace components, without having to remove portions of the structure in which they are mounted.

.4 Generator areas should be provided with room lighting, power, ventilation and heat (from generator supply) for maintenance. Marine lights should be provided for status.

.5 The areas shall be insulated and heated so as to minimize maintenance on the units.

.6 Generator rooms and transfer switch locations shall be provided with an emergency battery lighting pack for breakdown safety and maintenance on the units.

2.4 Equipment Type

.1 Generators shall be sourced from original equipment suppliers such as Cummins, Cat or equivalent so that parts are readily available and locally supplied and supported.

.2 Fuel filters shall be Racor pleated filters or SFU approved equal.

.3 Obtain approval list of acceptable manufacturers and products from SFU Facilities. System shall be compatible with existing SFU operating control systems.

2.5 Loadbank Requirements

.1 If generators are only carrying a light load from the building, a loadbank shall be installed so
that the generator runs at fifty percent of rated load at a minimum. This loadbank shall be of such a design that resistors can be taken out as building loads increase over time.

.2 To assist with maintenance, generators shall have a second circuit breaker on the generator output prior to the transfer switch. This is for tying in load banks for annual testing without disturbing cables and lugs of normal loads, as per CSA C282-05 B18. The output of the second breaker shall extend to a terminal box complete with connecting lugs or camlok connections.

2.6 Time Delay

.1 The time delay on restoral to utility should be set to fifteen minutes, rather than the normal ten minutes. Allowing the generator to continue running for fifteen minutes after the reset of the transfer switch to the utility is better for the generator and ensures smoother power transfer in the event of multiple interruptions and power surges (which occur frequently on an outage).

2.7 Automatic Transfer Switches

.1 Automatic Transfer Switches (ATS) shall be supplied with fully rated double-bypass capability.

.2 A point shall be monitored downstream of the transfer switch to ensure successful transfer - transfer switch has proper function (power is on load side of switch).

.3 The entire ATS & bypass assembly shall be certified to CSA C22.2 No. 178.

.4 ATS shall have a minimum 18 cycle Withstand and Close-on Rating on all equipment rated at 800 amps and greater.

.5 ATS bypass/isolation handles shall be permanently attached & require a maximum of two steps to perform bypass/isolation operation.

.6 ATS main contacts and bypass contacts shall be fully withdrawable on equipment rated at 800 amps and greater.

.7 All components within the ATS shall be supplied and supported by the ATS provider.

.8 Closed Transition Transfer Switches (CTTS) shall include a separate redundant protection relay to prevent any possible back feed to the utility. All methods of providing this form of protection shall be submitted to SFU Facilities for approval prior to equipment installation.

.9 CTTS redundant backfeed protection may be a reverse power relay set not more than 10% of the generator rating or extended parallel relay set at not more than 300mSec.

.10 Transfer switches shall be Asco, (or equivalent).

2.8 Fuel Tanks

.1 All diesel fuel tanks shall be above ground and double walled unless a single walled tank is contained by a separate containment tank, for example, a day tank.

.2 Underground tanks that are inherited with their piping systems shall be pressure tested every two years. Above ground tanks shall be visually inspected once per year and pressure tested every five years.

.3 Fuel storage tanks shall be protected from freezing.
2.9 Maintenance Manuals

.1 Complete sets of manuals, (these shall include operators, owners, troubleshooting, full repair manuals as well as any disks and software diagnostics), shall go to the shop level before sign off and acceptance of units. Coordinate type and quantity with Division 01, Section 01 78 23 Operation and Maintenance Data.

.2 A complete set of manuals for each Transfer Switch shall be provided. The manuals shall include all schematics and wiring diagrams for actual supplied components. Generic manuals will not be accepted.

2.10 Emergency Lighting Battery Packs

.1 Emergency lighting battery packs, where used, shall be ‘Ready-Lite’, 12V only, 360 watt units. The battery packs shall not be self-testing as this disturbs the building users.

.2 Heads to be 9 watt units mounted on manufacturer supplied shelf and shall not be hard wired to the AC supply. The units shall be mounted on a manufacturer supplied shelf designed for the purpose and plugged into a receptacle only and shall be rated for 120 VAC.

***END OF SECTION***
1.1 GENERAL

1.2 Related Technical Requirements

.1 Section 27 05 05 Communication Rooms Design Guidelines – 2.13

1.3 Coordination Requirements

.1 SFU Facilities
.2 Coordinate commissioning of the Emergency Lighting System with SFU Safety and Risk Services
.3 SFU IT

2.1 MATERIAL AND DESIGN REQUIREMENTS

2.2 General

.1 All interior building lighting shall be supplied from 120/277 volt power systems.

.2 Lighting design shall incorporate the principles of sustainability and its products and systems shall be energy conserving, long life, have a low cost of ownership and be accessible for service and maintenance.

.3 For interior building lighting solutions, preference shall be given to (LED) light sources.

.4 Daylight harvesting opportunities shall be implemented in areas where natural daylight is available.

.5 Uniformity and low brightness contrast shall be achieved by judicious use of luminaires and their locations.

.6 All lighting shall be designed to suit the task and task location rather than the general lighting. Latest versions of ASHRAE 90.1, IESNA and WorkSafeBC guidelines shall be taken into consideration and calculations submitted where requested.

.7 As a general rule, the following task lighting levels shall be used:

<table>
<thead>
<tr>
<th>Task</th>
<th>Lighting Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Offices</td>
<td>500 lux maintained.</td>
</tr>
<tr>
<td>Classrooms and Seminar Rooms</td>
<td>500 lux maintained.</td>
</tr>
<tr>
<td>Corridors</td>
<td>100 lux maintained.</td>
</tr>
<tr>
<td>Washrooms</td>
<td>150 lux maintained.</td>
</tr>
<tr>
<td>Special areas</td>
<td></td>
</tr>
<tr>
<td></td>
<td>such as laboratories, Audio/Video rooms, drafting rooms, etc., in accordance with the user’s task requirements and IESNA recommendations.</td>
</tr>
</tbody>
</table>

.8 When mounting luminaires in high ceiling spaces, consideration must be given to ensure access for maintenance such as lamp and ballast changing. The use of scaffolding is discouraged. Indoor lighting shall be accessible either from ladders on flat surfaces such as floors or stair landings or from powered lifts with a maximum lift of 6.1 m. Building access, floor construction, and elevators shall permit entry and use of existing SFU lift equipment for proper and safe maintenance. Lift can pass through a standard 3’x7’ door opening. If special equipment is required for lighting maintenance, then the consultant shall, prior to tender, prepare and submit maintenance plan to SFU for review and approval and it shall contain documentation describing the special equipment and a maintenance schedule and spare parts list.
.9 The lighting design proposed for all public areas such as corridors and stairways shall ensure the life safety of building occupants at all times and shall also minimize lighting energy required to zero, if possible, when the building is un-occupied. (i.e. lights off until occupancy has been detected or an emergency has occurred). A portion of the lighting fixtures shall be wired to an emergency power panel if an emergency generator is available. Lighting circuits fed from emergency power panels shall be arranged so that they may be switched or dimmed during normal operation.

.10 Non-linear specialty fixtures such as pot lights, cylinders, wall sconces, wall washers and other decorative lighting shall be minimized and shall not exceed 10% of the total quantity of fixtures in the building project. When used, these luminaires shall not be enclosed and shall incorporate vertically aligned medium base screw-in LED lamps.

.11 In general, Metal Halide (MH) lighting solutions are not acceptable. In exceptional circumstances where MH is required to achieve the lighting design requirements then Ceramic Metal Halide lamps shall be used and shall be consistent with ANSI standards, and shall be equipped with compatible 120 volt ANSI compliant ballasts.

.12 Banks of multiple switches shall be labeled to avoid confusion.

2.3 Lamps

.1 Lamps shall be the longest life available.

.2 Use of LED lamps is encouraged and as substitutes for traditional applications. LED lamps shall be Energy Star rated.

2.4 Ballasts

.1 All fluorescent lighting ballasts shall operate from 120 volt input voltage and shall be instant start electronic type with standard ballast factor. Ballasts shall have parallel lamp operation.

.2 Ballast output frequency shall be greater than 42 kHz.

.3 Dimming ballasts shall be instant start with 0-10 volt control.

.4 Ballasts shall have lamp end-of-life detection and shutdown circuitry that meets ANSI standards.

2.5 Lighting Controls

.1 Lighting controls will follow ASHRAE 90.1 requirements, as well as the Technical Requirements in this section.

.2 All interior lighting shall have controls such that when the lighting is not needed, it will automatically be either turned off or dimmed to a low output condition.

.3 For new building projects, addressable devices and systems form the control structure for lighting. These systems are to operate independently of the BAS.

.4 Occupancy sensors using microphonic technology are preferred, and may be either line voltage or low voltage types. Low voltage occupancy sensors with 1 or 2 poles and local power packs are preferred. Slave power packs are not acceptable. The occupancy sensor time delay settings shall be adjusted to 10 minutes for offices, classrooms or theatres and 20 minutes for washrooms.
.5 Offices, classrooms, and lecture theatres shall have light control switches at all entrances, exits and vestibules. These interior spaces shall also have occupancy sensors, mounted at a high level in a corner and arranged for semi-automatic operation such that manual operation of the local switches is required to energize the lighting while occupancy sensors and local switches will de-energize the lighting. Large spaces may need more than one sensor.

.6 Corridors, lobbies, atria and similar public spaces shall be controlled by the BMS system and shall also have occupancy sensors, mounted at high levels, and arranged for full automatic operation. The BMS system shall energize lighting in these areas in the early morning and will also disable the occupancy sensors in these areas during the daytime occupied condition. Late at night when the building is un-occupied, the BMS system will energize the occupancy sensors and lighting in these areas will be turned off automatically once the un-occupied sensor time-out period has expired. The occupancy sensor time delay settings shall be adjusted to 20 minutes for corridors and public spaces. Large spaces may need more than one sensor.

.7 Occupancy sensors are not permitted in interior spaces that may be or may become hazardous, such as electrical and mechanical service rooms.

.8 Mechanical and Electrical services rooms must have illuminated light switch.

.9 All classrooms and lecture theatres shall have LV lighting control switches at all entrances and exits to the space. In addition, LV switching controls shall be installed at the instructor’s end of the space. Classroom and lecture theatre lighting control shall include zoning and separate zone control. Zone 1 comprises the white board area; zone 2 comprises the front of the room; zone 3 deals with lighting in the front seating area; and zone 4 deals with back seating area lighting. The extent of zoning and multi-level of control within zones will vary depending upon size of the teaching space.

.10 Where applicable, all classrooms, lecture theatres, offices, corridors, stairways and other public spaces shall incorporate daylight harvesting via use of interior mounted photocells and arranged to take advantage of free illumination while maintaining acceptable minimum illumination levels within the space.

.11 LED dimmers shall be compatible with the LED lamps used and their drivers.

.12 New dimmable CFL lamps shall be left on at full power for 3 days (72 hours) before engaging dimmers.

2.6 Exit Signage

.1 Exit lighting shall be provided in accordance with the BC Building Code and the Canadian Electrical Code as amended by BC Electrical Safety regulations.

.2 All exit signs shall be illuminated by LED light sources.

.3 Exit signs shall be powered at 120 volts from emergency power panels, if available.

2.7 Emergency Lighting

.1 Emergency lighting must be installed in accordance with the B.C. Building Code.

.2 Individual light fixtures shall not contain batteries.

.3 The battery packs shall be long life type and either 12 volts DC or 24 volts DC and shall be in accordance with CSA C22.2 No. 141.
.4 All battery packs shall be mounted and secured on an appropriately sized shelf.

.5 Generator and Electrical rooms and washrooms shall be provided with an emergency battery lighting pack.

.6 If 12 volt DC is used they shall be the 36 watt or 360 watt units only and should not be self-testing as clients do not understand the self-test and call in a trouble call unnecessarily.

.7 If 24 volts DC are used they shall be either a 360 watt unit or a 720 watt unit only. They shall also be a basic model without meters or self-testing.

.8 For both 12 volt DC and 24 volt DC systems, the heads and remote heads shall be 9 watts each.

.9 Battery packs that are fed from a 120 volt AC. source shall have a 120 volt duplex receptacle mounted adjacent so that the battery pack can be plugged into the receptacle.

2.8 Lighting Power Density

.1 The installed lighting power shall not exceed the lighting power allowance developed in accordance with the latest version of ASHRAE 90.1

2.9 Approved Lighting Fixture Products Standard

<table>
<thead>
<tr>
<th>Application</th>
<th>Light Source</th>
<th>Fixture Mfr</th>
<th>Fixture Model</th>
<th>Mounting</th>
<th>Voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Classrooms, Offices T-bar ceiling</td>
<td>LED 2x2</td>
<td>Cooper Encounter</td>
<td>22-EN-LD2-39</td>
<td>Recessed</td>
<td>120/277</td>
</tr>
<tr>
<td>Classrooms, Student Lounges open ceiling</td>
<td>LED linear</td>
<td>Ledalite Sync</td>
<td></td>
<td>Suspended</td>
<td>120/277</td>
</tr>
<tr>
<td>Public area T-bar ceiling</td>
<td>LED 2X2 or 1X4</td>
<td>Cooper Encounter</td>
<td>22-EN-LD2-39 or</td>
<td>Recessed Pot</td>
<td>120/277</td>
</tr>
<tr>
<td>Classroom, Office T-bar with occupancy and daylight control</td>
<td>LED 2X2</td>
<td>Philips Clear Appeal</td>
<td>2CAG30L835-2-DS-UNV-DIM-SWZG2</td>
<td>Recessed</td>
<td>120/277</td>
</tr>
<tr>
<td>Public area</td>
<td>LED pot fixture</td>
<td>Standard Products</td>
<td>LED/PRESTO/DL6ID/9W</td>
<td>Recessed</td>
<td>120/277</td>
</tr>
</tbody>
</table>

Alternates may be approved, coordinate with SFU Facilities.

***END OF SECTION***
1.1 GENERAL

1.2 Coordination Requirements

.1 SFU Facilities
.2 Coordinate commissioning of the Emergency Lighting System with SFU Safety and Risk Services
.3 SFU IT

1.3 Description

.1 SFU requirements for Exterior Lighting.

2.1 MATERIAL AND DESIGN REQUIREMENTS

.1 Design should be developed together with SFU campus development intent and input.

.2 For each project, exterior lighting must be provided for all roadways, plazas, walks, steps, etc., to a level sufficient to meet safety requirements of all users, but as a minimum to meet IESNA published standards where available. Where public use of the project at night is required, this lighting shall extend beyond the boundaries of the project site to include contiguous access and parking areas.

.3 Lighting design shall incorporate the principles of sustainability and its products and systems shall be energy conserving, long life, have a low cost of ownership and shall be easily and safely accessible for service and maintenance. If special equipment is required for lighting maintenance, then the consultant shall, prior to tender, prepare and submit a Lighting System Maintainability Plan to SFU for review and approval and it shall contain documentation describing the special equipment and a maintenance schedule and spare parts list.

.4 Exterior lighting is supplied with electrical energy from nearby buildings. For each project where existing exterior lighting will be impacted by planned new construction, the new project scope shall include all needed adjustments, removals or relocations to the existing systems to ensure continued operation of existing exterior lighting systems beyond the project boundaries, as well as new exterior lighting for the new project. The scope for remediation of existing lighting systems shall be as per the original design intent.

.5 Lighting equipment shall be vandal proof by use of proper design and sufficient mounting height.

.6 Building highlighting/floodlighting is discouraged.

.7 Landscape (garden-shrub-lawn) type lighting is not acceptable.

.8 Exterior lighting shall be arranged for full automatic operation and shall be controlled by the BMS system.

.9 Where feasible, floodlighting of high quality, low glare design installed on building areas inaccessible to the public can be used.
.10 In all cases, lamps of low energy input-high lumen output with appropriate color rendition shall be used.

.11 Preferred line of light poles shall be Cree Edge Series.

.12 Poles shall be steel and be painted with one coat of primer and 2 coats of paint.

.13 Poles complete with luminaries shall be able to withstand 160 km/h winds.

.14 Poles and bollards exterior lighting shall be controlled by SFU wireless clock transmitter.

### 2.2 APPROVED LIGHTING FIXTURE PRODUCTS STANDARD

#### Exterior Lighting

<table>
<thead>
<tr>
<th>Application</th>
<th>Light Source</th>
<th>Fixture Mfr</th>
<th>Fixture Model</th>
<th>Colour</th>
<th>Mounting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poles 10-12 feet</td>
<td>LED 27 Watt</td>
<td>Cree Edge</td>
<td>XAL-13042LEDA277V8K</td>
<td>Black</td>
<td>Side mount</td>
</tr>
<tr>
<td>Poles 13-16 feet</td>
<td>LED 53 Watt</td>
<td>Cree Edge</td>
<td>BXSPB-HT3ME-A40K-UL</td>
<td>Black</td>
<td>Side mount</td>
</tr>
<tr>
<td>Poles 13-16 feet spider mount</td>
<td>LED 42 Watt</td>
<td>Cree</td>
<td>ARE-EDR3M-R3-06-EUL-350</td>
<td>Black</td>
<td>Top mount</td>
</tr>
<tr>
<td>Poles 20-23 feet</td>
<td>LED 136 Watt</td>
<td>Cree</td>
<td>STRLWY-HT1-ULA-40K</td>
<td>Black</td>
<td>Side mount</td>
</tr>
<tr>
<td>Parkade</td>
<td>LED strip</td>
<td>Beghelli Spada</td>
<td>SPA-4HT-40W-WT40-120/277</td>
<td>Silver</td>
<td>Low ceiling chain hung or surface mount</td>
</tr>
<tr>
<td>Building Perimeter Wall</td>
<td>LED</td>
<td>Hubbell Laredo</td>
<td>LNC2-18LU</td>
<td>Black</td>
<td>Wall Mount above 9 feet</td>
</tr>
<tr>
<td>Building Perimeter Door and Stairwells</td>
<td>LED</td>
<td>Hubbell Laredo</td>
<td>LNC2-9LU</td>
<td>Black</td>
<td>Wall mount below 8 feet</td>
</tr>
<tr>
<td>Building Soffit</td>
<td>LED</td>
<td>Luminaire LED</td>
<td>SWP610-HO</td>
<td>Black</td>
<td>Wall Mount</td>
</tr>
<tr>
<td>Low Bay Industrial</td>
<td>LED</td>
<td>Digital Lumens</td>
<td>DLE-12-ST/HV</td>
<td>Grey</td>
<td>Surface</td>
</tr>
<tr>
<td>Parking Lot Poles 23 feet</td>
<td>LED 129 Watt</td>
<td>Kim Largent</td>
<td>SLVT-TS-4K-450-BL-LDL</td>
<td>Black</td>
<td>Top mount</td>
</tr>
<tr>
<td>Pathway Bollard</td>
<td>LED 22 Watt</td>
<td>Cree</td>
<td>PWY-EDG-3M-P4-02-E-UL-BK-350</td>
<td>Black</td>
<td>Concrete base</td>
</tr>
</tbody>
</table>

Alternates may be approved, coordinate with SFU Facilities.

***END OF SECTION***
1.1 **GENERAL**

1.2 **Related SFU Technical Requirements**

   .1 Division 27
   .2 Section 27 10 00 Structured Cabling

1.3 **Coordination Requirements**

   .1 Coordinate with SFU Facilities
   .2 Coordinate with SFU IT
   .3 Electrical consultant

1.4 **Description**

   .1 SFU general requirements for communications *Division 27*.

2.1 **MATERIAL AND DESIGN REQUIREMENTS**

2.2 **General Communications Infrastructure Summary**

   .1 The Contractor shall provide Division 27 systems at SFU campus buildings as described herein and as indicated on the supplied drawings.

   .2 The following communications sub-divisions are part of division 27:
      - Structured Cabling
      - Emergency Phones (Code Blue)
      - Intercom Phones

2.3 **Scope of work**

   .1 Unless otherwise noted, provide for all labour and material to constitute complete and operational Structured Cabling system as described herein and on drawings.

   .2 Any apparatus, appliances, materials, or work not shown on the drawings, but mentioned in the specifications, or vice versa, or any incidental accessories necessary to make the work complete and ready for operation, even if not particularly specified, shall be furnished, delivered, and installed by the Contractor, without additional expense to the Owner.

   .3 Coordinate installation with division 26 contractor and other trade contractors to facilitate installation work. Extra costs arising from conflicts or delay due to improper contractor’s coordination shall be the responsibility of the Contractor. The cost of close coordination with other trade contractors shall be the responsibility of the Contractor.

   .4 Provide all equipment, personnel, & resources necessary to facilitate infrastructure testing and commissioning.

   .5 Provide as-built documents, diagrams, manuals, tests results, warranties and other documentation as specified.

   .6 Provide applicable infrastructure operation and maintenance training to SFU.
Provide seismic restraints in accordance with local building codes and regulations and any additional requirements specified herein. Contractor shall be responsible for all costs associated with obtaining all necessary professional approvals for all seismic restraints and related shop drawings. Seismic restraints without prior approval by a professional Seismic Engineer shall be rejected by the Owner.

2.4 Reference Manufacturers & Products

Reference manufacturers and/or products are described herein as a minimum reference performance requirement. Equivalent products may be considered by SFU only if it is of equal or better performance (e.g. improved delivery of signal, head-room, immunity to alien signals, power delivery, mechanical properties etc.) and brings a benefit to the Project. This review will occur during the Shop Drawing review stage.

2.5 Pre-Approved Manufacturers & Products

Pre-approved manufacturers and products shall be used within the quotation. It is the discretion of SFU whether equivalent or superior products may be used. This review will occur during the Tender stage.

2.6 Product Alternates and/or Substitutes

During the tender stage, the bidder shall be responsible for ensuring that proposed product alternates and/or substitutes meet and/or exceed the published performance specifications.

Submit request for alternates and/or substitutes to SFU with sufficient information to facilitate suitability review. Contractor shall submit requests for alternates and/or substitutes minimum 7 days prior to tender close. Approved alternate products shall be confirmed by an Addendum minimum 3 days before tender closing.

No alternates nor substitutes may be installed, without prior approval by SFU. If the Contractor substitutes any product without written permission from SFU, he/she shall be responsible for costs associated with supplying and/or installing products that will meet or exceed the published specifications, that are approved by SFU.

2.7 Contractor Qualifications

Telecommunication contractor shall be Belden IBDN CSV in good standing with Belden and must be pre-approved by SFU. See Section 27 10 00 for list of pre-approved installation companies. Other contractors may apply for pre-qualification in writing minimum 2 weeks prior to tender closing date. And will be notified by an addendum.

Both Contractor and subcontractor(s) shall be competent in installing the system(s) undertaken to perform work for. Competence is having the adequate skill in installing such systems AND relevant experience in installing similar systems.

The Contractor must have worked for a minimum of seven (7) years on systems of this type and size. Upon request, the Contractor must submit evidence of qualifications, experience and references to SFU.
.4 Notwithstanding other requirements stipulated herein, the requirement of competence shall apply to all systems.

2.8 Contractor Responsibilities

.1 Establishment and verification of dimensions, elevations, grades, boundaries shown on drawings and, reporting of any errors or inconsistencies to SFU before starting Work. Starting Work shall imply that the Contractor has verified all items and found them to be correct. Additional costs arising out of any subsequent rectifications shall be borne by the Contractor.

.2 Coordinate Work with other trades in an efficient and harmonious manner.

.3 Take whatever measures are required to protect new and existing Communication equipment from damage due to dust contamination or construction work activity, to the satisfaction of SFU representative.

.4 Take necessary measures to maintain security and prevent unauthorized access to Communication rooms.

.5 The contractor is responsible for ensuring the infrastructure is not damaged during the installation process (i.e. improperly supported cable bundles).

.6 Contractor is responsible for the protection of the infrastructure from exposure to any elements that would void Belden certification. For example paint on cables is not acceptable.

2.9 Regulatory Requirements

.1 Contractor shall comply with the latest versions of British Columbia Building Code, and Canadian Electrical Code, including all Provincial and other amendments, local by-laws and regulations by AHJ. When multiple codes and/or regulations apply, follow the most stringent provision.

- Canadian Electrical Code
- BC Electrical Safety Act
- Work Safe BC
- British Columbia Building Code
- British Columbia Fire Code Regulation
- Municipal by-laws
- Worker’s Compensation Act
- Industry standards ANSI, TIA, BICSI

.2 Materials shall bear the approval of the Canadian Standards Association and where applicable, CUL, ULc or alternately shall bear local approval.
2.10 Damage

.1 Where existing structure, grade or pavement is required to be removed, altered or otherwise defaced to facilitate electrical installation, it will be contractor’s responsibility to arrange for such work.

.2 Any equipment, structure, pavement or grade damaged by the execution of this Contract will be repaired to its original condition. Any cost incurred for such work shall be at cost to contractor.

.3 Irreparably damaged equipment; structures, walls, surfaces etc. shall be replaced at cost to Contractor.

.4 If the finish of new equipment, structures, walls, surfaces etc. is damaged by this contractor, the Contractor, at the discretion of SFU, shall either replace or restore the equipment, structures, walls, surfaces etc. to its original condition by re-spraying, refinishing, etc, at no cost to SFU.

.5 Openings and cutouts shall not be burned into panels. Oversize openings shall not be patched up with loose plates or oversize washers. Oversized openings will be considered damage to the equipment and are to be treated as specified above.

.6 The Contractor shall use extreme care when working near existing services and any services disturbed will be replaced at his cost to the satisfaction of SFU.

2.11 Shop Drawings

.1 Minimum forty (40) business days prior to ordering material and/or start of installation, the Contractor shall submit to SFU for approval:
   - Six (6) printed copies of shop drawings
   - One (1) soft copy of shop drawings (in electronic format)
   - Product samples (if requested)

.2 Shop drawings submittal shall include:

   a) Equipment/material list in tabular format with following columns:
      - Specification Reference – if applicable, indicate relevant Section and Clause paragraph numbers of the Specifications and/or Drawings.
      - Manufacturer – product brand
      - Part Number – clearly identifying the product (including any accessories, and equipment options).
      - Description – brief description of the item
      - Notes – column dedicated for Consultant’s notes during review.

      In addition to electronic PDF file format, provide equipment/material list to SFU in MS Word or MS Excel format.

   b) Catalogue cut-sheets shall clearly indicate (using a yellow highlighter pen or a red arrow) product part number, accessories, and options. Submit only information pertinent to the project. Advertising literature and brochures of general nature will be rejected.
c) Single-line system diagrams showing equipment interconnections including cable and signal type.

d) Drawings for custom-fabricated hardware, indicating layout, critical dimensions, materials, finish, labeling and other relevant information. (Where applicable, include description of operation).

e) A description of all changes to the electrical, mechanical, or architectural aspects of the building that the Contractor has determined are necessary to achieve the installation and functional operation of the proposed systems.

f) A description of all proposed deviations from the Specifications.

g) Additional Shop drawing requirements for Structured cabling System are included in Section 27 10 00 Clause 1.10. Refer to them for detailed instructions.

.3 If a submittal is not complete, assume the cost for re-evaluation of subsequent submittals. These costs will be charged at SFU prevailing charge-out rates.

.4 By submitting shop drawings, product data, and samples, the Contractor signifies that he or she have carefully reviewed and verified materials, quantities, field measurements, and related field construction criteria. It also signifies the Contractor has checked, coordinated, and verified that all information contained with shop drawings, product data, and samples conforms to the requirements of the Work and of the Contract Documents.

.5 Consultant’s review of shop drawings does not infer any comment on quantities shown on the drawings. Shop drawing review does not relieve the Contractor of the responsibility of receiving required approvals from inspection authorities.

.6 The Contractor shall not order or perform any portion of the Work requiring submittal and review of shop drawings, product data, or samples until SFU has approved the respective submittal.

2.12 Delivery, Storage, and Handling

.1 All materials and equipment shall be new. Deliver and store materials in original, unopened packaging. Assume all packing, transportation, and insurance costs.

.2 Ensure that all equipment and materials delivered to the site are received in writing by the Construction Manager or electrical superintendent.

.3 Store materials in a safe and secure location, and protect against damage. Coordinate storage requirements with the general contractor.

.4 Any equipment that is mounted on the floor, ceiling, and walls during the construction stage shall be protected from dust, dirt, paints, and accidental breakage due to activity by other trades. All other equipment that does not need to be mounted ahead of time shall be mounted during the finishing stage of the Work.

2.13 Coordination on Site
1. Coordinate and cooperate with other trades for timely accomplishment of installation including supply of special materials, rough-in information, and sequencing of work. Pay particular attention to the impact of the work of others that acceptance of an alternative product may create.

2. Coordinate and cooperate with other trades for timely accomplishment of system interfacing including supply of special materials, physical connections, testing, and adjusting.

3. Coordinate and cooperate with other trades for space needs and other needs to result in assemblies that are well integrated into the surrounding work.

4. The Contractor shall advise SFU of any specific equipment, materials or installation that are non-conforming with laws, by-laws or regulations of authorities having jurisdiction.

5. Immediately upon discovering any apparent conflict between the Specifications and the drawings, or between two drawings, report the discrepancy to SFU for direction before proceeding with the affected work.

6. When requested, Contractor shall attend coordination site meetings with the Project Manager, Consulting Engineer and/or Owner’s Representative.

2.14 Sequence and Scheduling

1. The Contractor shall submit a complete Construction Schedule within seven (7) days of Awarding of Contract.

2. The Construction Schedule shall indicate project milestones such as shop drawings, demolition, installation, labeling, testing, training, O&M Manual submission, As-built drawings submission, substantial completion and project closeout dates for individual systems in various work areas.

2.15 Drawings and Specifications

1. The Contract drawings and specifications form an integral part of the contract documents. Neither the drawings nor the specifications shall be used alone. Work omitted from the drawings but mentioned or reasonably implied in the specifications, or vice versa, shall be considered as properly and sufficiently specified and shall be provided.

2. Where conflict exists between drawings and specifications the specifications shall take precedence over the drawings.

3. The contract includes for provision of a total number of outlets and/or devices equivalent to the quantity shown or specified. The right is reserved to change outlet / device locations as may be required by SFU or as may be necessary to place these clear of obstruction. No extra will be allowed for such changes unless, in the opinion of SFU, these changes increase the total amount of material and labour.

4. Outlets and or devices may be relocated up to 7 meters from the position shown on contract drawings without cost to the Owner, provided the unit is not installed prior to receiving direction for such relocation.

5. Drawings are generally diagrammatic and are intended to indicate the scope and
general arrangement of the Work. The Contractor shall not scale the drawings, but rather take field measurements.
.6 The Contractor shall obtain information from SFU where exact locations are not indicated.

.7 The Contractor shall maintain one (1) complete set of white prints to be used exclusively for purposes of recording changes, deviations and revisions from the original contract (pay particular attention to the size and location of conduits, back-boxes etc.).

.8 White prints to be updated weekly by Contractor on site and must be available for SFU review bi-weekly. As-built drawings will confirm location and identification of all communication outlets, communication rooms, backbone runs and fire-stop design and records documentation.

2.16 Permits, Fees, Taxes and Inspections

.1 Prior to execution of work, the Contractor shall obtain all necessary permits and licenses for compliance with Federal, Provincial and Municipal laws and regulations.

.2 The Contractor shall be responsible for all permit, inspection and re-inspection fees.

.3 The Contractor shall pay for all associated taxes.

.4 The contractor must request and coordinate representation from SFU to inspect installation of the cabling system during, but not limited to the following stages of construction: Rough-in, telecommunication room construction, testing and completion.

***END OF SECTION***
1.1 **GENERAL**

1.2 **Grounding and Bonding for Communications Systems**

1. Grounding shall adhere to requirements specified in Canadian Electrical Code, ANSI/TIA 607-C and other applicable standards.

2. Telecommunications Main Grounding Busbar (TMGB) shall be typically provided in Communications room that is the closest to grade and to Electrical Main Grounding Busbar. TMGB will have minimum dimensions of 6.35mm (0.25") thick and 100mm (4") wide. Length shall be as needed to accommodate all connections plus 25% space and not less than 305mm.

3. The TMGB shall be bonded to the Electrical Main Grounding Busbar with grounding wire equal to that of the Telecommunications Bonding Backbone (TBB).

4. Telecommunications Ground Busbar (TGB) shall be provided in remaining Communications rooms. TGM shall have minimum dimensions of 6.35mm (0.25") thick and 50mm (2") wide. Length shall be as needed to accommodate all connections plus 25% space and not less than 305mm.

5. Telecommunications Bonding Backbone (TBB) shall bond the TMGB with TGBs in each Telecommunications Room. Each TGB shall be also bonded to the ground of electrical panel board serving the Telecommunications Room and to building steel structure.

6. The TBB shall be an insulated stranded copper conductor. TBB conductor size shall be as indicated on the drawings. Jacket shall be GREEN color and shall be FT4/FT6 rated as required.

7. Grounding Equalizer (GE) shall bond two or more TBBs in multistory building. The GE conductor shall be equal to that of TBB.

8. Grounding Connectors shall be in standard EIA bolt sizing corresponding to the Grounding Busbar bolt hole pattern. Surface of all bonding and grounding connectors used on TMGB and TGB shall be of a material that provided low electro-chemical potential of <0.3V between connector and grounding busbar.

9. TMGB and TGB shall be UL listed copper electro-tin-plated busbars provided with predrilled holes in standard BICSI pattern. The holes shall correctly match with listed lugs and hardware.

10. Provide bonding of telecommunication racks, cabinets, cable trays, conduit to TGB/TMGB using minimum 6 awg stranded copper bonding conductor and compression connector.

11. All wires used for telecommunications grounding purposes shall be identified with green insulation or green tape. Non-insulated wires shall be identified at each termination point using green tape. All cables and busbars shall be identified and labeled in accordance with applicable standards.

12. Use joint compound when making bonding connections between metal surfaces on racks, cabinets, cable runway, cable tray and busbars.
1.3 Pathways for Communications Infrastructure - Overview

.1 Generally rough-ins are provided by division 26. However, there may be some areas where some additional sleeves or short pieces of conduits are required. Contractor shall allow for some miscellaneous rough-ins in the scope of work.

.2 Supply and install rough-ins (conduits, raceways, boxes etc.) as required to provide a complete pathway for cabling.

.3 All specified items shall be installed as per manufacturer’s requirements, CEC, ANSI/TIA 569-D and any other applicable standards.

.4 All items installed shall not compromise the performance of the Cable Plant.

.5 All items installed shall be supported only by architectural structures (i.e. walls, slabs, etc.)

1.4 Hangers and Supports for Communications Systems

.1 Communications cabling shall be supported by cable tray or placed in conduit.

.2 Horizontal cables shall not be supported by structures that are not intended for cable support (i.e. luminaire, mechanical/ sprinkler pipes etc.).

.3 Only in rare circumstances (and only after Owner’s approval) J-Hooks may be used in locations where conduit or cable tray cannot be installed. Spacing between J-hoops must be not more than 1000mm. J-Hooks must have complete horizontal and vertical 1” bend radius control. Cable supported by J-hook shall be bundled with Velcro tape at maximum 300mm. Maximum cable bundle size per J-hook is 2”.

.4 Bracket mounting to suspended ceiling drop wires is not allowed.

.5 Reference product: Panduit J-Mod cable support system

1.5 Conduits and Backboxes for Communications Systems

.1 All indoor conduits shall be EMT. Outdoor conduits shall meet code requirements.

.2 Fittings in dry locations shall be steel or malleable iron set screw type fastener with insulated throats or non-metallic bushings on all open ends.

.3 Fittings in wet locations shall be steel or malleable iron in rain tight, compression-type, with insulated throat or non-metallic bushings on all open ends.
1.6 Sleeves for Communications Systems

.1 Sleeves or short sections of conduit shall be provided for all holes that permit communications cabling to pass through physical barriers. This includes cored holes, drilled holes, cut holes etc.

.2 The diameter of the Sleeve shall correspond to that of the hole and satisfy conduit fill requirements as outlined in ANSI/TIA and other standards plus 20% for future growth.

.3 Where suitable, sleeves 2" and larger in diameter shall be re-enterable type. Reference product: Hilti SpeedSleeve or approved equivalent.

.4 Sleeves and conduits shall be fire stopped according to the requirements of the AHJ.

1.7 Cable Trays for Communications Systems

.1 Cable Trays will act as the pathways for backbone and horizontal cabling. Unless otherwise noted all cable trays shall be 450 x 100mm (18" x 4") wire-mesh type. Where cable tray changes direction, provide sweeping bends. Bends will have curved corners (both for the inside and outside corner). Utilize pre-manufactured radius corners for tees, intersections and locations where sweeping bend would not fit. Reference product: Cablofil Radius 90 degree kit RADT90KIT with RADT90RS radius shield. All bends are to be performed in accordance with manufacturer's instruction sheets and shall conform to BICSI standards. Sharp corners will not be acceptable

Reference product: Cablofil CF 105 or approved equivalent.

1.8 Surface Raceways for Communications Systems

.1 Metallic Surface Raceways shall have the following requirements:
   - Capable of containing low voltage cabling as well as power cabling.
   - Have an electrical barrier between communications and power cabling.
   - CSA approved

Reference manufacturer: Wiremold 5400

1.9 Vibration Control

.1 Use vibration isolators for ceiling-mounted, floor-mounted, or wall-mounted equipment as required. Especially when it is evident that mounting surface transmits vibrations from mechanical equipment or moving loads.

.2 Select vibration isolators that have a high shear rating and sufficient weight capacity to support the physical load. The approved vibration isolator shall be manufactured by Mason Industries.

.3 Select appropriate vibration isolators that are intended to support equipment from the ceiling, wall, or floor. Use of the wrong type of vibration isolator may cause the supporting structure to fail during operation.

.4 Consult a specialist for the proper vibration isolators required to effectively address various vibration problems.
1.10 Seismic Control

.1 All racks, cabinets and cable trays are to be secured to prevailing local seismic codes.

.2 Select fasteners having a high shear rating and high tensile strength for anchoring the racks to the floor. Select fasteners appropriate for the floor construction.

.3 Ensure that floor anchors are placed deep enough into the slab in accordance with local requirements (e.g.: a typical seismic requirement is 8-inches). Where the slab is not thick enough, penetrate the slab, and secure the anchors from the floor below. In this event, ensure that the rack may be unbolted and removed without the anchor bolts falling through to the floor below.

.4 Ensure that racks are plumb when anchored.

Anchor top of racks that are greater than 36-inches in overall height to a wall to reduce tension load on the floor anchors.

.5 In addition to any other requirements stated herein, provide rear support for any piece of equipment that meets all of the following criteria:

- The unit exceeds 10-pounds per unit of its total vertical racking height (e.g. if a piece of equipment occupies 3-RU of rack space and weighs more than 30-pounds;
- Its centre of gravity is towards the rear;
- And, its overall depth is greater than 2.5 times its total vertical racking height (e.g. if a piece of equipment occupies 3-RU of rack space and has a depth of greater than 13 inches).

1.11 Cable and Wire Management - General

.1 Components of the premise distribution system shall be installed in a professional manner consistent with BICSI best practices.

.2 Ensure that all wiring, cabling and connector applications are in strict adherence to Standard Industry Practice and to local codes. Where these may vary, one from the other, follow the most stringent requirements.

.3 Generally, wire and cables shall be, if installed, in the ceiling space parallel to walls and as close to the walls as possible. Easy access to cables shall be maintained through the length of installation. Use Velcro-wraps to bundle the same systems cables together.

.4 Exposed cabling must be combed and/or routed in such a manner as to ensure all bundled cabling is neat and parallel to all other cables in the bundle. Exposed cable bundles to be wrapped at a maximum distance of 300 mm.

.5 Wraps shall be loose so they can be easily rotated without damage to the cabling. The number of cables managed by wraps shall not exceed 25.

.6 Horizontal fill ratios for conduit, cable trays, raceways and ducts shall conform to standards and manufacturer recommendations.

.7 All cabling shall be continuous without joins, or splices. No splices, junctions, or connections are permitted between ends of the cable.
.8 Provide adequate distribution rings and wire management accessories to permit a neat installation.

.9 All miscellaneous corresponding hardware components shall be of the same manufacturer.

.10 Communications cabling system wiring and equipment installation shall be in accordance with best industry practices as established by BICSI TDM and the approved manufacturer.

.11 Wiring shall meet all provincial and local electrical codes. All wiring shall test free from all ground loops and shorts.

.12 Cables on plywood back boards shall be wrapped at maximum 300mm on centers or closer as necessary to install cables neatly and tidily. Install equipment and wiring in closets to provide a logical progression for cabling and to minimize cables crossing.

.13 Maintain manufacturer’s minimum bend radius for all cables. At initial cable installation on tray, run cables parallel to each other with a minimum of crossovers.

.14 Standards for separation distances from electromagnetic sources are currently under study. Minimum clearance between cables and power sources until the new guidelines are available are found in CAN/CSA T530.

**Separation Distances from EMI Sources:**

<table>
<thead>
<tr>
<th>Condition</th>
<th>Minimum Separation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2kVA</td>
</tr>
<tr>
<td>Unshielded power lines or electrical equipment in proximity to open/nonmetal pathway</td>
<td>127mm 5”</td>
</tr>
<tr>
<td>Unshielded power lines or equipment in proximity to a grounded metal conduit pathway</td>
<td>64mm 2.5”</td>
</tr>
<tr>
<td>Power lines enclosed in shielded or grounded metallic conduit pathway</td>
<td>-</td>
</tr>
</tbody>
</table>

.15 All optical fibre and copper cables shall be handled, installed and supported as per the manufacturer’s guidelines as a minimum standard. During the laying of the cable, installer shall take care not to over stress the cable. After the cable is installed, installer shall make sure that all parts of the cable are fully supported and shall be stress free at both ends and throughout their length.
.16 Appropriate attention shall be given to the handling of Category 6A copper and optical fiber cables to ensure that bending radius conforms to the manufacturer’s requirements. At no time shall the cable’s static or dynamic bending radius be exceeded.

.17 Fiber optic cables shall be installed in separate conduits from other cables. Where fiber optic cables are in cable trays or share conduits with other cables, split flexible tubing of orange color shall be used and shall be FT4 or FT6 rated as required.

.18 All cables shall be free from defects caused by but not limited to: shorts, damaged conductors and wiring crossovers.

.19 All cabling installed in conduit shall come with a pull-string by Division 27 contractor (pull-string is for future additions).

.20 If multiple conduits or sleeves are available for structured cabling, cables of different types (e.g. fiber x Cat 6A) shall be placed in separate conduits.

.21 In locations with multiple parallel conduits or sleeves the conduits/sleeves shall be filled to capacity with the same cable type (e.g. Category 6A) as per industry standards and manufactures recommendation, before using another conduit for the same cable type. The intent is to keep spare conduit capacity for future addition.

.22 Some conduits are reserved for other systems and noted on the drawings (e.g. CATV, CELL, Security, ...). Do not use these conduits for structured cabling.

.23 Conduits noted on the drawings as "SPARE - reserved for future use" may be used only, if approved by SFU under special circumstances.

1.12 Cable and Wire Identification - General

.1 Labeling of cables shall adhere to SFU standards.

.2 Identification markings shall be uniform for each system.

1.13 Cable and Port Identification for Structured Cabling

.1 Each cable shall be identified at both ends by laser-imprinted cable labels such as Panduit.

.2 Each outlet shall be identified with Brother P-Touch type labels attached to the faceplate. Unless noted otherwise, all labels shall have BLACK lettering (approximately 3mm high) on WHITE background. Only at locations where black outlet faceplates are specified, the labels shall have white lettering on black background.

Faceplate labels shall have following format:

```
XXX-861
1275 - 2
```

Where:

<table>
<thead>
<tr>
<th>XXXX</th>
<th>Building Code for building where Face Plate resides (1056)</th>
</tr>
</thead>
<tbody>
<tr>
<td>861</td>
<td>Closet number where set run comes from (as per drawings)</td>
</tr>
</tbody>
</table>
1275  = Room number where Face Plate resides (as per drawings)
2  = Face Plate number within the room. Assign Face Plate numbers sequentially (1, 2, 3, ...) and clockwise within a room.

In addition, all individual ports on outlet faceplates shall be labeled as "A", "B", "C", "D", ..., with small printed stick-on labels. For port numbering sequence refer to outlet detail drawings.

.3 Racks within a TC will be numbered sequentially on the upper left corner when viewed from the front. Rack #1 is always the rack closest to the wall.

.4 Patch Panels will be numbered sequentially and individually. Ports will be numbered within each Patch Panel. For example if we are using 24 port Patch Panels they will be numbered PP01, PP02, PP03 etc... Ports will be 1-24 for each Patch Panel.

.5 Patch panel label format:

XXXX-1275
2 - A
Where:
XXXX  = Building Code for building where Face Plate resides (1056)
1275  = Room number where Face Plate resides.
2  = Face Plate number within room
A  = Port location on Face Plate.

.6 Final SFU room numbers shall be used for all labeling. Do NOT use construction numbers!

1.14 Testing of Structured Cabling

.1 Provide for the following testing report as follows:
- All tests, for each outlet detailed in the scope of work and pass Category 6A with no conditional passes or fails accepted.
- Test shall adhere to ANSI/TIA 1152 (including all addenda and TSB) and other applicable standards.

The following parameters shall be shown on test results:
- Wiremap
- Insertion Loss
- Length
- Near-End Crosstalk (NEXT) Loss, local and far end
- Power-Sum Near-End Crosstalk (PSNEXT) Loss, local and far end
- Attenuation to Crosstalk Ration, Far End (ACRF)
- Power Sum Attenuation for Crosstalk Ration, Far End (PSACRF)
- Return Loss, local and far end
- Propagation Delay
- Delay Skew
.2 Test will be done as a permanent link test in accordance to Belden specs. The test analyzer shall be Level IIIe performance or better and calibrated as per Manufacturers recommendations.

.3 Provide detailed test results in graphical as well as numerical format for each cable. Test result shall be in electronic PDF format and native format (e.g. FLW) on a labeled CD submitted with O&M Manuals. Do NOT print detailed test results.

.4 In addition provide a summary test report (one line per tested Category 6A cable) in electronic PDF format on CD and also printed on paper. Include in O&M Manuals.

.5 Each strand in fiber optic cables shall be tested for correctness of termination and overall transmission loss using an approved fiber optic transmission loss test instrument. System loss measurements shall be conducted at all wavelengths for each cable type of the completed installation to manufacturers loss values.

.6 A certification report listing both the calculated and measured loss for each fiber optic link. The report shall be submitted with the test results as called for above in the Operating and Maintenance Manuals.

.7 Verify all Category 3 backbone cabling polarity, continuity and length.

.8 System manuals shall include all tests and Manufacture’s System warranty as per 1.17.

.9 All tests shall be sorted by type of cable then by telecom room number and then alphanumerically by port ID label.

.10 All test data shall be provided in SI units.

.11 Submitted test shall show final SFU room numbers. Do NOT use construction numbers!

1.15 Operating and Maintenance Manuals

.1 Operating and Maintenance Manuals shall containing the following:

a) Detail contact information on installation and service companies. Warranty certificate.

b) As-installed riser diagrams and drawings of installed cabling and equipment. For communication devices indicate signal type and settings.

c) Product list in tabular format with following columns:

- Manufacturer – product brand
- Part Number – clearly identifying the product (including any accessories, and equipment options).
- Description – brief description of the item.

d) Catalogue cut-sheets shall clearly indicate (using electronic yellow highlighter pen or red arrow) product part number, accessories, and options of installed products. Provide only information pertinent to the project.

e) Operating manuals.
f) Installation and service manuals with information on maintenance, care, service and adjustment.

g) Cleaning instructions for all devices installed in the field.

.2 Manuals shall be generated in searchable electronic PDF format. Any markups and/or highlighting must be done electronically.

.3 All pages of O&M Manuals (including a cover page) shall be saved as a single PDF file. The file shall contain electronic bookmarks for all products grouped by installed systems to facilitate easy and fast lookup of the information. Cable tests shall be a separate PDF file.

.4 The content of printed and DPF Manuals shall be generated in searchable electronic PDF format. Any markups and/or highlighting must be done electronically.

.5 Manuals shall show final SFU room numbers. Do NOT use construction numbers!

.6 The Contractor shall submit to SFU for approval:

- One (1) CD disk with Operating and Maintenance Manuals in PDF format.
- One (1) CD disk with a complete set of Technology As-built Drawings in AutoCAD and PDF formats.
- One (1) printed copy of Operating and Maintenance Manuals.

.7 After implementing review comments, the Contractor shall provide following Operating and Maintenance Manuals:

- Two (2) CD disks with Operating and Maintenance Manuals in PDF format.
- One (1) CD disk with a complete set of Technology As-built Drawings in AutoCAD and PDF formats.
- Two (2) printed copies of Operating and Maintenance Manuals.

.8 With Operating and Maintenance Manuals include the following, if applicable:

- Installation disks (including licensing and passwords) for all required software.
- Back-up CD-disk containing final and accepted configuration of the system.
- Keys for all installed devices and equipment.
- Driver bits for tamper-resistant fasteners.
1.16 Cutover & Training

.1 Provide all necessary work and coordinate cutover sequence of operation with SFU.

.2 Contractor to coordinate with Service Provider and/or SFU to ensure that there is no disruption to communication services.

.3 Contractor shall be available upon request for a period of 30 days after substantial completion to assist Owner during commissioning of the Communications Systems.

.4 Provide, as a condition of Issuance of the Final Certificate for Payment, on-site operations and maintenance training to representatives named by the Owner. The exact scope and duration of this training is to be mutually agreed upon by the Contractor and the Owner, but will be no less than 2 days.

.5 Operations Training:
   - To be a minimum duration of two hours. The purpose of this training is to familiarize the Owner’s operations staff with operating procedures.
   - Provide 4 complete Operations & Maintenance Manuals for training.

.6 Maintenance Training
   - To be a minimum duration of two hours. The purpose of this training is to familiarize the Owner’s technical staff with maintenance and troubleshooting procedures.
   - Provide the Owner’s technical staff with a procedure to facilitate service requests in a prompt and timely manner.
   - Provide 4 completed Maintenance Manuals for this training.

1.17 General Warranty

.1 Warrant all supplied products, regardless or manufacturer, for a minimum of one (1) year on parts and one (1) year on labour without limitation other than those stated herein. This warranty is to apply to all equipment malfunctions not caused by abuse or misuse by the Owners or their agents. This warranty is to include all equipment modified by the Contractor, as well as the modifications themselves.

.2 Warrant all supplied software and firmware, regardless of manufacture, for a minimum of one (1) year without limitations other than those stated herein. During this period, provide all major updates and upgrades at no cost, whether normally charged for by the manufacturer or not.

.3 Warrant the installation work for a minimum of one (1) year on labour without limitation other than those stated herein. This warranty is to apply to all malfunctions directly attributable to faulty workmanship or materials.

.4 Warrant software programming done on programmable systems for a minimum of one year on labour without limitation other than those stated herein. This warranty is to apply to all bugs, glitches, or other program malfunctions directly attributable to programming errors. This does not include adding features after the final programming changes have been made (i.e. changes made after the first month or two of full operation). This also does not apply to any programming changes made by the Owner or its agents.
.5 Begin warranty period upon Substantial Performance of Work.

.6 Process all warranty requests from the Owner or its agents during the warranty period. If this results in a service call, charge the Owner for the service call at prevailing labour rates (i.e. this warranty is not an “on-site” warranty). In the event that a reported malfunction proves to be caused by abuse or misuse by the Owner or its agents, charge the Owner for the repairs, if authorized to make such repairs by the Owner, at prevailing labour rates.

.7 If any manufacturer’s existing warranty on any supplied product is less than the terms specified herein, is prorated, or has limitations, extend the manufacturer’s warranty to meet the requirements stated herein. Assume all costs associated with such warranty extensions.

.8 In the event that any manufacturer’s warranties are for a longer term than specified herein, ensure that all such warranties are fully transferred to the Owner. Transfer of any warranty to the Owner must not in any manner diminish the Contractor’s responsibilities as stated herein.

.9 Submit manufacturer’s warranty certificates and registration forms as required under the “SUBMITTALS” article.

.10 Nothing in any of these warranties is to limit any rights or remedies the Owner may otherwise have under the Contract with respect to defects in material and workmanship.

.11 Restrict warranty and problem evaluation to normal working hours unless the Owner agrees to pay the difference in labour rates for overtime or off-hours work.

.12 Warrant that replacement parts will be available from the Contractor for a minimum of five (5) years following Substantial Performance of Work.

1.18 Manufacturers Structured Cabling System Warranty

.1 Provide following warranty/guarantee coverage from a Manufacturer approved by SFU.

.2 **Product Warranty:** All components installed in the system will be warranted for a period of minimum **25 years** from the date of substantial completion against defects in materials and workmanship. For the same period, these components will be warranted to meet or exceed the specifications of ANSI/TIA standards for the category of installed system. If a component fails during the warranty period, the Manufacturer and the Contractor will repair or replace the failed component, including labour, at no cost to the original registered owner of the Certified Structured Cabling System.

.3 **System Application and Performance Guarantee:** to assure that the structured cabling system shall support 1Gigabit Ethernet applications for Category 6A media and 10Gigabit Ethernet and Fibre Channel over fiber. If the system fails to operate at standard performance parameters, Manufacturer and the Contractor will repair or replace the system as required, including labour at no cost to the original registered owner.
.4 The guarantee must be from the warranty underwriting Manufacturer for a minimum of 25 years from the date of substantial completion.

.5 The name and address of the building/facility and location of site must appear on the warranty document.

.6 The contractor must be fully approved and certified by the warranty underwriting manufacturer prior to responding to the bid as a prequalification.

1.19 Final Acceptance

.1 Final Acceptance shall be granted upon resolution of deficiencies (if any) resulting from the Substantial Performance Review. In addition, the following stipulations must be met.

.2 The Contractor shall supply to SFU NS positive test results for approval and system acceptance.

.3 Submit to SFU, a certificate stating that system is fully operational; and that meets all standard requirements as instructed in the contract documents and as required.

.4 Provide warranties as specified under the article “WARRANTY” 1.17 and 1.18.

.5 Provide all requirements as specified under the article “CLOSE OUT SUBMITTALS”.

***END OF SECTION***
1.1 GENERAL

1.2 General Cable Plant Description

.1 Provide complete cable plant at SFU campus building.

.2 The cable plant shall include:

- Communications Rooms with termination hardware.
- Voice/Data backbone as per Communications Riser diagram.
- Horizontal Cabling
- Patch cords and cross-connects
- Testing, Commissioning, Warranty

1.3 Scope of Work

.1 Unless otherwise noted, provide for all labour and material to constitute complete Structured Cabling system as described herein and on drawings.

.2 Cables and terminations shall be provided and located as shown and in the quantities indicated on the drawings and as specified (whichever is more).

1.4 Application Standards

.1 Furnish and install complete with all accessories an ANSI/TIA 4966-2014 Telecommunications Infrastructure Standard for Educational Facilities, Category 6A building Telecommunications Wiring Infrastructure (a.k.a. Cable Plant). The Cable Plant shall serve as a vehicle for transport of data, video and voice telephone signals throughout the building from designated demarcation points to telecommunication outlets located at various desk, workstation and other locations as indicated on the contract drawings and described herein. Applications standards supported should include, but not be limited to, IEEE Standard 802.3an – 10GBASE-T, 10GBASE-LR/LW.

1.5 Reference Standards for Structured Cabling

.1 All materials, workmanship and/or installation practices and activity shall meet or exceed the following reference standards:

- ANSI/TIA-568.1-D Commercial Building Telecommunications Cabling Standard
- ANSI/TIA 568C.2-1 Transmission Performance Specifications for 4-Pair 100 Ohm Category 6A Cabling.
- ANSI/TIA-569-D Commercial Building Standard for Telecommunications Pathways and Spaces.
- CAN/CSA T529CAN/CSA T530
- Best practices of BICSI-TDM
- Latest version of CSA C22.1-Canadian Electrical Code Part 1 including B.C. Amendment and Regulation.
- UL Cable Certification Program.
- NEMA.
- ASTM.
- IEEE
1.6 Qualifications

.1 Pre-qualified contractors shall be as stipulated in Section 27 10 00 Clause 1.10.

.2 Only contractors pre-qualified by SFU and authorized to provide installation services by the approved manufacturers are permitted to submit the bid.

.3 Upon request, the contractor shall show proof of a contractual relationship with the manufacturer, and shall submit the manufacturer’s CSV certification to SFU NS.

1.7 Quality Assurance

.1 A minimum of 50% of telecommunications installers shall have current manufacturer’s certification at all times while performing the installation.

.2 Manufacturer refers to the company that manufactures the components and is responsible for the design and installation guidelines used by the contractor to complete this cabling system installation. The manufacturer along with the contractor is responsible for the final warranty and certification of the installation and application assurance.

.3 Testing shall be performed by Telecommunications Technicians who are qualified to perform related tests as required by the manufacturer in accordance with the manufacturer’s methods.

.4 The Contractor (including subcontractors if any) shall have a proven 7 years track record in projects of similar nature. This is requirement for pre-qualification.

1.8 Abbreviations Terminology

.1 CATV - Cable T.V.

CER - Communications Equipment Room

CP - Consolidation Point

EF - Entrance Facility

FDC - Fibre Distribution Centre (fibre splice tray or termination tray)

IDF - Intermediate Distribution Frame

TGB - Telecommunications Ground Busbar

TMGB - Telecommunications Main Ground Busbar

SFU NS – SFU Network Services

TO - Telecommunications Outlet

TR - Telecommunications Room

WA - Work Area
Other acronyms can be found in the ANSI/TIA Standards.

.2 Words “Tender” and “Bid” used in this contract documents shall mean the same and are interchangeable.

.3 Words “Tenderer” and “Bidder” used in this contract documents shall mean the same and are interchangeable.

.4 Words “Design Professional”, “Consultant” and “Engineer” used in this contract documents shall mean the same and are interchangeable.

.5 Words “Telecommunications Room” shall include Closets, Media, and Audio Visual Communications Rooms.

.6 Words “Data Outlet” and “Computer Outlet” used in this contract documents shall mean the same and are interchangeable.

1.9 Pre-approved Manufacturer

.1 All components (connectors, cabling, panels etc.) of the structured cabling systems for telecommunication system provisions shall be from a pre-approved manufacturer. The manufacturer shall provide a minimum 20-year legal assurance warranty for products and the applications listed herein.

1.10 Pre-approved Installation Companies

.1 Pre-approved installation companies are available through IT Services. Contact SFU’s IT Services for the list.

.2 Successful bidder must be a current Belden IBDN Certified System Vendor (CSV) and employ on this project Belden trained personnel.

1.11 Shop Drawings

.1 In addition to requirements of Section 27 00 01 Clause 2.11, the Contractor shall submit six (6) sets of the following shop drawings and construction documents to SFU:

   .1 Plan view drawings illustrating the layout of all Mechanical, Electrical, and Communication components and equipment in each Telecommunications room.

   .2 Elevation drawings of all walls of each Telecommunications room, clearly showing the proposed layout of all termination hardware, grounding & bonding components, equipment cabinets, communications equipment, power receptacles, lighting fixtures, cable tray, conduit, entry ducts, etc. NOTE that all final layouts of all racks shall be as later determined by SFU NS.

   .3 Proposed rack and patch-bay elevation drawings

   .4 Vertical and horizontal Backbone cable topology, riser duct, and horizontal cable count diagrams.

   .5 System block diagrams depicting the interconnection between Telecommunications rooms, system components, sub-systems and equipment cabinet layouts.
.6 Communication Bonding & Grounding System.

.7 Fire-stop design, identifying all locations to be fire-stopped, complete with documentation, a list of all firestopping materials to be used, and fire-stop systems to be installed.

.2 Submit documentation minimum 40 business days prior to ordering material and the start of installation.

.3 Prior to installation contractor shall submit to SFU NS for review the following shop drawings comprising of but not limited to:

1. Complete parts number list.
2. Cable data list
3. Documentation proving the cabling systems compliance to the permanent link performance as specified by ANSI/TIA 568-C.2 (including all addenda and TSB), and other applicable standards for Category 6A performance.
4. A complete telecommunications cabling system layout, including cable routing, wiring closet (s) and telecommunications outlet connector cables designation. The layout shall detail locations of all equipment and indicate all wiring pathways. Use contract drawing as a base. The layout is subject to approval by SFU NS.
5. Manufacturer's technical documentation on all devices used in cabling system.
7. Layout of Telecommunication Rooms (subject to approval by the Owner)

1.12 Wiring Record

.1 Provide wiring record table indicating: outlet and cable identification, cable length, outlet floor location, termination location (i.e. patch panel), patch panel field and port number, workstation outlet identification. This information shall be provided to SFU prior to commissioning.

.2 The Contractor shall maintain one (1) complete set of white prints to be used exclusively for purposes of recording changes, deviations and revisions from the original contract (pay particular attention to the size and location of conduits, back-boxes, splices etc.).

.3 This drawing will be updated on site weekly by contractor; and available for reviewed by SFU representative.

***END OF SECTION***
1.1 **GENERAL**

1.2 **Communications Equipment Rooms General**

.1 Equipment in Telecommunications Rooms shall be installed as per industry standards (CEC, ANSI/TIA and any other applicable codes and/or standards), best practices of BISCI TDM and shall adhere to manufacturers recommendations to constitute a complete system.

2.1 **PRODUCTS AND EXECUTION**

2.2 **Communications Cabinets, Racks, Frames and Enclosures**

.1 Provide floor mounted communication Racks and/or Cabinets for installation of patch panels and owner supplied network equipment.

.2 Quantities of racks and cabinets shall be as indicated on drawings. (SFU standard is to use Racks for all installations, and Cabinets shall be used only when specifically noted on drawings or herein).

.3 Racks shall be BLACK, 19" wide and provide minimum 45RU capacity.

Pre-approved product: Chatsworth 55053-703

.4 All racks and cabinets are to be secured to prevailing local seismic standards. This contractor is fully responsible for all seismic installation requirements (this may include the services of a Professional Structural Engineer if required by local Codes, Standards and/or Bylaws).

.5 All racks, cabinets and frames shall be grounded to common telecommunications ground using a standard ground lug and green jacketed #6 ground wire according to ANSI/TIA- 4966 standard.

.6 Ensure proper fasteners are used for mounting equipment to the rack.

2.3 **Communications Termination Blocks and Patch Panels - General**

.1 Unless otherwise specified herein and/or drawings patch panels shall be arranged as per standard practice.

.2 Cables shall be terminated sequentially (by cable number) from left to right (viewed from front of panel) and top to bottom.

.3 Category 6A cables shall be routed to the back of patch panels from both (left and right) sides. Cables terminated on the left side of a patch panel shall come from the left. And cables terminated on the right side of a patch panel shall come from the right. Category 6A cables shall not cross centerline of the patch panels.

.4 Contractors shall submit proposed layout of equipment racks and equipment positioning to SFU NS, prior to installation.
2.4 Communications Copper Termination Blocks

.1 Belden A0266828 QCBIX1A distribution connectors shall be used to terminate Category 3 voice backbone.

.2 Distribution connectors shall be installed on 250-pair wall-mounted QMBIX mounts Belden A0270164.

.3 Provide Belden A0270168 Distribution Rings between two adjacent mounts.

.4 Contractor shall obtain approval for termination block layout from SFU NS prior to installation (refer to Section 27 10 00 Clause 1.11).

2.5 Communications Copper Patch Panels

.1 Rack-mounted Patch Panels shall be used:
   ● to terminate all horizontal Category 6A cables, unless noted otherwise
   ● as Voice backbone patch-fields (wired from the back of patch panel to wall-mounted BIX connectors).

.2 Patch Panels shall be rack-mounted (1RU high), black color, flat, 24-port, preloaded with black 8-pin modular data jacks.

.3 Patch Panels for Category 6A horizontal cabling shall meet or exceed Category 6A performance and utilize REVConnect termination technology.

   Pre-approved product: Belden 10GX REVConnect (RVAPPF1U24BK)

.4 Voice Patch Panels for 25-pair Category 3 cable shall meet or exceed Category 5e performance.

   Pre-approved product: Belden CAT5E HD-BIX (AX103260).

.5 Provide minimum 10% spare patch panel ports for future additions.

.6 Provide cable tie bar in the rear of patch panels to manage cable routing.

.7 Contractor shall obtain approval for patch panel layout from Consultant & SFU prior to installation (refer to Section 27 10 00 Clause 1.11).

2.6 Communications Optical Fiber Patch Panels

.1 Fiber enclosure shall be rack-mounted, black color and have capacity to terminate all fiber-optic cables plus spare space for minimum 2 future cassettes. Enclosure shall be FiberExpress ECX 4U patch panel housing Belden ECX-04U.

.2 Enclosures shall be loaded with sufficient quantity of cassettes to facilitate splicing and termination of all fiber-optic cables.

.3 Cassettes shall be Belden FiberExpress ECX splice cassette type with blue adapter plates. Module capacity shall be 24-fiber for backbone cabling.
Pre-approved product: Belden FCSX12LDFS.

.4 All cassettes shall be fully loaded with BLUE color UPC single mode LC type connectors with tight buffer 900µm pigtailed. Reference product Belden FTSLC900PR12 or approved equivalent.

.5 Fusion splice pigtailed to fiber backbone cables and cover with 250µm - 900µm heat shrink protectors. Reference product Belden FXFUHS9T2CB25 or approved equivalent.

2.7 Communications Coaxial Cable Splitters

Not Applicable.

2.8 Communications Cable Wraps

.1 In all areas, Velcro type wraps shall be used. Plastic tie wraps are NOT permitted on this project.

.2 Install Velcro wraps at maximum 300mm intervals inside Telecommunications Room. The number of cables managed by Velcro type wraps shall not exceed the number specified by the manufacturer.

Reference Product: Chatsworth Saf-T-Grip

2.9 Communications Cable Wall Management

.1 Provide Belden A0270168 Distribution Rings between two adjacent BIX mounts to manage cross connection wires.

2.10 Communications Cable Rack Management

.1 Provide 6" wide Vertical cable management channel on both sides of each equipment rack. Cable manager shall have hinged removable front cover.

Pre-approved product: Chatsworth 30092-703

.2 Where two (or more) racks are installed side-by-side provide 10" wide Vertical cable management channel(s) between racks.

Pre-approved product: Chatsworth 30093-703

.3 Provide Horizontal cable management above top patch panel AND then below every other patch panel. Cable manager shall be 2RU high and come with hinged removable front cover.

Pre-approved product: Chatsworth 30130-719

.4 All patch cables shall be hidden from view except for 75mm (3-inch) of exposed cord at the jack.

.5 Provide wire management bars at the back of patch panels to relieve strain on cable terminations.
2.11 Telecommunications Room Cable Tray

.1 Cable Trays shall be of rigid wire mesh type.

.2 Wire mesh cable management system shall be continuous, rigid and welded.

.3 The metal shall be carbon steel wire, ASTM A 510, Grade 1008. The wire shall be welded, formed and then surface treated by manufacturer.

.4 Cable trays within Telecommunications rooms shall have minimum dimensions of 450 x 100mm (18" x 4"), unless otherwise specified.

.5 Installation of Cable Trays shall be as per manufacturers requirements. Only manufacturer approved connecting hardware shall be used. This includes all turns, extensions etc.

.6 Manufacturer approved cable drop outs shall be used where cables exit cable trays to maintain minimum bend radii.

.7 Wire mesh tray shall be installed without sharp elbows or corners. All bends are to be radius turns and shall be performed in accordance with manufacturers instruction sheets and shall conform to BICSI standards. Sharp corners will not be acceptable.

Reference product: Legrand Cablofil CF 105 or approved equivalent.

2.12 Plywood Backboard

.1 Plywood backboards shall have the following features:

- 19mm thick Fir void-free plywood which is fire rated
- 2440mm (8') height
- Smooth surface on exposed side
- Mounted directly onto walls without a stand-off.
- Painted with 2 coats of paint on the exposed side and edges. Fire resistant label to be left unpainted and visible throughout.

.2 Plywood Backboard shall be installed approximately 5" above the floor. Power receptacles shall be installed flash to the plywood backboard.
2.13 Rack Mounted Power Distribution Strip

.1 Each communications rack shall be equipped with one 20A Power Strip.

.2 Power strip shall be rack-mounted and occupy one rack space.

.3 Each power strip shall have a minimum of six NEMA 5-20R rear-facing receptacles plus one receptacle facing the front of the rack. Rear receptacles shall be adequately spaced so that equipment power supply transformers can be plugged in adjacent to each other without overlapping.

.4 20A circuit breaker shall be located on the power strip's front panel.

.5 Power strip shall provide EMI filtering and surge protection.

Reference product: Middle Atlantic PD-920R or approved equivalent.

***END OF SECTION***
1.1 GENERAL

1.2 Communications Backbone Cabling General

.1 Backbone wiring infrastructure consists of (but is not limited to): Fiber optic cable, multi-pair telephone tie cables, required terminations hardware and cross-connects.

.2 Unless specified otherwise, provide:
   - Voice backbone as per riser diagram.
   - Data backbone as per riser diagram.

.3 All backbone cabling shall be terminated and properly labeled on both ends.

2.1 PRODUCTS AND EXECUTION

2.2 Communications Copper Backbone Cabling

.1 Voice backbone cabling shall be 24 AWG solid, multi-pair UTP, Category 3. Number of pairs shall be as indicated on riser drawings.

.2 Indoor cables shall be FT-6 or FT-4 rated as required. Cables placed in underground ducts, outside of buildings shall be rated for outdoor use with water blocking members.

   Pre-approved manufacturer: Belden

2.3 Communications Copper Cable Terminations and Cross-connects

.1 Backbone cables shall terminate on BIX fields in each Communications room. Cross connect to an adjacent BIX field that is connected to rack-mounted Category 5e Voice backbone patch panels. Voice “backbone” Category 5e patch panels shall be cross-connected with GRAY colored (RJ-45-style) patch cords (refer to Section 27 16 00 Clause 1.3.3) to voice ports on “horizontal” Category 6A patch panels.

.2 Cross-connect all BIX fields as instructed by the Owner's representative.

   Pre-approved manufacturer: Belden

2.4 Communications Optical Fiber Backbone Cabling

.1 Fiber backbone shall be capable of supporting 10-Gigabit Ethernet and 10-Gigabit Fibre Channel.

.2 Data backbone cable shall be single-mode fiber. Number of fiber strands shall be as indicated on riser diagram drawings.

   96-strand single mode cables shall be Belden BYW1850.

   48-strand single mode cables shall be Belden BYW1564.
.3 Cables shall be indoor-outdoor type with FT6 rated jacket. Cables placed in underground ducts, outside of buildings shall be loose tube rated for outdoor use with water blocking members. All fiber cable to be reinforced with Aramid yarn for strength and contain no metallic elements.

Pre-approved manufacturer: Belden

2.5 Communications Optical Fiber Splicing and Terminations

.1 Fiber optic cables shall be terminated on rack-mounted patch panels (refer to Section 27 11 00 for details).

.2 Fiber optic connectors shall be LC duplex type.

Pre-approved manufacturer: Belden

.3 Provide a 3-meter service loop at both cable ends. Fiber service loops shall be placed on the wall and attached with proper loop mounting hardware (Ref: Polygon 8900-24 circular cable manager).

***END OF SECTION***
1.1 GENERAL

1.2 Communications Horizontal Cabling General

.1 Provide a complete and operational horizontal wiring infrastructure as specified herein and on drawings.

.2 Horizontal wiring infrastructure consists of but is not limited to:
   ● Patch panels
   ● Horizontal cables
   ● Telecommunications outlets
   ● Code Blue emergency phones and strobes
   ● Security cabling to Code Blue emergency phones

.3 The SFU standard is to provide one (1) “Set Run” to every telecommunications wall outlet and/or floor outlet box. Unless specified otherwise, a Set Run is defined as two (2) 4-pair UTP cables from the outlet location to patch panel in Communications room, fully terminated, labeled and tested.

.4 In general, there is no distinction between voice & data for horizontal runs. Unless noted otherwise, all horizontal cables shall terminate on universal patch panel system, which will permit assignment from the data hardware or voice hardware by the use of different color-coded patch cords.

.5 Contractor shall allow in the Tender price for Wireless Access Point (WAP) locations in quantities as indicated on the drawings. Actual WAP locations shall be as determined by SFU at a later time. Allow for cable length of up to 90 meters per each WAP cable.

.6 Copper Horizontal Cabling shall meet or exceed all applicable ANSI/TIA standards (including all Addendums and Technical Service Bulletins) and IEEE Standards for Category 6A performance.

.7 Horizontal cables length shall not exceed 90 meters. Coordinate conduit routing to ensure cables are not too long.

2.1 PRODUCTS AND EXECUTION

2.2 Communications Copper Horizontal Cabling

.1 Horizontal cable shall be 24 AWG solid, 4-pair bonded UTP Cable jacket shall be small diameter and shall be rated FT-4 or FT-6 as required and be BLUE color. Cable shall exceed Category 6A requirements and support Belden 10GX System (with transmission speeds up to 10 Gb/s).

Pre-approved products: CMP / CMR cable Belden 10GXS33 D15 / 10GXS32 006

.2 Unless noted otherwise, homerun all horizontal 4-pair UTP cables to Telecommunications Rooms. Route cables to a Telecommunications Room on the same floor as the outlet floor. For outlets on floors without a telecom room, route cables as indicated on the riser diagram drawing.
.3 Unless noted otherwise, terminate all horizontal 4-pair UTP cables on 24-port Category 6A rack-mounted patch panels. Refer to Section 27 11 00 Clause 2.04.3 for patch panel details. Cables shall be terminated sequentially (by cable number). Exact rack layout shall be confirmed with SFU NS prior to termination.

.4 Terminate all 4-pair UTP Category 6A cable in T568A Wire Map configuration.

.5 Provide a 3-meter service loop for each cable in Communications room. Place service loop in cable tray.

2.3 Communications Optical Fiber Horizontal Cabling

.1 Not Applicable

2.4 Communications Faceplates and Connectors - Overview

.1 Category 6A UTP outlet connectors shall be 8-pin modular jacks terminated in T568A Wire Map configuration. The Jacks must accept RJ-45 or RJ-11 modular plugs without causing any damage or degradation to the connectors.

.2 For detailed configuration of various outlet types refer to drawings.

2.5 Typical Wall-mounted Data Outlet (REG)

.1 Typical copper office/workstation outlet shall be a 4-port, single-gang Belden MediaFlex Angled entry faceplate, AX106635, white color. Refer to detail REG for additional details.

.2 Typical port assignment shall be:

- Port “A” (upper left): Voice – Cat 6A Belden 10GX REVConnect module, RVAMJKUBK-S1, black color.
- Port “B” (upper right): Data – Cat 6A Belden 10GX REVConnec module, RVAMJKUBK-S1, black color.
- Port “C” (lower left): Spare - blank insert, Belden AX102262, white color.
- Port “D” (lower right): Spare - blank insert, Belden AX102262, white color.

If the drawings indicate 2 numbers (separated by a forward slash) for a copper outlet, the second number designates additional ports wired to a special separate patch panel at a local hub (NOT in the telecom room). The respective wall jacks shall be yellow color, Belden RVAMJKUYL-S1.

.3 All ports shall be labeled as “A”, “B”, “C”, “D”, …, with small printed labels. This labeling applies to all outlet types.

2.6 Multi-User Outlet (MU)

.1 Typical multi-user outlet shall be a 8-port, double-gang Belden MediaFlex Angled entry faceplate, Belden AX106655, white color. Other parts are similar to REG outlet type. Refer to detail MU for additional details.
2.7 Wall-mounted Telephone Outlet (WT)

.1 Each outlet identified on drawings as “WT” (Wall-mounted Telephone) shall have stainless steel faceplate (Belden AX102005) with one black Category 6A VoIP port (Belden RVAMJKUBK-S1).

.2 Faceplate shall be mounted flush with the surface of the wall to accommodate installation of wall-phones. Refer to detail WT for additional details.

.3 Telephone is provided by SFU.

2.8 Wireless Access Point (WAP)

.1 Each outlet identified on drawings as Typical Wireless Access Point shall have a white MediaFlex Angled Faceplate Kit (Belden AX106635) with two black Category 6A data ports (Belden RVAMJKUBK-S1) installed in accessible ceiling space.

.2 Provide patch cord of suitable length to reach from outlet location to WAP device. Label patch cord end with cable number. Install WAP underside finished ceiling. Refer to detail WAP1 for additional details.

.3 In locations, where accessible ceiling space is not available, terminate each Category 6A cable with black Category 6A REVConnect data jack (Belden RVAMJKUBK-S1) in the back box. Provide 600mm long patch cord from data jack in outlet box to WAP device. Refer to detail WAP2 for additional details.

.4 WAP devices, including mounting hardware, will be supplied to the contractor by SFU.

.5 Provide a polycarbonate NEMA 4X rated weatherproof enclosure Oberon 1024-00 if WAP is installed outside. Cable jacks (Belden RVAMJKUBK-S1) shall be installed in white 2-port side entry box (Belden AX105353). Refer to details WAP3 for additional details.

2.9 Security IP Camera Outlet (CAM)

.1 Provide one Category 6A data drop to each CAM location.

.2 Typically, cameras are mounted to back boxes on fixed ceilings or walls. Terminate Category 6A cable with black Category 6A REVConnect data jack (Belden RVAMJKUBK-S1) in the camera back box. Refer to detail CAM1 for additional details.

.3 If camera is installed on a removable ceiling panel, Provide data outlet in accessible ceiling. Outlet shall have a white MediaFlex angled faceplate (Belden AX106635) with one black Category 6A data port (Belden RVAMJKUBK-S1). Refer to detail CAM 2 for additional details.

.4 Camera with a data cord is provided by Division 28.
2.10 Projector Outlet (PJ)

.1 Each outlet identified on drawings as “PJ” (Projector) shall have a white MediaFlex Angled Faceplate (Belden AX106635) with one black Category 6A data port (Belden RVAMJKUBK-S1). Refer to detail PJ for additional details.

.2 Projector with a data cord is provided by AV trade.

2.11 Flat Screen Outlet (FS)

.1 Each outlet identified on drawings as “FS” (Flat Screen) shall have a white MediaFlex Angled Faceplate (Belden AX106635) with one black Category 6A data port (Belden RVAMJKUBK-S1). Refer to detail FS for additional details. Refer to A/V elevation drawings for outlet location.

.2 Flat Screen with a data cord is provided by AV trade.

2.12 Outlet for A/V Equipment (AV)

.1 Outlet is identified on drawings as “AV” shall have a white MediaFlex Angled Faceplate (Belden AX106635) with black Category 6A data ports (Belden RVAMJKUBK-S1) in quantities indicated on floor plan drawings.

.2 This outlet is typically located at A/V equipment racks. Refer to detail AV for additional details. Refer to A/V drawings for outlet location.

.3 AV equipment with data cord is provided by AV trade.

2.13 Data Outlet for AV Keypad (AK)

.1 Each outlet identified on drawings as “AK” shall have one Category 6A data cable Terminated Category 6A cable with black Category 6A REVConnect data jack (Belden RVAMJKUBK-S1) in the keypad back box. Refer to detail AK for additional details.

.2 Keypad with a data cord is provided by AV trade.

2.14 Floor Box Outlet (FB)

.1 Each outlet identified on drawings as floor box shall have KeyConnect Decora style adapter. Decora adapter shall be typically 2-port type (Belden AX104112) with black Category 6A data ports (Belden RVAMJKUBK-S1). Locations requiring 3 or 4 cables shall utilize additional Decora style adapter (Belden AX104121) in a separate gang of the box. Refer to detail FB for additional details.
2.15 Poke-Thru Outlet (PT)

.1 Each outlet identified on drawings as poke-thru (PT) shall have KeyConnect Decora style adapter. Decora adapter shall be typically 2-port type (Belden AX104112) with black Category 6A data ports (Belden RVAMJKUBK-S1). Locations requiring 3 to 4 data ports shall utilize 4-port Decora style adapter (Belden AX102266). Locations requiring 5 to 6 data ports shall utilize 6-port Decora style adapter (Belden AX104118). Refer to detail PT for additional details.

2.16 Data Outlets on Surface Raceways (SR)

.1 Outlets shown on surface raceways shall have KeyConnect Decora style adapter. Decora adapter shall be typically 2-port type (Belden AX104112) with black Category 6A data ports (Belden RVAMJKUBK-S1). Locations requiring 3 or more cables shall utilize additional Decora style adapter (Belden AX104121) in a separate device cut-out of the surface raceway. Refer to detail SR for additional details.

2.17 Data Outlets on Pac-Pole (POL)

.1 Outlets shown on Pac-Poles shall have KeyConnect Decora style adapter. Decora adapter shall be typically 2-port type (Belden AX104112) with black Category 6A data ports (Belden RVAMJKUBK-S1). Locations requiring 3 - 4 cables shall utilize 4-port Decora style adapter (Belden AX102266). Locations requiring 5 or more cables shall utilize 6-port Decora style adapter (Belden AX104118) or additional Decora style adapters in a separate device cut-out of the Pac-Pole. Refer to detail POL for additional details.

2.18 Security Outlet (SEC)

.1 Each outlet identified on drawings as “SEC” (Security) shall have a white MediaFlex Angled Faceplate (Belden AX106635) with one to four black Category 6A data ports (Belden RVAMJKUBK-S1). SEC outlet box shall be surface mounted in Communications room on plywood below cable tray close to security panels. Coordinate exact location with Division 28 contractor. Refer to detail SEC for additional details.

.2 Security panel with a data cord is provided by Division 28.

2.19 Data outlet for Building Management (BMS)

.1 Each outlet identified on drawings as “BMS” (Security) shall have a white MediaFlex Angled Faceplate (Belden AX106635) with one to four black Category 6A data ports (Belden RVAMJKUBK-S1). BMS outlet box shall be surface mounted in a Utility room close to BMS panels. Coordinate exact location with mechanical trade. Refer to detail BMS for additional details.

.2 BMS panel with a data cord is provided by Division 25.
2.20 Code Blue Phone (CB)

.1 Provide hands-free emergency phones at locations indicated on floor plan drawings as "CB". Station shall have a single button to call for help.

Reference Product: Code Blue 501-d with dual call (HELP and INFO) buttons or an approved equivalent.

.2 Provide blue wall-mounted beacon/strobe light above the CB station. The beacon light shall be illuminated at all times. And the strobe light shall flash only when CB station is in use. Program strobe flash sequence as directed by SFU representative.

Reference product: Code Blue S-1000 light with Code blue 40075 wall mount bracket or approved equivalent.

.3 Refer to drawing detail CB for additional details.

.4 Provide one Category 6A cable, one 2c 16AWG 24V power cable and one 4c 22AWG control cable to each CB phone location. Terminated Category 6A cable with black Category 6A REVConnect data jack (Belden RVAMJKUBK-S1) in the station back box.

.5 Provide power supplies with backup batteries in telecom room.

.6 Wire as per drawing detail CBW. Note: Connections at security control panels by Division 28.

2.21 Door Intercom Station (IC)

.1 Provide one Category 6A data drop to each IC location. Terminate Category 6A cable with black Category 6A REVConnect data jack (Belden RVAMJKUBK-S1) in the door intercom back box. Provide 600mm long cord to intercom station. Refer to detail IC for additional details.

.2 Provide weather-proof hands-free IP intercom station with a single call button.

Reference product: Viking Electronics E-32-IP-EWP or approved equivalent.

***END OF SECTION***
1.1 GENERAL

1.2 Cross Connect Wire

.1 Cross connect BIX fields as per owner requirements.

.2 Wires shall be 24 AWG solid tinned copper, 1-pair Category 3. Conductors shall be insulated with semi-rigid PVC. One insulated conductor in a pair shall be white and other in visibly distinct solid color.

.3 Pair-untwist shall not exceed 75mm from the point of termination.

1.3 Copper Patch Cords

.1 Cords shall be Category 6A, 4-pair bonded UTP, FT-4 rated. Cords shall be factory terminated on both ends, with 8-pin modular plugs in T568A-ISDN pin assignment and come with snagless over-molded strain-relief boots. Cords shall exceed Category 6A requirements and support 10GX System performance. Mechanical durability rating shall be minimum 1000 mating cycles.

.2 Equipment Patch Cords shall interconnect horizontal Data runs to user supplied network equipment. Data cords shall be 2.1 meters long, BLUE color. Supply one (1) BLUE Patch Cord for each horizontal Category 6A cable terminated on REVConnect patch panels.

Pre-approved product: Belden CA21106007 modular cord.

.3 Voice Patch Cords shall cross connect horizontal Voice runs to Voice “backbone” patch panels. Voice patch cords shall be 2.1 meters long, GRAY color. Supply one (1) GRAY Patch Cord for each Category 6A cable serving a Code Blue station plus three extra cords.

Pre-approved product: Belden CA21108007 modular cord.

1.4 Copper Work Area Cords

.1 Work area cords shall be Belden Modular cords.

.2 Unless noted otherwise, work area cords shall be minimum 3 meters long. Some locations, (e.g. Multi-user outlets) might require longer cords.

.3 Work area cords shall be bonded 4-pair UTP Category 6A BLUE color, RJ-45 type connectors on both ends.

.4 For REG, MU, FB, PT, SR, POL type of outlets supply one (1) BLUE Category 6A modular cord per each horizontal Category 6A cable serving these outlets. Cord length shall be as required to reach work area computer and phone but not less than 3 meters.

Pre-approved product: Belden CA2110601x modular cord.

.5 For elevator phone outlet supply one (1) GREY Category 5e modular cord per each horizontal cable serving these outlets. Cord length shall be as required to reach elevator phone demarcation.
Pre-approved product: Belden C5011080xx.

.6 For all other outlet types refer to drawings for cord requirements.

1.5 Optical Fiber Singlemode Patch Cords

.1 SM fiber patch cords shall be 2-strand OS2 fiber ZIP cords. Jacket shall be FT-4 rated and be in YELLOW color. Cords shall come with factory installed blue LC duplex connectors on both ends and have molded strain-relief rubber boots. Minimum durability rating shall be 500 mating cycles.

.2 For each 48 fiber strands of backbone cabling installed provide: eight (8) SM duplex patch cords 2.2 meters long plus two (2) SM duplex patch cords 3 meters long.

Pre-approved products: Belden FPSLDLD02M2 and Belden FPSLDLD003M duplex fiber patch cords.

***END OF SECTION***
1.1 GENERAL

1.2 Related Technical Requirements

.1 Section 27 10 00 Structured Cabling
.2 Section 25 05 00 BAS

1.3 Coordination Requirements

.1 SFU Facilities Services
.2 SFU IT Services

2.1 MATERIALS AND DESIGN REQUIREMENTS

2.2 General Requirements

.1 The fire alarm system shall be a complete electrically supervised, single stage, non-coded addressable system. The system shall incorporate only addressable notification appliances in addition to speakers if required.

The system shall be either Honeywell or Simplex. Equivalent vendors will be evaluated by SFU Facilities. Approval of equivalent equipment will be provided in writing by SFU Facilities.

.2 All fire alarm systems must be designed by a Professional Engineer currently registered in BC.

.3 All fire alarm systems shall comply with the following standards:
   .1 CAN/ULC-S524.
   .2 BC Fire Code.
   .3 Canadian Electrical Code as amended for British Columbia.

.4 BAS system interaction is limited. Fire alarms will shut down equipment through hardwire connections. The BAS will automatically start equipment once fire alarm is cleared — all buildings monitor status of fire alarm signal sent to BAS.
   .1 Review Section 25 05 00 BAS for details on BAS reset point.

.5 Each ancillary function of the fire alarm system should have its own independent bypass switch, (i.e. fans, door holders, security locks, bells, elevator homing, BMS, monitoring, etc.). Each switch is to be clearly labeled with LED annunciation of its normal and active positions.

.6 Commissioning/Verification

   .1 At the completion of verification of the fire alarm system and before fire alarm monitoring is connected, SFU Facilities shall be provided with:
      .1 A colour photocopy of the current red line electrical drawings.
      .2 A complete copy of the Verification Report.
      .3 A complete list in excel format of all field devices installed.
      .4 A detailed fire alarm matrix describing device inputs and outputs. Included are all smoke control sequences, FEO Service matrix and other ancillary operations.
      .5 A copy of the currently installed fire alarm panel program
Verification of design and commissioning will involve integrated testing as per CAN/ULC-S1001.

All smoke control shall be controlled by hard wired interlocks with the fire alarm panel whenever possible. BMS control of smoke control system components shall not be allowed.

Avoid nodes and networked panels in buildings where possible. One panel is preferred.

All batteries for a fire alarm system shall be located in one, easily serviced location.

Ancillary functions requiring 120VAC shall be fed from separate circuits, independent of the A.C circuit that feeds the fire alarm panel.

2.3 Main Control Panel

The main control panel shall be modular type, complete with all necessary plug-in modules or plug-in cards, and shall contain zone indication and all manually operated functions in the front cover behind a lockable door with viewing window. The panel shall contain enough bypass switches with at least 3 spares to provide each special system and/or ancillary system with bypass capability.

The location of fire alarm control panel shall be in the Main Electrical Room.

The 120VAC circuit supplying the Main Fire Alarm Control Panel shall have a surge protection device installed in or connected to a 4" square electrical box within 1m of FACP or as per manufacturer specifications. Preferred device is a Ditek DTK-120HW or equivalent.

2.4 Pre-Action Control Panel for Sprinkler System

Pre-action control panel for sprinkler system, if required, shall be capable of disabling notification circuits, solenoid circuits and alarm monitoring for testing purposes.

A drawing showing all connected initiation detectors and zone shall be provided to SFU Facilities.

A complete sequence of operation shall be provided to SFU Facilities.

2.5 Central Fire Alarm Monitoring

All fire systems linked by fiber backbone to be monitored on a centralized network at the approved fire monitoring station staffed by SFU Security at the Discovery 1 building dispatch centre.

This system monitors all SFU fire alarm and the dispatch will contact the Burnaby Fire Department for response.

Fire systems are installed by contractor but the fiber connection from the building panel to the SFU network is the responsibility of SFU. The wireway route carrying the fiber is specified by SFU to the electrical contractor for installation.

2.6 Gongs

Gongs shall be installed as per CAN/ULC S524.
2.7 Alarm Annunciator

.1 The location of the annunciator shall be acceptable with the Fire Chief and Building Operations Electrical Engineer.

.2 The fire alarm annunciator shall be located on the inside of the building envelope to protect against rain and weather damage.

.3 The fire alarm annunciator shall be mounted on an insulated wall or on standoffs to avoid cold condensation issues.

.4 The annunciator shall be manufactured by a company usually engaged for such equipment.

.5 The fire alarm annunciator shall have a keyed enable switch to avoid tampering by the public when in alarm acknowledge, supervisory acknowledge and trouble acknowledge functions.

2.8 Other Requirements

.1 No combined type detectors will be acceptable.

.2 Each valve, switch, contact, etc. shall be monitored by an individual module.

.3 All remote monitor, isolator and relay modules shall be mounted in a dedicated electrical box external to the cabinet of the equipment they monitor or control with manufacturer supplied mounting brackets and covers.

.4 Door hold open devices shall be monuments rather than integrated door closure and hold open devices.

.5 Where an Emergency Generator is supplied the Fire Alarm Control Panel and all remote Fire Alarm equipment shall be supplied with power from the Life Safety Distribution.

.6 Where an Emergency Generator is supplied the Fire Alarm System shall monitor the Generator and Transfer Switch for any and all abnormal conditions.

.7 The Fire Alarm System shall monitor for: Generator Trouble (any condition that would not allow the generator to operate or transfer power) and Generator Run. Both signals are required to be Supervisory Alarms.

.8 Beam type detectors shall be Fire Ray 5000 Approval of equivalent equipment will be provided in writing by Building Operations Electrical Technical Specialist.

.9 Aspiration type detection shall be VLP-012 VESDA LaserPLUS or equivalent. The end sampling point of each pipe run shall terminate 1m to 2m above finished floor in a readily accessible area to allow for system testing and maintenance. Approval of equivalent equipment will be provided in writing by Building Operations Electrical Technical Specialist.

.10 For VSD equipment, connections including fire and DDC interlocks will run directly to VSD and no through the starter.

2.9 Panel Manufacturer’s Responsibility and Inspection Requirements

.1 Notwithstanding the Contractor’s obligations, the entire fire alarm system shall be the responsibility of the panel manufacturer. Prior to acceptance of the system by the Consultant, the manufacturer shall check the entire system and certify the operation of all
.2 The manufacturer shall make an inspection of the new fire alarm equipment installed under this contract, including those components necessary to the direct operation of the system such as manual stations, fire detectors and controls. The inspection shall comprise of an examination and subsequent verification of all equipment in accordance with the standard for testing fire alarm systems ULC-CAN4-S537. All equipment of the fire alarm system shall be listed for use with the panel manufacturer.

.1 In case of partial occupancy of a building; a partial verification of the fire alarm system may be performed. This shall not waive the requirement of a complete verification as part of the substantial completion process for the entire building when complete.

***END OF SECTION***
1.1 MATERIALS AND DESIGN REQUIREMENTS

1.2 Grading

.1 Grades of lawns and plantings shall comply with best management practices related to site drainage, and be kept within safe, stable and maintainable limits using appropriate slope retention design and construction methods.

.1 Site-specific design strategies should be used to avoid excessive, inaccessible or unsafe slopes. Such strategies may include, but not be limited to: terraced landscapes, retaining walls, enclosed planters, access ramps, pathways and stairs.

.2 Sloped landscapes must be graded appropriately in relationship to buildings, hardscape and other site elements such that mowers, excavators or other equipment used for maintenance or renovation purposes, are not at risk of losing traction, slipping, and rolling downslope causing injury to operators, bystanders, or damage to property (see .4 below).

.3 Sloped landscapes must be structurally stable, and be resistant to surficial erosion or shifting of under-bearing soils, plants, trees or geotextile. Landscape maintenance staff must be able to access and negotiate sloped landscapes on foot or with equipment as needed without undue ergonomic stress, potential injury, loss of footing, or loss of equipment control.

.4 To keep slopes within reasonably safe and workable limits, maximum allowable slopes on SFU Campus shall not exceed 5:1 for lawns, and 3:1 for planted slopes.

.5 For specialized circumstances, such as planted slopes for storm water detention ponds, or stream bank stabilization, variance from the above criteria may be granted subject to pre-approval by Campus Landscape Architect in consultation with SFU Facilities. Nonetheless, erosion control technologies such as matting, geo-grids, geo-synthetic bags etc. must be used to ensure stability of soils, mulches and the proper establishment of slope plantings as discussed in 1.1.3 above.

.6 All projects should consider providing a site-specific erosion and sediment control plan. Review project specific requirements and approve Plan (if applicable) with SFU Project Manager and SFU Facilities.

.2 Under no circumstances should rough or finished grades of lawn, planting or paving result in the burying or otherwise obscuring of existing utility service covers, valve-boxes, manholes, catch basins, or the like. Should a circumstance arise where a service will fall below proposed finish grades, contractor must halt work and contact the owner immediately before proceeding.

***END OF SECTION***
1.0 DESIGN REQUIREMENTS

1.1 Unless specified by SFU Facilities and site-specific design requirements, all standard municipal hardscapes should conform to BC Landscape Standard and Master Municipal Construction Documents (MMCD), current editions.

1.2 Landscape structures should reference the appropriate architectural sections of the SFU Owners’ Technical Requirements.

1.3 It is imperative that hard landscape steps, furniture, walls and railings are designed to be resistant to skateboarding damages. After-the-fact add-on straps and studs are less desirable than surfaces that have been pre-considered as targets, and aesthetically designed to deter skateboarders. Preferred deterrents should be considered at the schematic design stage. Design strategies should include incorporation of air gaps, notching, and offsets in seat walls, uneven surfaces, and other creative alignments and articulation of surfaces, walls, steps and railings.

1.4 Building façade and tree pruning require using heavy equipment such as manlifts. Both soft and hard landscaping must be designed to accommodate the loading and movement of this equipment in and around buildings.

.1 Structural soils, root protection and plants must be considered in these areas.

.2 Coordinate as early as possible in the conceptual and design development phases with SFU Facilities.

1.5 Irrigation controls must be AC powered. DC controls are not permitted.

1.6 Base allowable plant list is listed as follows:

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<th>BOTANICAL NAME</th>
<th>COMMON NAME</th>
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<td>Acer griseum</td>
<td>Paperbark Maple</td>
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<tr>
<td>Acer macrophyllum</td>
<td>Broadleaf Maple</td>
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<td>Eddie's Pacific Dogwood</td>
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<td>Oyama Magnolia</td>
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<td>Lodgepole Pine</td>
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</tr>
<tr>
<td>Sambucus racemosa</td>
<td>Red Elderberry</td>
</tr>
<tr>
<td>Spiraea douglasii</td>
<td>Hardhack</td>
</tr>
<tr>
<td>Symphoricarpus alba</td>
<td>Snowberry</td>
</tr>
</tbody>
</table>

1.7 Any plant selections outside of those listed in part 1.6 will have to be reviewed by SFU Facilities and SFU Biology Department.

***END OF SECTION***
Owners Technical Requirements (OTR)

Infrastructure Asset Data Submission Specifications and Procedures

SFU Facilities Services

Tuesday, December 5, 2017
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1. Introduction and Overview

This document describes Owners Technical Requirements (OTR) and procedures for providing SFU Facilities Services with data representing existing and new infrastructure assets upon construction completion of infrastructure design and construction projects.

Asset data required by SFU Facilities Services to enable efficient lifecycle management practices for infrastructure and to meet TCA requirements by accounting for infrastructure on financial statements.

2. Technical Background

SFU Facilities Services infrastructure asset data submission standards and procedures outlined in this document were developed to facilitate the transfer of infrastructure data to SFU Facilities Services upon the completion of construction of infrastructure projects. Data is not only required for newly constructed infrastructure assets, but also for existing infrastructure that has been affected by the project.

SFU Facilities Services has adopted the MMCD Municipal CAD Standard and will require consultants to use this standard when working on infrastructure design projects. The standard makes use of AutoCAD Map 3D object data to accommodate asset attribution. Consultants engaged with infrastructure design and construction projects must obtain SFU Facilities Services CAD Standard files directly from SFU Facilities Services and not from MMCD, as they have been amended with SFU specific items.

AutoCAD Civil 3D can be used to design sanitary sewer, storm drainage and watermain pipe networks but is not required. The benefit in using AutoCAD Civil 3D is reduced physical property and material data entry in the AutoCAD Map 3D object data tables.

2.1. Infrastructure Project Data

The 4 sets of data created for each infrastructure project upon construction completion are summarized in the following bullets:

1. **Existing Recorded Assets – (by SFU and Consultant)** – existing infrastructure data sourced from SFU GIS in an AutoCAD drawing for the project area using R-* layers in the SFU MMCD C3D drawing template.

2. **Survey Recorded Assets (by Consultant)** – surveyed infrastructure asset data sourced from consultants pre-engineering topographic surveys in AutoCAD Civil 3D drawing using V-* layers in SFU MMCD C3D drawing template.

3. **Design Recorded Assets (by Consultant)** – proposed infrastructure design data created by consultants in AutoCAD Civil 3D drawing using C-* layers in SFU Facilities Services MMCD C3D drawing template.

4. **Construction Recorded Assets (by Consultant)** – asset data representative of as constructed conditions created by consultants in AutoCAD Civil 3D drawing using C-* layers in SFU Facilities Services MMCD C3D drawing template.

The Construction Recorded Assets drawing is created by updating a renamed copy of the Design Recorded Assets drawing. These updates include i) addition of new assets not accounted for during the design ii) updating design asset data to reflect constructed conditions iii) removal of asset data identified in the design but not constructed and iv) attachment of Map 3D object data tables with attribution to constructed assets.
3. Asset Data Submission Standards

The following sections summarize SFU Facilities Services asset data submission standards.

3.1. Project Data Overview

This section summarizes the specific items that constitute an infrastructure design and construction package created with SFU MMCD Municipal CAD Standard.

The benefit to consultants using AutoCAD Civil 3D pipe networks (pipe and structure objects) to model sanitary, storm and watermain infrastructure is that the physical properties of pipes and structures are extracted from the LandXML file created from AutoCAD Civil 3D pipe networks. Using AutoCAD Civil 3D objects means that consultants are not required to enter physical properties in the AutoCAD Map 3D object data tables.

Sanitary, storm and watermain designs represented with AutoCAD polylines and blocks require consultants to enter physical properties for pipes and structures in the AutoCAD Map 3D object data tables.

The following list of deliverables is to be provided by the consultant to SFU Facilities Services once construction is complete:

1. **Existing Recorded Assets Drawing** – this AutoCAD drawing contains information on existing assets and is modified by the consultant to indicate the assets that have been affected (improved, removed, abandoned) by the project.

2. **Survey Recorded Assets Drawing** – this AutoCAD Civil 3D drawing created from the SFU MMCD Civil 3D drawing template contains the pre-engineering base plan and existing ground surface model, and is used by SFU Facilities Services to validate the location of existing assets in the GIS that are not affected by the project.

3. **Design Recorded Assets Drawing** – the AutoCAD Civil 3D design model drawing created from the SFU MMCD Civil 3D drawing template containing proposed sanitary sewer, storm drain, watermain and road design.

4. **Construction Recorded Drawing** – a copy of the original design recorded drawing is used to record details of newly constructed infrastructure assets. Attribution of new assets is completed using AutoCAD Map 3D object data tables.

5. **LandXML File for Pipe Networks** – a LandXML containing pipe network data is required to provide physical properties for sanitary, storm and watermain modeled using AutoCAD Civil 3D pipe networks. Using AutoCAD Civil 3D to design pipe networks means that consultants are not required to enter pipe and structure physical properties in the AutoCAD Map 3D object data tables.

6. **Production Drawings** – production drawings source data from the design model drawings and are representative of the final plans that make up a design and construction drawing set.

All drawings are to be provided in AutoCAD or AutoCAD Civil 3D release 2016.

3.2. Data Provided by SFU at Project Start

At the beginning of the infrastructure design project, SFU Facilities Services will provide consultants with a pre-design data package containing information on existing recorded assets. In addition to a high
resolution aerial photograph for the project area, SFU will provide an existing recorded assets drawing with underground, road and property features represented using AutoCAD polylines and blocks.

The existing recorded assets drawing is created using MMCD layering standards. Layers in the existing recorded assets drawing reference the same NCS (National CAD Standard) layer structure used for design, however a R-* prefix modifier is used to identify layers containing existing recorded data. All record R-* layers are assigned colour grey (8) and reference the same linetypes used by the existing survey layers V-*. The block names in the existing recorded assets drawing reference the same blocks used for existing survey assets.

The existing recorded assets drawing does not contain AutoCAD Civil 3D or Map 3D object data. Some of the record data layer names and block names are shown in the following illustration.

Note: Existing recorded infrastructure data provided by SFU Facilities Services at project initiation is not reliable for detailed design project activity. Consultants, therefore, are required to supplement pre-engineering existing recorded asset data with field data collected using topographic survey data collection and reduction practices.

The existing recorded assets drawing is created to reference the NAD83 Zone 10N grid coordinate zone. Consultants shall apply a grid to ground scale factor (X,Y only) about 0,0 when attaching the existing recorded assets drawing as an AutoCAD external reference to the design drawings created at a ground level coordinate system.

3.3. Object Data Tables

AutoCAD Map 3D object data tables are defined in SFU MMCD drawing template, and are used to attribute design and construction recorded assets. The following sections describe the object data tables for SFU Facilities Services assets.
3.3.1. Object Data Table CBAS

Use AutoCAD Map 3D object data table CBAS to assign attributes to design and construction recorded drainage catch basins represented AutoCAD blocks or Civil 3D structures.

Catch basin block and layer names are shown in the following table.

<table>
<thead>
<tr>
<th>Drawing</th>
<th>Block Name</th>
<th>Layer Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design and Construction Recorded Assets PR Storm</td>
<td>Catchbasin Double</td>
<td>C-DRAN-STRC</td>
</tr>
<tr>
<td>Catchbasin Manhole</td>
<td>C-DRAN-STRC</td>
<td></td>
</tr>
<tr>
<td>Design and Construction Recorded Assets PR Storm</td>
<td>Catchbasin Side Inlet</td>
<td>C-DRAN-STRC</td>
</tr>
<tr>
<td>Catchbasin Top Inlet</td>
<td>C-DRAN-STRC</td>
<td></td>
</tr>
<tr>
<td>Design and Construction Recorded Assets PR Storm</td>
<td>Lawn Drain</td>
<td>C-DRAN-STRC</td>
</tr>
</tbody>
</table>

Refer to the object data table CBAS in the Appendices for a complete list of attributes and their allowable values.

3.3.2. Object Data Table FITT

Use AutoCAD Map 3D object data table FITT to assign attributes to design and construction recorded water fittings represented with AutoCAD blocks.

Fitting block and layer names are shown in the following table.

<table>
<thead>
<tr>
<th>Drawing</th>
<th>Block Name</th>
<th>Layer Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design and Construction Recorded Assets PR Water</td>
<td>Air Valve</td>
<td>C-WATR-STRC</td>
</tr>
<tr>
<td>Bends</td>
<td>C-WATR-STRC</td>
<td></td>
</tr>
<tr>
<td>Blowoff</td>
<td>Cap</td>
<td>C-WATR-STRC</td>
</tr>
<tr>
<td>Cross</td>
<td>Flush</td>
<td>C-WATR-STRC</td>
</tr>
<tr>
<td>Hub Flange</td>
<td>Hydrant</td>
<td>C-WATR-STRC</td>
</tr>
<tr>
<td>Manhole</td>
<td>Meter</td>
<td>C-WATR-STRC</td>
</tr>
<tr>
<td>Reducer</td>
<td>Reducer</td>
<td>C-WATR-STRC</td>
</tr>
<tr>
<td>Robar</td>
<td>Service</td>
<td>C-WATR-STRC</td>
</tr>
<tr>
<td>Tee</td>
<td>Valve</td>
<td>C-WATR-STRC</td>
</tr>
<tr>
<td>Valve Air</td>
<td>Thrust Block</td>
<td>C-WATR-STRC</td>
</tr>
<tr>
<td>Valve</td>
<td>Valve</td>
<td>C-WATR-STRC</td>
</tr>
</tbody>
</table>
Refer to the object data table FITT in the Appendices for a complete list of attributes and their allowable values.

### 3.3.3. Object Data Table HYDR

Use AutoCAD Map 3D object data table HYDR to assign attributes to design and construction recorded fire hydrants represented with AutoCAD blocks.

The fire hydrant block and layer names are shown in the following table.

<table>
<thead>
<tr>
<th>Drawing</th>
<th>Block Name</th>
<th>Layer Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design and Construction Recorded Assets</td>
<td>EX Water Hydrant</td>
<td>R-WATR-STRC</td>
</tr>
<tr>
<td>Design and Construction Recorded Assets</td>
<td>EX Water Vent</td>
<td>R-WATR-STRC</td>
</tr>
<tr>
<td>Design and Construction Recorded Assets</td>
<td>PR Water Hydrant</td>
<td>C-WATR-STRC</td>
</tr>
</tbody>
</table>

Refer to the object data table HYDR in the Appendices for a complete list of attributes and their allowable values.

### 3.3.4. Object Data Table ILLM

Use AutoCAD Map 3D object data table ILLM to assign attributes to design and construction recorded luminaire fixtures represented with AutoCAD blocks.

The luminaire block and layer names are shown in the following table.

<table>
<thead>
<tr>
<th>Drawing</th>
<th>Block Name</th>
<th>Layer Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction Recorded Assets</td>
<td>PR Utility Lighting Davit Luminaire Pole</td>
<td>C-UTIL-ELEC-MUNI</td>
</tr>
<tr>
<td>Construction Recorded Assets</td>
<td>PR Utility Lighting Post Top Luminaire Pole</td>
<td>C-UTIL-ELEC-MUNI</td>
</tr>
</tbody>
</table>

Refer to the object data table ILLM in the Appendices for a complete list of attributes and their allowable values.

### 3.3.5. Object Data Table MHOL

Use the AutoCAD Map 3D object data table MHOL to assign attributes to design and construction recorded sanitary and storm manholes represented with AutoCAD blocks or AutoCAD Civil 3D structure objects.

AutoCAD Civil 3D object data for constructed manholes is sourced from the LandXML file for physical property data. If AutoCAD Civil 3D is not used to represented constructed manholes, then AutoCAD Map 3D object data tables must be populated with the required physical properties.

Manhole layer names for AutoCAD block and AutoCAD Civil 3D object placement are shown in the following table.

<table>
<thead>
<tr>
<th>Drawing</th>
<th>Block Name</th>
<th>Layer Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design and Construction Recorded Assets</td>
<td>PR Sanitary Manhole</td>
<td>C-SSWR-STRC</td>
</tr>
<tr>
<td>Design and Construction Recorded Assets</td>
<td>PR Storm Manhole</td>
<td>C-DRAN-STRC</td>
</tr>
</tbody>
</table>

Refer to the object data table MHOL in the Appendices for a complete list of attributes and their allowable values.
3.3.6. Object Data Table PAVE

Use AutoCAD Map 3D object data table PAVE to assign attributes to design and construction recorded pavement areas represented with closed AutoCAD polylines. For design and construction recorded pavement areas, polygons are drawn to the pavement limits and attributed accordingly.

Layers for pavement polylines are shown in the following table.

<table>
<thead>
<tr>
<th>Drawing</th>
<th>Layer Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design and Construction Recorded Assets</td>
<td>C-ROAD-EDGE</td>
</tr>
</tbody>
</table>

Refer to the object data table PAVE in the Appendices for a complete list of attributes and their allowable values.

3.3.7. Object Data Table PIPE

Use the AutoCAD Map 3D object data table PIPE to assign attributes to design and construction recorded sanitary, storm and water pipe represented with AutoCAD polylines or AutoCAD Civil 3D pipe objects.

If AutoCAD Civil 3D is not used to represented design and constructed pipes then AutoCAD Map 3D object data tables must be populated with the required physical properties.

Pipe layer names for polyline placement are shown in the following table.

<table>
<thead>
<tr>
<th>Drawing</th>
<th>Layer Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design and Construction Recorded Assets</td>
<td>C-DRAN-PIPE</td>
</tr>
<tr>
<td>Design and Construction Recorded Assets</td>
<td>C-SSWR-PIPE</td>
</tr>
<tr>
<td>Design and Construction Recorded Assets</td>
<td>C-SSWR-FORC</td>
</tr>
<tr>
<td>Design and Construction Recorded Assets</td>
<td>C-WATR-PIPE</td>
</tr>
</tbody>
</table>

Refer to the object data table PIPE in the Appendices for a complete list of attributes and their allowable values.

3.3.8. Object Data Table SRVC

Use the AutoCAD Map 3D object data table SRVC to assign attributes to design and construction recorded sanitary, storm and water pipe service lines represented with AutoCAD polylines or Civil 3D pipe objects. Note that the service attributes are attached to the service polyline and not the service block.

Service layer names for polyline and pipe objects are shown in the following table.

<table>
<thead>
<tr>
<th>Drawing</th>
<th>Layer Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design and Construction Recorded Assets</td>
<td>C-DRAN-SRVC</td>
</tr>
<tr>
<td>Design and Construction Recorded Assets</td>
<td>C-SSWR-SRVC</td>
</tr>
<tr>
<td>Design and Construction Recorded Assets</td>
<td>C-WATR-SRVC</td>
</tr>
</tbody>
</table>

Refer to the object data table SRVC in the Appendices for a complete list of attributes and their allowable values.
3.3.9. **Object Data Table VALV**

Use AutoCAD Map 3D object data table VALV to assign attributes to design and construction recorded sanitary and water valves represented with AutoCAD blocks or Civil 3D objects.

Valve blocks and layer names are shown in the following table.

<table>
<thead>
<tr>
<th>Drawing</th>
<th>Block Name</th>
<th>Layer Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design and Construction Recorded Assets</td>
<td>PR Water Valve</td>
<td>C-WATR-STRC</td>
</tr>
<tr>
<td>Design and Construction Recorded Assets</td>
<td>PR Sanitary Valve</td>
<td>C-WATR-STRC</td>
</tr>
</tbody>
</table>

Refer to the object data table VALV in the Appendices for a complete list of attributes and their allowable values.

3.3.10. **Object Data Table WALK**

Use AutoCAD Map 3D object data table WALK to assign attributes to design and construction recorded walkway / sidewalk and path polylines. Walkways and sidewalks are shown as closed polylines representing the exterior limits and paths are drawn as centrelines.

Walkway and path layer names for polyline placement are shown in the following table.

<table>
<thead>
<tr>
<th>Drawing</th>
<th>Layer Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design and Construction Recorded Assets</td>
<td>C-ROAD-WALK</td>
</tr>
<tr>
<td>Design and Construction Recorded Assets</td>
<td>C-ROAD-PATH</td>
</tr>
</tbody>
</table>

Refer to the object data table WALK in the Appendices for a complete list of attributes and their allowable values.

3.4. **Existing Recorded Assets**

SFU Facilities Services must capture the lifecycle status change of existing assets affected by the infrastructure project for financial accounting and asset management practices.

The existing recorded assets drawing is provided by SFU Facilities Services to consultants at project initiation, and shows graphical infrastructure data in the project area and is sourced from SFU GIS. Existing assets are represented with AutoCAD polylines and block definitions.

The SFU existing recorded assets drawing for the project area contains no attribution, however consultants are required to indicate the new lifecycle status of existing infrastructure assets by changing the colour of the AutoCAD entities in the drawing using the following colours:

- Replacement (Colour 1, Red)
- Betterment (Colour 2, Yellow)
- Abandoned (Colour 3, Green)
- Removed (Colour 4, Cyan)

Blocks representing manholes, catchbasins and other non-linear features can be exploded prior to changing the colour. These colour changes are finalized in the existing recorded assets drawing upon construction completion.
3.5. Design Recorded Assets

Design recorded assets represent newly designed assets that SFU Facilities Services will track for both financial accounting and asset management purposes.

Design recorded assets are represented in the design recorded assets drawing, which is created using ground level coordinates to facilitate the generation of construction staking data.

AutoCAD Civil 3D provides an advantage to consultants using pipe networks to model sanitary, storm and water infrastructure. When using AutoCAD Civil 3D, physical properties for pipes and structures (manholes) are extracted from the LandXML file, which means physical property and material attributes in AutoCAD Map 3D object data tables for pipes and structures (manholes only) are not required. If sanitary, storm and water infrastructure is represented with AutoCAD polylines and blocks, physical properties must be assigned in the AutoCAD Map 3D PIPE and MHOL object data tables.

AutoCAD Civil 3D objects are only recognized for the following types of infrastructure:

- Sanitary – pipes and manholes only
- Storm – pipes and manholes only
- Watermain – pipes only

Use AutoCAD Civil 3D pipe networks to model sanitary, storm and water infrastructure. Pressure pipe networks are currently not supported.

3.6. Construction Recorded Assets

Construction recorded assets reflect the as constructed conditions. The design recorded assets drawing is copied and renamed and is updated to represent the following construction activity:

- Updates to design recorded assets based on as construction conditions such as changed manhole / Catchbasin locations and pipe invert elevations
- Addition of new assets not initially accounted for in the design recorded assets drawing
- Removal of assets reflected in the design recorded drawing but not actually constructed

Methodologies for the creation and attribution of construction recorded assets are the same as those for design recorded assets.

3.6.1. Sanitary Sewer Naming Conventions

AutoCAD Civil 3D pipe networks (pipes and structures) or AutoCAD entities (blocks and polylines) can be used for sanitary sewer designs. A single entity or pipe object is required to represent a sanitary sewer pipe between manholes.

Use the following naming convention for AutoCAD Civil 3D sanitary sewer pipe networks:

PRSSWR<#>

The number sign # is used incrementally when assigning names to multiple sanitary sewer pipe networks.
3.6.2. Storm Drainage

AutoCAD Civil 3D pipe networks (pipes and structures) or AutoCAD entities (blocks and polylines) can be used for storm drainage designs. A single entity or pipe object is required to represent a storm drainage pipe between manholes.

Use the following naming convention for AutoCAD Civil 3D storm drainage pipe networks:

PRDRAN<#>

The number sign # is used incrementally when assigning names to multiple storm drainage pipe networks.

3.6.3. Water

AutoCAD Civil 3D pipe networks (pipes only and blocks) or AutoCAD entities (polylines and blocks) can be used for watermain designs.

A single entity / object is required to represent watermain pipe between fittings. Use the following naming convention for AutoCAD Civil 3D watermain pipe networks:

PRWATR<#>

The number sign # is used incrementally when assigning names to multiple watermain pipe networks.

AutoCAD Civil 3D should only be used to mode the pipes in a watermain network. All fittings are to be represented using AutoCAD blocks.

4. Infrastructure Project Data Structure and Deliverable Requirements

This section provides guidelines for engineering and construction project data structure required for SFU Facilities Services infrastructure data submissions. The intent of standardized digital submissions is to improve the process for updating SFU Facilities Services infrastructure asset database records. This means that the emphasis for the digital submission is on the model drawings and not the sheets themselves.

An infrastructure design and construction project archive consists of the following data:

1) Design Model Data
   a) Existing Recorded Assets Drawing
   b) Survey Recorded Assets drawing
   c) Design Recorded Assets drawing
   d) Construction Recorded Assets drawing
2) Drawing Production Data
   a) Design and Construction drawings
3) AutoCAD Sheet Set Manager DST file

All drawings are produced to ground level coordinates.

These drawings are discussed in the following sections.
4.1. Existing Recorded Asset Drawing

The only changes made to the existing recorded assets drawing are the colour changes to reflect the new lifecycle state of infrastructure assets affected by the project. AutoCAD entities, layouts and AutoCAD Civil 3D objects should not be added to the existing recorded drawing. AutoCAD entities representing existing assets should not be removed from the existing recorded data drawing.

The naming standard for the existing recorded asset drawing is as follows:

- `<ProjectNumber>_ExistingRecorded.dwg`

The existing recorded drawing references UTM NAD83 Zone 10N grid coordinate system and can be attached as an AutoCAD external reference to the design drawing to facilitate updates to existing asset data. The grid to ground scale factor can be applied to the X and Y insertion scales in the `Attach External Reference` dialog box.

This is shown in the following illustration.

[Image of the Attach External Reference dialog box and a map showing how to update data]

Use the AutoCAD `refedit` command to update AutoCAD Map 3D object data in the existing recorded assets drawing. Consultant may also choose to not attach the existing recorded assets drawing and open the drawing directly to update attributes on existing assets, however attaching and editing through the Xref will make it easier to identify existing assets that have changed as a result of the project.

4.2. Survey Recorded Assets

The survey recorded assets drawing contains the pre-engineering base plan and the existing ground surface model for the project, and should be created using SFU Facilities Services MMCD Civil 3D drawing template file.

Base plan linework is created using of AutoCAD Civil 3D figures. Symbols are represented using AutoCAD Civil 3D point objects. The project ground to grid factor shall be clearly identified in model space in the existing survey drawing.
The survey recorded assets drawing shall clearly display the list of survey control monuments used to coordinate the survey. Details for grid to ground level scaling including the scale factor are to be clearly indicated. Scaling shall be done around 0,0.

The naming standard for the submitted existing survey drawing is as follows:

4) `<ProjectNumber>_Survey.dwg`

The survey recorded assets drawing is submitted to SFU Facilities Services for the sole purpose of validating asset location for existing infrastructure assets not affected by the project.

**4.3. Design Recorded Assets Drawing**

Design recorded assets drawings must not be spatially fragmented and should contain all design data and attribution for the project. Design model drawing to ground level coordinates to facilitate construction layout.

Infrastructure design data is represented in a single or several design model drawings depending on the size of the project. For instance, sanitary, storm and water can be represented in 1, 2 or 3 design model drawings. Production drawings are created as independent drawings that reference data from design model drawings using AutoCAD external references and AutoCAD Civil 3D reference objects.

Design model drawings are required at the project IFC (Issued for Construction) phase. The naming standard for design model drawing(s) is as follows:

- `<ProjectNumber>_Design<#>.dwg`
- `<ProjectNumber>_SanStmWat<#>.dwg`
- `<ProjectNumber>_Roads<#>.dwg`

If multiple design model drawings are provided use the `<#>` in the file name to increment them accordingly.

In addition to the design model drawings, a LandXML file is required for sanitary, storm and water utility data designed using AutoCAD Civil 3D pipe networks. The file naming standard for the LandXML file is the same as for the design model drawing.

The design model drawings are copied to create construction recorded drawings. These copied drawings are updated to reflect as constructed locations and attributes.

**4.4. Construction Recorded Assets Drawing**

The constructed recorded assets drawing(s) is created by copying the design recorded assets drawing(s). These drawings are updated during and after construction to reflect the following:

- Adjusted asset location based on as-constructed conditions
- Data attachment using object data tables

The naming standard for constructed recorded drawing(s) is as follows:

- `<ProjectNumber>_ConstructionRecorded<#>_GroundtoGridScaleFactor>.dwg`

For example, if the project number is 82180, all design data is in a single drawing, and the ground to grid scale factor is 0.99959 then the file name is as follows:
• **82160_ConstructionRecorded_0.99959.dwg**

If multiple construction recorded drawings are provided use the `<#>` in the file name to increment them accordingly. The scale factor is required in the drawing name to facilitate the conversion of ground based design and construction data to the NAD 83 Zone 10N coordinate system used by SFU Facilities Services GIS. In circumstances where consultants design is created using grid level coordinates, the ground to grid scale factor referenced in the drawing name is 1.

In addition to the constructed recorded drawings, a LandXML file is required for sanitary, storm and water utility data designed using AutoCAD Civil 3D pipe networks. The file naming standard for the LandXML file is the same as for the constructed recorded drawing.

### 4.5. Recommended Drawing Structure

The emphasis for submissions is on the data in the design and construction recorded drawings. SFU recommends the use of AutoCAD external references and Civil 3D data shortcuts to share data among design model and production drawings.

A summary of recommended data sharing mechanisms is summarized in the following bullets:

1) **Existing Recorded Drawing**
   - a) Attached to Design drawing as AutoCAD Xref to facilitate updates to lifecycle status of existing recorded assets

2) **Survey Drawing**
   - a) Attached to Design drawing as AutoCAD Xref to show existing conditions and to facilitate design tie ins
   - b) Attached to Production drawings to show existing conditions
   - c) Create Civil 3D data shortcut to share existing surface(s) with design drawings

3) **Design and Construction**
   - a) Attaches Survey drawing as AutoCAD Xref to show existing conditions and design tie ins
   - b) Creates Civil 3D reference object for existing surface(s) from survey drawing data shortcut for existing surface profile creation and corridor / grading object daylighting
   - c) Create Civil 3D data shortcuts to share alignments, profiles and pipe networks with production drawings and other design model drawings
   - d) Attaches to Sections production drawing as AutoCAD Xref for generation of section data

4) **Production Drawings (Plan and Profile)**
   - a) Attaches Survey drawing as AutoCAD Xref to show existing conditions
   - b) Create Civil 3D reference objects from design drawing data shortcuts for proposed alignments, profiles and pipe networks

5) **Production Drawings (Section)**
   - a) Attaches alignment as Civil 3D reference object from design drawing data shortcut
   - b) Attaches design drawing as AutoCAD external reference for the generation of section data

AutoCAD external references should be created using relative paths, so they can resolve properly when transferred between PC’s. All drawings can be in a single project folder.

Please review the Appendix B for a data sharing diagram that graphically displays the data.
Appendix A – Asset Types and Attributes
<table>
<thead>
<tr>
<th><strong>SERVICE_STATUS</strong></th>
<th><em>SEE ATTRIBUTE SHEET</em></th>
</tr>
</thead>
<tbody>
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<td>Financial transaction</td>
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<tr>
<td>I</td>
<td>= In service</td>
</tr>
<tr>
<td>NETN</td>
<td>= Net New (Acquisition)</td>
</tr>
<tr>
<td>REPL</td>
<td>= Replacement (Acquisition)</td>
</tr>
<tr>
<td>BETT</td>
<td>= Betterment (Acquisition)</td>
</tr>
<tr>
<td>ABND</td>
<td>= Abandoned (Disposal)</td>
</tr>
<tr>
<td>RMVD</td>
<td>= Removed (Disposal)</td>
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<tr>
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<th><em>SEE ATTRIBUTE SHEET</em></th>
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<tr>
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# Object Data Table – BASE (Structure Granular)

**SUBJECT:** CAD/C3D Object to Object Data Table & Field Descriptions  
**SOURCE:** MMCDA – Master Municipal Construction Documents Association  
**REVISION DATE:** November 2, 2017

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<td>NETN = Net New (Acquisition)</td>
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<tr>
<td></td>
<td>RMVD = Removed (Disposal)</td>
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<td><strong>OWNER</strong></td>
<td><em>SEE ATTRIBUTE SHEET</em> Ownership of assets</td>
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<td></td>
<td>SFU = University owned asset</td>
</tr>
<tr>
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<td>SFUCT = SFU Community asset</td>
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<tr>
<td></td>
<td>PRVT = Privately owned asset</td>
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<td>CITY = City of Burnaby</td>
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<td>Installing or Existing Project Id</td>
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<td>P81000 = Sample project ID</td>
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<td><strong>CONDITION, EXP_LIFE, CONST_COST</strong></td>
<td>Future Uses</td>
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**Layer**  
C-LANE-BASE  
C-ROAD-BASE  

**Entity Type**  
Closed Polyline

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<th>Subordinate type</th>
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<table>
<thead>
<tr>
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<th>Average Thickness of materials</th>
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<tbody>
<tr>
<td>100</td>
<td>Sample value (mm)</td>
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</tbody>
</table>

**MATERIAL**  
BG = Base Gravels  
PM = Pumice
Object Data Table – CBAS (Catch Basin, Inlet Structures)

**SUBJECT:** CAD/C3D Object to Object Data Table & Field Descriptions

**SOURCE:** MMCD – Master Municipal Construction Documents Association

**REVISION DATE:** November 2, 2017

---

**ASSET_KEY**
- SFU Unique Identifier
- Do not add, delete or modify

**SERVICE_STATUS** *SEE ATTRIBUTE SHEET*
- Financial transaction
  - I = In service
  - NETN = Net New (Acquisition)
  - REPL = Replacement (Acquisition)
  - BETT = Betterment (Acquisition)
  - ABND = Abandoned (Disposal)
  - RMVD = Removed (Disposal)

**OWNER** *SEE ATTRIBUTE SHEET*
- Ownership of assets
  - SFU = University owned asset
  - SFUCT = SFU Community asset
  - PRVT = Privately owned asset
  - CITY = City of Burnaby

**PROJECT_ID**
- Installing or Existing Project Id
  - P81000 = Sample project ID

**FACILITY_ID**
- Facility ID provided by SFU
  - 1234 = Sample Facility ID

**CONDITION, EXP_LIFE, CONST_COST**
- Future Uses

**INSTALL_DATE**
- Date asset was installed
  - 2013-DEC-03 = Sample Value

**RÉTIRED_DATE**
- Date asset was retired
  - 2013-DEC-03 = Sample Value

**RÉTIRED_PROJECT_ID**
- Project Id retiring asset
  - P81000 = Sample project ID

**UNIT_TYPE**
- Subordinate type
  - CB = Curb Catch Basin
  - CBI = Catch Basin Type I
  - CBII = Catch Basin Type II
  - CBIII = Catch Basin Type III
  - CBV = Catch Basin Type V
  - CBVA = Catch Basin Type V-A
  - CBVII = Catch Basin Type VII
  - CI = Curb Inlet
  - CO = Clean Out
  - DM = Diversion Manhole
  - GB = Grate Catch Basin
  - GI = Grate Inlet
  - LAWNBN = Lawn Basin
  - MB = Manhole Basin
  - MH = Manhole
  - SB = Sand Box

---

**Layer**
- C-DRAN-CBAS

**Entity Type**
- C3D or Block

---

**ASSET_KEY**
- SFU Unique Identifier
- Do not add, delete or modify

---

**SERVICE_STATUS** *SEE ATTRIBUTE SHEET*
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**OWNER** *SEE ATTRIBUTE SHEET*
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**PROJECT_ID**
- Installing or Existing Project Id
  - P81000 = Sample project ID

---

**FACILITY_ID**
- Facility ID provided by SFU
  - 1234 = Sample Facility ID

---

**CONDITION, EXP_LIFE, CONST_COST**
- Future Uses

---

**INSTALL_DATE**
- Date asset was installed
  - 2013-DEC-03 = Sample Value

---

**RÉTIRED_DATE**
- Date asset was retired
  - 2013-DEC-03 = Sample Value

---

**RÉTIRED_PROJECT_ID**
- Project Id retiring asset
  - P81000 = Sample project ID
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<th><strong>Entity Type</strong></th>
<th><strong>Description</strong></th>
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<tbody>
<tr>
<td>C-WATR-STRC</td>
<td>C3D or Block</td>
<td>ASSET_KEY, OWNER, PROJECT_ID, SERVICE_STATUS, UNIT_TYPE, ROTATION, CONDITION, EXP_LIFE, CONST_COST, INSTALL_DATE, RETIRED_DATE, RETIRED_PROJECT_ID</td>
</tr>
</tbody>
</table>

**SERVICE_STATUS**

- I = In service
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**OWNER**

- SFU = University owned asset
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- CITY = City of Burnaby

**PROJECT_ID**

- Installing or Existing Project Id
- P81000 = Sample project ID

**CONDITION, EXP_LIFE, CONST_COST**

**INSTALL_DATE**

- Date asset was installed
- 2013-DEC-03 = Sample Value

**RETIERED_DATE**

- Date asset was retired
- 2013-DEC-03 = Sample Value

**UNIT_TYPE**

- **Subordinate type**
  - 11 ¼ = Bend 11 ¼ Degree
  - 22 ½ = Bend 22 ½ Degree
  - 45 = Bend 45 Degree
  - 90 = Bend 90 Degree
  - SPECL = Bend Special
  - TEE = Tee Fitting
  - CROSS = Cross Fitting
  - REDUCE = Reducer
  - COUPLN = Coupling (Robar)
  - FABSTF = Fabricated Stub and Flange
  - FABX = Fabricated Cross
  - FABT = Fabricated Tee
  - FABBND = Fabricated Bend
  - CAPEND = Capped End
  - INCOUP = Insulated Coupling (Robar)
  - VICTCU = Victaulic Coupling (Robar)
  - SLEEVE = Sleeve
  - TESPL = Split Tee
  - ADAPRT = Adaptor
  - CHANEL = Drain Channel
  - DECHMH = De-Chlorination Manhole

**ASSET_KEY**

- SFU Unique Identifier
- Do not add, delete or modify

**ASSET_KEY**

**OWNER**

**PROJECT_ID**

**INSTALL_DATE**

**RETIERED_DATE**

**RETIERED_PROJECT_ID**

**Rotation**

- Future Uses – Block rotation angle
**Object Data Table – HYDR (Fire Hydrant)**

**SUBJECT:** CAD/C3D Object to Object Data Table & Field Descriptions

**SOURCE:** MMCDA – Master Municipal Construction Documents Association

**REVISION DATE:** November 2, 2017

---

**SERVICE_STATUS**

*SEE ATTRIBUTE SHEET*

- **I** = In service
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**OWNER**

*SEE ATTRIBUTE SHEET*

- **SFU** = University owned asset
- **SFUCT** = SFU Community asset
- **PRVT** = Privately owned asset
- **CITY** = City of Burnaby

**PROJECT_ID**

- **Installing or Existing Project Id**
- **P81000** = Sample project ID

**FACILITY_ID**

- **Facility ID provided by SFU**
- **1234** = Sample Facility ID

**ASSET_KEY**

**SFU Unique Identifier**

Do not add, delete or modify

**Layer**

**C-WATR-HYDR**

**Entity Type**

C3D or Block

**UNIT_TYPE**

Subordinate type

- **B** = Break Away
- **N** = Non Break Away
- **1-I** = TC 1I Slide Gate
- **1** = TC 1 Slide Gate
- **COMPRES** = Compression Hydrant
- **CLOW B** = Brigadier M-93
- **MUEL M** = Modern Centurion
- **STNDPI** = Standpipe

**MFG_NAME**

Future Uses – Manufacture Name

**CONDITION, EXP_LIFE, CONST_COST**

Future Uses

**INSTALL_DATE**

- **Date asset was installed**
- **2013-DEC-03** = Sample Value

**RETIRED_DATE**

- **Date asset was retired**
- **2013-DEC-03** = Sample Value

**RETIRED_PROJECT_ID**

- **Project Id retiring asset**
- **P81000** = Sample project ID

**ROTATION**

Future Uses – Block rotation angle
### CAD/C3D Object to Object Data Table & Field Descriptions

**SUBJECT:** CAD/C3D Object to Object Data Table & Field Descriptions

**SOURCE:** MMCDA – Master Municipal Construction Documents Association

**REVISION DATE:** November 2, 2017

#### Object Data Table – ILLM (Illumination)

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<tr>
<td>ASSET_KEY</td>
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<tr>
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<td>City of Burnaby</td>
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<tr>
<td>POLE_OFFSET</td>
<td>Offset ABC from curb or distance from PL</td>
<td>A = Offset Class A</td>
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<td>POLE_SHAPE</td>
<td>Pole Shape</td>
<td>CIRC = Circular</td>
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<td>UNIT_TYPE</td>
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<td>LSST</td>
<td>LS &amp; Traffic Signal</td>
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<td>LSSBPC</td>
<td>LS &amp; Service Base &amp; Photo Cell</td>
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# CAD/C3D Object to Object Data Table & Field Descriptions

## Service Status

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<th>Description</th>
<th>Example</th>
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<td>SFU Community asset</td>
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## Facility Id

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## Asset Key

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## Entity Type

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<td>C-SSWR-STRC</td>
<td>C3D or Block</td>
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<tr>
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## Unit Type

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<th>Subordinate Type</th>
<th>Description</th>
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<td>ADAV</td>
<td>Double Acting Air Valve</td>
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<tr>
<td>AMH</td>
<td>Air Release Valve</td>
<td></td>
</tr>
<tr>
<td>CB</td>
<td>Catch Basin</td>
<td></td>
</tr>
<tr>
<td>CBM</td>
<td>Catch Basin Manhole</td>
<td></td>
</tr>
<tr>
<td>CO</td>
<td>Clean Out Or Flusher</td>
<td></td>
</tr>
<tr>
<td>DE</td>
<td>Dead End (No MH)</td>
<td></td>
</tr>
<tr>
<td>DIV</td>
<td>Flow Diversion Manhole</td>
<td></td>
</tr>
<tr>
<td>DMI</td>
<td>Drop Manhole Inside</td>
<td></td>
</tr>
<tr>
<td>DMO</td>
<td>Drop Manhole Outside</td>
<td></td>
</tr>
<tr>
<td>FMTR</td>
<td>Flow Meter MH</td>
<td></td>
</tr>
<tr>
<td>FRP</td>
<td>Fiber Reinforced Plastic MH</td>
<td></td>
</tr>
<tr>
<td>INLET</td>
<td>Inlet End - No MH</td>
<td></td>
</tr>
<tr>
<td>OCS</td>
<td>Outlet Control Structure</td>
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<tr>
<td>OILN</td>
<td>Oil Interceptor Manhole</td>
<td></td>
</tr>
<tr>
<td>OUTFAL</td>
<td>Outfall - Outlet End Of Pipe</td>
<td></td>
</tr>
<tr>
<td>PRS</td>
<td>Pressure Manhole</td>
<td></td>
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<tr>
<td>PTRANS</td>
<td>Pipe Transition (No MH)</td>
<td></td>
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<tr>
<td>SPS</td>
<td>Sewer Pump Station</td>
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</tr>
<tr>
<td>STD</td>
<td>Standard</td>
<td></td>
</tr>
<tr>
<td>SUM</td>
<td>Sump MH (Storm-No Channel)</td>
<td></td>
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<tr>
<td>SV</td>
<td>Sewer Valve (No MH)</td>
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<tr>
<td>SWMOI</td>
<td>Storm Water Mgmt/Oil Int</td>
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<td>TRP</td>
<td>Trap Manhole (Gas)</td>
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## Condition

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<thead>
<tr>
<th>Field</th>
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<tr>
<td>INSTALL_DATE</td>
<td>Date asset was installed</td>
<td>2013-DEC-03</td>
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<tr>
<td>RETIRED_DATE</td>
<td>Date asset was retired</td>
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## COVER_TYPE

<table>
<thead>
<tr>
<th>Manhole Cover Type</th>
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<tbody>
<tr>
<td>BC</td>
<td>Burnaby Combined Standard</td>
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<tr>
<td>BD</td>
<td>Burnaby Drainage Standard</td>
<td></td>
</tr>
<tr>
<td>BS</td>
<td>Burnaby Sanitary Standard</td>
<td></td>
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<tr>
<td>G</td>
<td>Metro Vancouver</td>
<td></td>
</tr>
<tr>
<td>L</td>
<td>Locked / Secured</td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>Non Standard</td>
<td></td>
</tr>
<tr>
<td>S</td>
<td>Solid</td>
<td></td>
</tr>
<tr>
<td>T</td>
<td>Standard Two Hole</td>
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<td>WT</td>
<td>Watertight</td>
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## RIM_ELEV

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<th>Manhole Rim Elevation</th>
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<th>Example</th>
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<tbody>
<tr>
<td>123.12</td>
<td>Sample value (m)</td>
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## DIA

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<thead>
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<th>Manhole Barrel Diameter</th>
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<td>1050</td>
<td>Sample value (mm)</td>
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## DEPTH

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<tr>
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<td>Sample value (m)</td>
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<td>SFU Unique Identifier</td>
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<table>
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<th>SERVICE_STATUS * SEE ATTRIBUTE SHEET *</th>
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<tr>
<td>Financial transaction</td>
</tr>
<tr>
<td>I</td>
</tr>
<tr>
<td>NETN</td>
</tr>
<tr>
<td>REPL</td>
</tr>
<tr>
<td>ABND</td>
</tr>
<tr>
<td>RMVD</td>
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<table>
<thead>
<tr>
<th>OWNER * SEE ATTRIBUTE SHEET *</th>
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<tbody>
<tr>
<td>Ownership of assets</td>
</tr>
<tr>
<td>SFU</td>
</tr>
<tr>
<td>SFUCT</td>
</tr>
<tr>
<td>PRVT</td>
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<td>CITY</td>
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<table>
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<td>P81000</td>
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<thead>
<tr>
<th>UNIT_TYPE * SEE ATTRIBUTE SHEET *</th>
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<tbody>
<tr>
<td>Subordinate type</td>
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<tr>
<td>STD</td>
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<tr>
<td>F</td>
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<tr>
<td>CP</td>
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<table>
<thead>
<tr>
<th>LENGTH</th>
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<tbody>
<tr>
<td>Pipe Length</td>
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<tr>
<td>Not required when using Civil 3D pipe</td>
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<tr>
<td>25.55</td>
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<thead>
<tr>
<th>SLOPE</th>
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<tr>
<td>Pipe Slope</td>
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<tr>
<td>Not required when using Civil 3D pipe</td>
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<td>1.55</td>
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<table>
<thead>
<tr>
<th>DIA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pipe Diameter</td>
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<tr>
<td>Not required when using Civil 3D structure</td>
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<tr>
<td>250</td>
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<table>
<thead>
<tr>
<th>MATERIAL * SEE ATTRIBUTE SHEET *</th>
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<tbody>
<tr>
<td>Pipe Material</td>
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<tr>
<td>CONC</td>
</tr>
<tr>
<td>CU</td>
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<tr>
<td>DI</td>
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<tr>
<td>PVC</td>
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<td>HDPE</td>
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<table>
<thead>
<tr>
<th>SHP * SEE ATTRIBUTE SHEET *</th>
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<tr>
<td>Pipe Shape</td>
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<td>CIRC</td>
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<table>
<thead>
<tr>
<th>INV_ELEV_DOWN</th>
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<tbody>
<tr>
<td>Downstream Invert Elevation</td>
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<tr>
<td>Not required when using Civil 3D pipe</td>
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<td>123.12</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>INV_ELEV_UP</th>
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</thead>
<tbody>
<tr>
<td>Upstream Invert Elevation</td>
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<tr>
<td>Not required when using Civil 3D pipe</td>
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<td>123.12</td>
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<table>
<thead>
<tr>
<th>JOINT_TYPE</th>
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<tbody>
<tr>
<td>Join Type between Pipe to Pipe</td>
</tr>
<tr>
<td>CONC</td>
</tr>
<tr>
<td>COMPCU</td>
</tr>
<tr>
<td>NEOPGS</td>
</tr>
<tr>
<td>FLANGE</td>
</tr>
<tr>
<td>LOKTYT</td>
</tr>
<tr>
<td>WELDED</td>
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### Object Data Table – **SRVC (Service Lines, Leads)**

**Subject:** CAD/C3D Object to Object Data Table & Field Descriptions

**Source:** MMCDA – Master Municipal Construction Documents Association

**Revision Date:** November 2, 2017

**Entity Type**

<table>
<thead>
<tr>
<th>Layer</th>
<th>Entity Type</th>
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<tbody>
<tr>
<td>C-DRAN-CBAS-LEAD</td>
<td>C3D or Polyline</td>
</tr>
<tr>
<td>C-DRAN-SRVC</td>
<td>C3D or Polyline</td>
</tr>
<tr>
<td>C-SSWR-SRVC</td>
<td>C3D or Polyline</td>
</tr>
<tr>
<td>C-WATR-HYDR-LEAD</td>
<td>C3D or Polyline</td>
</tr>
<tr>
<td>C-WATR-SRVC</td>
<td>C3D or Polyline</td>
</tr>
</tbody>
</table>

**Unit Type**

<table>
<thead>
<tr>
<th>Subordinate type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>D</td>
<td>Drainage</td>
</tr>
<tr>
<td>S</td>
<td>Sanitary</td>
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**Service Type**

<table>
<thead>
<tr>
<th>Service Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>DOM</td>
<td>Domestic Service</td>
</tr>
<tr>
<td>FRE</td>
<td>Fire Service</td>
</tr>
<tr>
<td>NS</td>
<td>No Service</td>
</tr>
</tbody>
</table>

**Backflow Preventor**

- **Y:** Yes
- **N:** No

**Inspection Chamber**

- **Y:** Yes
- **N:** No

**Length**

- **Pipe Length:** 5.52 m

**Dia**

- **Pipe Diameter:** 100 mm

**Material**

- **Pipe Material:**
  - **CU:** Copper
  - **PVC:** Polyvinyl Chloride

**Attributes**

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
<th>Sample Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Asset Key</strong></td>
<td>SFU Unique Identifier</td>
<td></td>
</tr>
<tr>
<td><strong>Owner</strong></td>
<td>Ownership of assets</td>
<td></td>
</tr>
<tr>
<td><strong>Project Id</strong></td>
<td>Installing or Existing Project Id</td>
<td>P81000</td>
</tr>
<tr>
<td><strong>Service Status</strong></td>
<td>Financial transaction</td>
<td></td>
</tr>
<tr>
<td><strong>Install Date</strong></td>
<td>Date asset was installed</td>
<td>2013-Dec-03</td>
</tr>
<tr>
<td><strong>Retired Date</strong></td>
<td>Date asset was retired</td>
<td>2013-Dec-03</td>
</tr>
<tr>
<td><strong>Retired Project Id</strong></td>
<td>Project Id retiring asset</td>
<td>P81000</td>
</tr>
</tbody>
</table>
Object Data Table – VALV (Valve)

**ASSET_KEY**
SFU Unique Identifier
Do not add, delete or modify

**SERVICE_STATUS** *SEE ATTRIBUTE SHEET*
Financial transaction
- I = In service
- NETN = Net New (Acquisition)
- REPL = Replacement (Acquisition)
- BETT = Betterment (Acquisition)
- ABND = Abandoned (Disposal)
- RMVD = Removed (Disposal)

**OWNER** *SEE ATTRIBUTE SHEET*
Ownership of assets
- SFU = University owned asset
- SFUCT = SFU Community asset
- PRVT = Privately owned asset
- CITY = City of Burnaby

**PROJECT_ID**
Installing or Existing Project Id
- P81000 = Sample project ID

**CONDITION, EXP_LIFE, CONST_COST**
Future Uses

**INSTALL_DATE**
Date asset was installed
- 2013-DEC-03 = Sample Value

**RETIRE_DATE**
Date asset was retired
- 2013-DEC-03 = Sample Value

**RETIRE_PROJECT_ID**
Project Id retiring asset
- P81000 = Sample project ID

**UNIT_TYPE**
Subordinate type
- ACAV = Combination Air Valve
- ADAV = Double Acting Air Valve
- ARV = Air Release Valve
- BTRV = Butterfly Valve
- BTVG = Butterfly Valve Geared
- CBSTOP = Curb Stop
- DDGV = Double Disk Gate Valve
- DSCV = Double Disc Swing Check Valve
- GV = Gate Valve Geared
- GVW = Gate Valve Wheeled
- PLGV = Plug Valve
- PRV = Pressure Reducing Valve
- RSVG = Resilient Seat Gate Valve
- SCV = Swing Check Valve
- SDV = Self Draining Standpipe
- SWGV = Solid Wedge Gate Valve
- UNKNOWN = Unknown

**MFG_NAME**
Manufacture Name
- CLOW = Clow
- MUELLR = Mueller
- TERMIN = Terminal City

**DIA**
Valve Diameter Size
- 200 = Sample value (mm)

**NORM_STATUS**
Valve Status
- C = Closed
- O = Open
- P = Partial Closure
**Object Data Table – WALK (Sidewalk, Trail)**

**SUBJECT:** CAD/C3D Object to Object Data Table & Field Descriptions

**SOURCE:** MMCDA – Master Municipal Construction Documents Association

**REVISION DATE:** November 2, 2017

### ASSET_KEY
- **SFU Unique Identifier**
  - Do not add, delete or modify

### SERVICE_STATUS * SEE ATTRIBUTE SHEET *
- Financial transaction
  - **I** = In service
  - **NETN** = Net New (Acquisition)
  - **REPL** = Replacement (Acquisition)
  - **BETT** = Betterment (Acquisition)
  - **ABND** = Abandoned (Disposal)
  - **RMVD** = Removed (Disposal)

### OWNER * SEE ATTRIBUTE SHEET *
- Ownership of assets
  - **SFU** = University owned asset
  - **SFUCT** = SFU Community asset
  - **PRVT** = Privately owned asset
  - **CITY** = City of Burnaby

### PROJECT_ID
- Installing or Existing Project Id
  - **P81000** = Sample project ID

### Layer Entity Type
- **C-ROAD-TRAL-BIKE** = Polyline
- **C-ROAD-TRAL-URBN** = Polyline
- **C-ROAD-WALK** = Polyline

### UNIT_TYPE
- Future uses - Subordinate type

#### LENGTH
- **LENGTH**
  - Length of walk
  - 20.12 = Sample value (m)

#### WIDTH
- **WIDTH**
  - Average Width of walk
  - 5.15 = Sample value (m)

#### THICK
- **THICK**
  - Thickness of material
  - 100 = Sample value (mm)

### MATERIAL
- **MATERIAL**
  - Material of walk
    - **ASPH** = Asphalt
    - **BWLK** = Boardwalk
    - **CONC** = Concrete
    - **GRVL** = Gravel
    - **PAVR** = Pavers
    - **MLCH** = Mulch

#### NAME
- **NAME**
  - Name of walk
  - MMCD TRAIL = Sample value
# Object Data Table – WWAY (Waterway)

**ASSET_KEY**
- SFU Unique Identifier
- Do not add, delete or modify

**SERVICE_STATUS** *(SEE ATTRIBUTE SHEET)*
- Financial transaction
  - I = In service
  - NETN = Net New (Acquisition)
  - REPL = Replacement (Acquisition)
  - BETT = Betterment (Acquisition)
  - ABND = Abandoned (Disposal)
  - RMVD = Removed (Disposal)

**OWNER** *(SEE ATTRIBUTE SHEET)*
- Ownership of assets
  - SFU = University owned asset
  - SFUCT = SFU Community asset
  - PRVT = Privately owned asset
  - CITY = City of Burnaby

**PROJECT_ID**
- Installing or Existing Project Id
  - P81000 = Sample project ID

**ASSET_KEY**
- OWNER
- PROJECT_ID
- SERVICE_STATUS
- UNIT_TYPE
- LENGTH
- WIDTH
- NAME
- ID
- CONDITION
- EXP_LIFE
- CONST_COST
- INSTALL_DATE
- RETIRED_DATE
- RETIRED_PROJECT_ID

**Layer**
- C-DRAN-WWAY
- Entity Type
- Polyline

**UNIT_TYPE**
- Subordinate type
  - A = Salmonid, potentially inhabited year round with access enhancement
  - A(0) = Salmonid, primarily during the overwintering period
  - B = Significant food, No fish
  - C = Insignificant food, No fish

**LENGTH**
- Length of waterway
  - 70.15 = Sample value (m)

**WIDTH**
- Average width of waterway
  - 5.35 = Sample value (m)

**NAME**
- Name of waterway
  - MMCD CREEK = Sample value

**ID**
- ID of waterway
  - 1234.CRK = Sample value

**CONDITION, EXP_LIFE, CONST_COST**
- Future Uses

**INSTALL_DATE**
- Date asset was installed
  - 2013-DEC-03 = Sample Value

**RETIRED_DATE**
- Date asset was retired
  - 2013-DEC-03 = Sample Value

**RETIRED_PROJECT_ID**
- Project Id retiring asset
  - P81000 = Sample project ID
Subject: Expanded Attribute Values and Descriptions

Source: MMCDA – Master Municipal Construction Documents Association

Revision Date: November 2, 2017

### Layer

<table>
<thead>
<tr>
<th>OWNER</th>
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<tr>
<td>...</td>
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</table>

### OWNER

Ownership of assets
- **BDT**: Burnaby Or Development Tree
- **BFAC**: Burnaby Facility
- **BINF**: Burnaby Infrastructure
- **BPUR**: Burnaby Purchasing
- **CITY**: City Of Burnaby
- **CMED**: C Media Outdoors
- **COQ**: Coquitlam
- **FIRE**: Burnaby Fire Department
- **GVRD**: Gurd Owned
- **HYDR**: BC Hydro
- **LIB**: Burnaby Library
- **MOT**: Ministry Of Transportation
- **NLBA**: No Longer Burnaby Client
- **NPP**: Native Or Public Planted
- **NW**: New Westminster
- **PARK**: Parks
- **POMO**: Port Moody
- **PRVT**: Private
- **RICH**: Richmond
- **SCHL**: School Board
- **SFU**: Simon Fraser University
- **TRNL**: Translink
- **VAN**: Vancouver

### SERVICE_STATUS

Financial transaction
- **ABND**: Abandoned (Disposal)
- **AUCT**: Auctioned
- **BETT**: Betterment (Acquisition)
- **CXRD**: Complex Road Segment
- **D**: Decommissioned
- **DRMV**: Duplicate Removed
- **FLAT**: Meter On Flat Rate
- **GISX**: GIS Expired
- **I**: In Service
- **ISLT**: In Service Long Term
- **ISSP**: In Service Special Use
- **ISST**: In Service Short Term
- **LOST**: Lost
- **MOD**: Asset Changed New Construction
- **NETN**: Net New (Acquisition)
- **NI**: Not In Use
- **NLBC**: No Longer Burnaby Client
- **NS**: No Service
- **O**: Out Of Service
- **PDEM**: Vacant Pending Demolition
- **PEND**: Pending
- **REPL**: Replacement (Acquisition)
- **REVW**: Under Review
- **RMVD**: Removed (Disposal)
- **RNAM**: Renamed
- **SAPM**: Now In SAP
- **SCRN**: Scrapped
- **SPLIT**: Split Mainline
- **SS**: Substandard Service
- **STLN**: Stolen
- **STOK**: In Stock
- **T**: Temporarily Out Of Service
- **U**: Not Constructed/Undeveloped
- **VAC**: Vacant
- **VAECL**: Vacant Long Term
### Attribute – **ILLM (UNIT_TYPE, POLE_COLOUR)**

#### SUBJECT:
Expanded Attribute Values and Descriptions

#### SOURCE:
MMCDA – Master Municipal Construction Documents Association

#### REVISION DATE:
November 2, 2017

### Layer
C-ILLM-STRC

### Entity Type
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<th>POLE_SHAPE</th>
<th>POLE_HEIGHT</th>
<th>POLE_COLOUR</th>
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<th>CONST_COST</th>
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<th>RETIRED_DATE</th>
<th>RETIRED_PROJECT_ID</th>
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</table>

### UNIT_TYPE

**Subordinate type**
- LIGHTF = Light Sportsfield
- LIGHTL = Light Parking Lot
- LIGHTP = Light Park
- LS = Lamp Standard Single Head
- LS2 = Lamp Standard Double Head
- LS3 = Lamp Standard Triple Head
- LSDECO = Decorative Light
- LSDR = L W. Duplex Receptacle
- LSOH = Lit Overhead Crossing
- LSOHS = Lit Overhead Crossing Special
- LSPC = Lampstand With Photocel
- LSPD = Pedestrian Light
- LSPED = Lamp Standard & Pedestrian Lgt
- LSPP = Lamp Standard Power Pole
- LSSBPC = LS Servicebase.Photocel
- LSSPCL = Special Light Type
- LSTS = Lamp Standard Traffic Signal
- OH = Overhead Crossing
- OHS = Overhead Crossing Special
- PED = Pedestrian Street Light
- SRVPN = Service Panel

### POLE_COLOUR

**Pole Colour**
- BLACK = Black
- BLUE = Blue
- BRONZE = Bronze
- CHARCOAL = Charcoal
- GALVAN = Galvanized
- GREEN = Green
- GREY = Grey
- ORANGE = Orange
- RED = Red
- RED/BL = Red/Blue
- RED/GR = Red/Green
- RED/YEL = Red/Yellow
- SILVER = Silver
- WHI/BL = White/Blue
- WHI/GR = White/Green
- WHI/GR/R = White/Green/Red
- WHI/RED = White/Red
- WHITE = White
- YELLOW = Yellow
## Expanded Attribute Values and Descriptions

**Subject:** MMCDA – Master Municipal Construction Documents Association  
**Source:** MMCDA – Master Municipal Construction Documents Association  
**Revision Date:** November 2, 2017

### Attribute – PIPE (UNIT_TYPE, SHP, MATERIAL)

#### Layer
- C-DRAN-CULV
- C-DRAN-PIPE
- C-ILLM-PIPE
- C-SSWR-PIPE
- C-WATR-PIPE

#### Entity Type
- Asset Key
- Owner
- Project ID
- Service Status
- Unit Type
- Length
- Slope
- Dia
- Material
- SHP
- Inv_Elev_Down
- Inv_Elev_Up
- Joint_Type
- Condition
- Exp_Life
- Const_Cost
- Install_Date
- Retired_Date
- Retired_Project_ID

#### UNIT_TYPE

**Subordinate type**
- **2#6** = 2#6 RW90 Feeders & 1#8 RW90
- **3#6** = 3#6 RW90 Feeders & 1#8 RW90
- **A** = Interceptor
- **C** = Combined Drainage/Sanitary
- **COND** = Conduit Only
- **CHEAD** = CB Lead
- **CTHO** = Cathodic Protection
- **D** = Drainage
- **DITENC** = Ditch Enclosure
- **F** = Force Main
- **G** = MetroVan Trunk Main
- **H** = Open Channel/Ditch
- **I** = Siphon
- **L** = Clean Out/Flusher
- **N** = Natural Flow Channel/Creek
- **O** = Overflow
- **P** = Pressure Gravity Main
- **SRVCON** = Service Conduit & 3#6 Feeders
- **S** = Sanitary Sewer
- **T** = Stub
- **V** = Culvert
- **W** = Water
- **VRX** = Culvert Large Crossing Road

#### MATERIAL

**Pipe Material**
- **ABS** = Acrylonitrile Butadiene Styrene
- **ACC** = American Concrete Cylinder
- **ACMP** = Asphalt Corrugated Steel Pipe
- **ACP** = Asbestos Cement Pipe
- **ACPPVC** = Asbestos Cement With Pvc Liner
- **BRK** = Brick
- **CI** = Cast Iron
- **CIC** = Cast Iron Cement Lined
- **CMP** = Corrugated Steel Pipe
- **CO** = Concrete Pipe
- **CON** = Poured-In-Place Concrete
- **CONC** = Concrete Pipe
- **CONPV** = Concrete Pipe With Pvc Liner
- **CU** = Copper
- **CUAS** = Copper Assured
- **CUPB** = Copper Polybutylene Combo
- **DI** = Ductile Iron Pipe
- **FRP** = Fiberglass Reinforced Pipe
- **GA-CU** = Galvanized And Copper
- **GALV** = Galvanized Pipe
- **GALVAS** = Galvanized Pipe Assumed
- **HDPE** = High Density Polyethylene
- **NCP** = Non-Reinforced Concrete Pipe
- **ORG** = Orangeberg
- **PB** = Polybutylene
- **PBASE** = Polybutylene Assumed
- **PEP** = Polyethylene Pipe
- **PLP** = Plastic Lined Pipe
- **PVC** = Polyvinyl Chloride Pipe
- **RCP** = Reinforced Concrete Channel
- **RCR** = Reinforced Concrete Pipe
- **RPM** = Reinforced Plastic Mortar Pipe
- **STL** = Steel Pipe
- **T** = Asbestos Cement (Transite)
- **URC** = Unreinforced Concrete
- **VCP** = Vitrified Clay Pipe
- **VCPPVC** = Vcpipe With Pvc Liner
- **VSG** = Vitrified Segmental Duct
- **WOD** = Wooden Pipe
- **XXX** = Other
- **ZZZ** = Not Known

#### SHP

**Pipe Shape**
- **ARCH** = Arched Pipe
- **CIRC** = Circular
- **CURV** = Curve Designation For Mapping
- **DITCH** = Ditch
- **EGG** = Egg Shape
- **HRSH** = Horseshoe Shape
- **NCCH** = Natural Channel
- **OVAL** = Oval
- **RCHN** = Rectangular Channel
- **RECT** = Rectangular Box
- **SEMI** = Semi-Elliptical
- **TCCH** = Trapezoidal Channel
- **VAR** = Variable Shape
- **VEE** = Vee Shaped
### Attribute – SRVC (UNIT_TYPE, SERVICE_TYPE, MATERIAL)

**SUBJECT:** Expanded Attribute Values and Descriptions

**SOURCE:** MMCDA – Master Municipal Construction Documents Association

**REVISION DATE:** November 2, 2017

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</table>
Appendix B – Recommended Data Sharing
**Design Model Drawings**

- `<ProjectNumber>_ExistingRecorded`
  - Existing Recorded Assets from SFU GIS

- `<ProjectNumber>_Survey`
  - Existing Points, OG Surface, Existing Pipe Networks and Base Plan Features

- `<ProjectNumber>_Design_0.9995883`
  - Corridor, OG/FG Combined Surface, Sanitary, Storm, Water Design Objects

- `<ProjectNumber>_ConstructionRecorded_0.9995883`
  - Corridor, OG/FG Combined Surface, Sanitary, Storm, Water Design Objects

**Production Drawings**

- `<ProjectNumber>_ProductionCover`
  - Cover Page, Key Plan, Legend, Notes

- `<ProjectNumber>_ProductionRoads`
  - Road Production Drawings

- `<ProjectNumber>_ProductionSanitary`
  - Sanitary Production Drawings

- `<ProjectNumber>_ProductionStorm`
  - Storm Production Drawings

- `<ProjectNumber>_ProductionWater`
  - Water Production Drawings

- `<ProjectNumber>_ProductionSections`
  - Design Cross Sections

**References**

1. OG Surface and Existing Pipe Networks
2. Existing Pipe Networks
3. Proposed Alignment/Profile, OG/FG Combined Surface, Proposed Pipe Networks

AutoCAD External Reference
Appendix C – Technical Procedures
This section outlines technical procedures in AutoCAD Civil 3D required to facilitate the post construction asset data submission for SFU Facilities Services.

**Installation and Usage of SFU Standards Files**

This section provides instructions for the installation of SFU Facilities Services MMCD Municipal CAD Standards drawing template and supporting files.

1. Copy **SFU MMCD Municipal CAD Standard** folder structure to Network Location

2. Start AutoCAD Civil 3D 2016

3. Create SFU Facilities Services AutoCAD profile and make it current
   a. Right click in the drawing area and select Options...
   b. Click the Profiles tab
   c. Click Add to List...
   d. In the Add Profile dialogue box, for Profile name type SFU Facilities Services
   e. Click Apply & Close
   f. In the Available profiles list, click SFU Facilities Services and click Set Current
The current profile is set to SFU Facilities Services. The next step is to set the paths for the template files, SHX files and plotting CTB files.

4. Set paths for drawing template, SHX and plotting CTB files
   a. In AutoCAD Options click the Files tab
   b. Expand Support File Search Path
   c. Click Add... and then Browse...
   d. In the Browse to Folder dialog box browse to \1_SFU MMCD Civil 3D 2016 folder and select the Linetype and SHX folder
   e. Click OK
   f. Collapse the Support File Search Path
   g. Expand Printer Support File Path
   h. Click Plot Style Table Search Path
   i. Click Add... and then Browse...
j. In the Browse to Folder dialogue box, browse to and select \SFU Municipal CAD Standard\Plot Style CTB folder and click OK

k. Collapse Printer Support File Path

l. Expand Template Settings and click on the path under Drawing Template File Location

m. Click Browse... and in the Browse to Folder dialogue box, browse to and select \SFU Municipal CAD Standard\Drawing Template folder and click OK

n. Click OK to close AutoCAD options

An AutoCAD profile has been created for SFU Facilities Services. When working on SFU Facilities Services infrastructure design and projects set the current profile to SFU Facilities Services in AutoCAD options first. This will ensure the default paths will be set for the drawing template, the plotting CTB files and the SHX files, where are referenced by the custom linetypes.

**Review Data Provided by SFU Facilities Services**

At project initiation you will be provided with an existing recorded assets drawing for the project area. The existing recorded assets drawing references a UTM NAD 83 Zone 10N grid based coordinate system. The data representing the existing assets in this drawing will be updated to reflect how existing assets have been changed as a result of the construction project.

1. From AutoCAD Civil 3D 2016 open 82180_ExistingRecorded.dwg

2. Zoom to the area surrounded by the circle

Notice the existing infrastructure data. All data in this drawing is represented with AutoCAD polylines and blocks on R-* layers (R for *Recorded*).

3. Review the various object data tables and the attributes

4. When you are finished close the drawing

SFU Facilities Services MMCD C3D drawing template is used to create the existing recorded assets drawing and the design drawings. The same object data tables are used for existing recorded assets and Construction Recorded Assets.
Create Existing Survey and Surface Model Drawing

The existing survey and surface model drawing is also created from SFU Facilities Services MMCD C3D Drawing template. AutoCAD polylines and blocks, and AutoCAD Civil 3D point objects and figures are used to represent existing surveyed features as per SFU Facilities Services data submission and display requirements.

The existing survey and surface model is ideally created to ground level survey coordinates as design and construction data is based on the information in this drawing. The existing survey and surface model is a standalone drawing and is attached to the design drawing(s) as an AutoCAD external reference. The existing ground surface model is referenced by design drawing(s) using AutoCAD Civil 3D data shortcuts and reference objects. The existing survey and surface model drawing is submitted to SFU Facilities Services at the end of the project.

SFU Facilities Services requires the existing survey and surface model drawing to validate and update the location of existing assets unaffected construction.

Create Design Model Drawings

Design model drawings are used to represent infrastructure design and construction details. Use the following guidelines when creating design model drawings:

1. Create using SFU Facilities Services MMCD C3D drawing template
2. Reference ground level coordinates to facilitate construction staking
3. Do not spatially fragment data across multiple design model drawings. All data for a specific infrastructure type must reside in a single drawing. Multiple infrastructure types can be located in a single or multiple design model drawings (for example, 1 drawing each of sanitary, storm and water design or 1 drawing containing sanitary, storm and water)
4. Drawing production sheets can either be layouts in the design model drawing or in separate standalone drawings. For the latter, use AutoCAD external references and AutoCAD Civil 3D data shortcuts and reference objects to share data with production drawings

Design model drawings are not submitted to SFU Facilities Services. A copy of design model drawings is used to add construction recorded data.

Construction Recorded Assets Drawings and LandXML Data

This section discusses procedures for creating the construction recorded assets drawing

1. Create a copy of your design model drawing(s) and rename them using the following naming convention:
   
   `<ProjectNumber>_ConstructionRecorded<#>_<GroundtoGridScaleFactor>.dwg`

2. In the construction recorded drawing, use the following steps to assign attributes to new assets using AutoCAD Map 3D object data. Attaching the object data is a 2 step process. You must first attach the object data tables and then assign the attribute values.
   a. Change to the Planning & Analysis Workspace
   b. On the Create tab, Drawing Object panel, click Attach/Detach object Data
c. In the Attach/Detach Object Data Table dialog box, from the dropdown list, select the appropriate object data table

d. Click Attach to Objects and select the objects in the drawing

Note: You can assign the object data table to multiple objects of the same type by first using the select similar command to select multiple assets and then using the previous selection set option after executing the Attach/Detach Object Data command and clicking the Attach to Objects command.

e. Use AutoCAD Properties window to modify the object data values. Refer to the object data table diagrams for the appropriate values.

Note: To assign the same values for multiple similar assets, use the select similar command and edit the values in the AutoCAD Properties window.

3. Sanitary, storm and water data is required in a LandXML file if these utilities are designed using AutoCAD Civil 3D. Use the following steps to create the LandXML file.

a. From Toolspace Prospector tab, expand Pipe Networks and Networks

b. Right click on Networks and click Export LandXML...

3. In the Export to LandXML dialog box, ensure just the pipe networks are selected, and nothing else
d. Click OK

e. In the Export LandXML dialog box use the following naming convention and enter the file name

     <ProjectNumber>_ConstructionRecorded<#>_<GroundtoGridScaleFactor>.xml

f. Click OK

Create a single XML file for every construction recorded drawing you create and assign a number to the file based on the naming convention above.

A LandXML file containing pipe network physical properties and materials has been created. Other attribute data assigned to AutoCAD Civil 3D manhole and pipe objects is aggregated to a single data record when the LandXML file is imported to SFU Facilities Services GIS.

**Prepare Data for Submission to SFU**

The final step is to prepare the data for submission to SFU Facilities Services. The following data files are required:

- Existing recorded assets drawing with updated attributes
• Existing survey assets drawing created using SFU Facilities Services MMCD C3D drawing template

• Design and construction recorded assets drawing(s)

Drawings should be submitted with no references. Promote any AutoCAD Civil 3D reference objects if they exist in the constructed recorded assets drawing.
1.1 GENERAL

1.2 SFU Facilities Jurisdiction

1 SFU Facilities oversees the overall management of energy and water. SFU Facilities is responsible for design, operation, maintenance, and overall stewardship for each of the following underground utility services:

1 Section 33 10 00 Water Utilities
2 Section 33 51 00 Natural Gas Distribution
3 Section 33 49 00 Storm Drainage
4 Section 33 30 00 Sanitary Sewerage Utilities
5 Section 33 71 00 Electrical Utility Transmission and Distribution
6 Section 33 00 10.1 SFU MMCD Infrastructure Data Standards

2 The demarcation point of service defining SFU Facilities’ responsibility is included in the respective sections as listed above.

3 Note that other systems which run below grade at SFU include compressed air and central heating.

1.3 Designer Responsibility

1 SFU Owners’ Technical Requirement establishes the minimum acceptable standards for the supply and installation of the underground utility services to the buildings on the campus. This is not a design manual. The designer is responsible to ensure that the standards stipulated herein are consistent with the project requirements and are adequate for the project design criteria. The designer shall define the project requirements in the project specification as part of the project tender document.

2 Reference the newest version of the City of Burnaby Engineering Design Criteria sections 3.0 Water distribution, 4.0 Sanitary Sewer and 5.0 Storm drainage for the minimum requirements on water distribution, sanitary and storm sewers.

3 Where comments in SFU Facilities Owners’ Technical Requirements is interpreted to conflict with the industry Standards, Acts and Codes, the compliance with the Standards, Acts and Codes shall prevail and the designer shall bring these conflicts in writing to the attention of the responsible manager at SFU Facilities.

4 The consultant and/or contractor shall provide drawings in accordance with the Owners’ Technical Requirements (OTR). Within 60 days from backfill, the consultant and/or contractor shall provide a set of Red Line drawings to SFU Facilities. Upon completion of installation of any new or modified underground utility services, Record drawings of underground utility services shall be provided to SFU Facilities Records Department. Record drawings shall show utility service and/or infrastructure details as constructed including, for example, pipe or infrastructure facility size, material, invert and rim elevations, etc. Service profiles shall be provided in congested areas indicating location of all services. See Section 01 77 00 Closeout Procedures for details.

5 Upon completion, full CCTV inspections/scope of all underground pipework must be completed on all projects and documentation provided to SFU Facilities (see specifications 33 82 01 CCTV Pipeline Inspection for requirements specific to storm and sanitary).
SFU Facilities requires SFU Infrastructure Data Standards (modified from MMCD Infrastructure Data Standards) for all the Utility design work & submission. All the documents & packages can be found at: https://vault.sfu.ca/index.php/s/GQO5n1r4dUvTwcW

Additional documentation and training videos can be found on https://apw.retrieve.com/ by creating an account to access.

2.1 SFU FACILITIES DEVELOPMENT SUPPORT SERVICES

2.2 Underground Utility Record Drawings

.1 Record drawings for all underground utility services must be submitted for SFU Facilities Records. Refer to section 01 78 39 Project Record Documents.

.2 See Section 33 00 10.1 SFU Infrastructure Data Standards.

2.3 Shutdowns

.1 SFU Facilities has sole authority and responsibility to perform shutdowns (or cross connections) of the systems within its jurisdiction. The cost for a service shutdown is based on time and materials, paid by the project.

2.4 Utility Service Connection Permits

.1 A service connection permit is required for any connection to a utility service as defined in the following Sections in Division 33:

.1 Section 33 10 00 Water Utilities
.2 Section 33 51 00 Natural Gas Distribution
.3 Section 33 49 00 Storm Drainage
.4 Section 33 30 00 Sanitary Sewerage Utilities
.5 Section 33 71 00 Electrical Utility Transmission and Distribution

.2 Service connections must be coordinated with SFU Facilities in advance.

.3 Additional permits from the provincial Electric Safety Branch, Gas Safety Branch, Boiler Safety Branch, plumbing permits and the Construction Permit from the city of Burnaby are the responsibility of the project team.

2.5 Development Permit Approval by SFU Facilities

.1 SFU Facilities has sole authority to authorize underground utility service aspects of any development.

***END OF SECTION***
1.1 **GENERAL**

1.1 Related SFU Technical Requirements

.1 Section 22 05 00 Plumbing General Requirements
.2 Section 22 05 00.1 Connection to SFU Potable Water System
.3 Section 20 00 05 Mechanical - General Requirements

1.2 Coordination Requirements

.1 Coordinate with SFU Facilities.
.2 SFU is responsible to ensure safe potable water is supplied to the consumers as required under Section 6 of the Drinking Water Protection Act. All Related Sections must be followed and coordinated very closely with SFU Facilities.

1.3 System Description

.1 The City of Burnaby has no responsibility beyond supply to water tower – everything downstream is SFU's responsibility. SFU operates under its own Water Operating Permit under the authority of Fraser Health Authority and the BC Drinking Water Protection Act.

.2 Refer to Sections 22 05 00 for details on SFU water policy.

2.1 **MATERIALS AND DESIGN REQUIREMENTS**

2.2 Responsibilities

.1 SFU Facilities is primarily responsible for operation, maintenance, and overall stewardship of the water distribution system.

.2 Unless otherwise agreed in writing, the project Designer is responsible for all design, permit, and inspection requirements of the B.C. Plumbing Code.

.3 The design engineer shall obtain a construction permit from the City of Burnaby for each new installation as well as for any modification of water mains in water transmission or distribution systems, including appurtenances like valves, standpipes or hydrants. These could be watermain projects for the replacement of old pipes, extension, upgrade or looping of the water network, or service connections larger than 3” in diameter.

.4 The Project Designer must incorporate all specific requirements for Metering, Design and Materials and Execution of this section into the contract drawings in the form of job-specific notes. Only making reference to SFU Owners’ Technical Requirements in the drawings is not sufficient.
2.3 Water Distribution Standards & Policies

.1 The latest revisions of the following standards shall apply to water distribution at SFU.

.1 City of Burnaby Engineering Design Criteria
.2 B.C. Master Municipal Construction Documents (MMCD).
.3 B.C. Water & Waste Association (BCWWA).
.4 American Water Works Association.
.5 CSA Standards (as applicable).

.2 Should there be discrepancies in the above standards or with this document, the City of Burnaby Design Criteria will prevail with the SFU Facilities Mechanical Superintendents approval.

2.4 Water Service Connections

.1 The first step to install new or substantially modified connections to the water distribution system at SFU is to seek approval from SFU Facilities.

.2 Note that a Plumbing Permit is also normally required as a plumbing requirement of the B.C. Building Code.

.3 Project design drawings shall provide building load for both peak domestic consumption in litres/second, and fire flow required in litres/second. SFU Facilities reserves the right to request the calculations used to estimate the peak consumption and fire flows.

.4 Any new connections to the water distribution system will be reviewed for consistency with SFU Owners’ Technical Requirements standards.

.5 At the request of the project, a flow test will be performed at the adjacent hydrant to the proposed service connection and the test results are to be provided in writing.

2.5 Metering

.1 A water meter shall be provided, complete with control valves, backflow preventer and chamber, at all commercial, industrial and institutional service connections, in accordance with the City of Burnaby Waterworks Regulation Bylaw No. 3325 and the latest version of the City Water Service, Water Billing & Water Meter Installation Guide.

.2 Water submetering requirements include metric output in cubic meters and pushing the data to the BMS Archiver. For full details, refer to Division 20, Section 20 00 06 Meters.

2.6 Service Connections and Water Mains

.1 Water service connections shall be designed per City of Burnaby Design Criteria

.2 The Project is responsible for permanent capping of un-used stub-outs.

.3 A parallel configuration consisting of two parallel lines each with DCVA is the standard for water entry into a building. Refer to SFU standard detail M-1 for details on SFU preferred DCVA design.
.4 If the building’s main water station inside the mechanical room is on the roof, a 1.5 inch hose connection on the combined fire/domestic water service shall be installed at ground level in an accessible location.

.5 Design consultants shall provide new irrigation service connection tie-in details including chamber location and size, pipe size, material, isolation valve (minimum 2” diameter off main), meter, strainer, backflow preventer and chamber drain connection to the storm system. When a solenoid valve is required to activate water flows, a water hammer arrestor shall be installed upstream of the solenoid valve.

.6 Pipe shall be Class 50 ductile iron pipe manufactured to AWWA C151; cement mortar lined to AWWA C104 and coated 1 mil. thick asphalt.

.7 Copper, up to 75 mm diameter, type K, joints brazed only.

.8 Joints shall be single rubber gasket for push-on bell and spigot type joints to AWWA C111, Tyton or approved equal.

.9 Flanged joints shall be AWWA C110; flat faced conforming to ANSI B16.1, Class 125.

.10 Fittings shall be ductile to AWWA C110 suitable for pressure rating of 2415 kPa. Cement mortar lined to AWWA C104. Minimum design pressure for piping 1,210 kPa.

.11 Bolts shall be medium carbon steel or Martensitic steel, ASTM A325 heavy hex finished, hot-dip galvanized to ASTM A153. Coarse threads shall have Class 2A tolerance before galvanizing. Bolt sizes to AWWA110.

.12 Nuts shall be heavy steel hex carbon steel to ASTM A563 Grade C hot-dip galvanized to ASTM A153.

.13 Tie rods shall be continuously threaded, quenched and tempered alloyed steel to ASTM A354, Grade BC, hot-dip galvanized to ASTM A153.

.14 Joint Restraint Devices
   .1 Each joint shall be restrained with the socket pipe clamp or equal, with prior approval.

2.7 Valves and Valve Boxes

.1 Gate Valves shall be manufactured to AWWA C509, ductile iron body, resilient seated, non-rising steam, hub or flanged ends.

.2 Stem seal shall be O-ring type. Valves to be complete with 50 mm square nut for underground operation. Manufacturer shall be Clow, or equal approved by SFU Facilities.

.3 Circular valve boxes shall be Nelson-type as manufactured by Terminal City or Dobney Foundry. Valve box riser pipe to be 150 mm diameter PVC DR35.

.4 Maximum distance between isolating distribution valves to be 100 m.

.5 Maximum depth of valve knuckles to be 600 mm.
2.8 Hydrants

.1 Fire Hydrants to be 150 mm diameter Terminal City type C-71-P hydrants subjected to hydrostatic pressure test of 2070 kPa in compliance with AWWA C502.

.2 Not more than 180 m apart, or 90 m from building.

.3 Minimum size of pipe connection 150 mm.

.4 Fire hydrant shall have isolating valve not more than 6 m in front of it.

2.9 Heavy Equipment Loads on Buried Pipe

.1 Loads on shallow buried pipe shall be evaluated in the design and construction planning phases. AWWA M41, Section 4.3 can be used as a guide for this evaluation.

3.1 EXECUTION REQUIREMENTS

3.2 Preparation

.1 As per MMCD Section 02666.

3.3 Trenching

.1 As per MMCD Section 02666.

.2 Trench alignment and depth as shown on Contract Drawings or as approved otherwise by SFU Facilities.

3.4 Granular Bedding

.1 As per MMCD Section 02666.

.2 Minimum soil cover to be 1.0 m.

.3 For pipe bedding use clean granular pipe bedding, graded gravel, 19 mm (-), MMS type 1. Bottom thickness shall be a quarter of pipe diameter, or minimum 100 mm thick. Top shall be minimum 300 mm thick. Sides shall be minimum 225 mm to maximum 300 mm thick.

.4 Place granular bedding (sand) material across full width of trench bottom in uniform layers to 100 mm depth.

.5 Use imported bedding when proposed work is installed under through paved areas, when Utilities Mechanical Engineer deems native material unsuitable for backfill, or when trench has been excavated in rock. Otherwise for trench backfill, native backfill may be used if free of rock greater than 25 mm and located in boulevards or easements. Approval by SFU Facilities is required.
3.5 Pipe Installation

.1 As per MMCD Section 02666.

.2 Utility Separation: A minimum 3 m horizontal clearance is required from either sanitary sewer or storm sewer piping, when they run parallel to water main. If this clearance cannot be met, water piping can be installed closer with prior approval from SFU Facilities. Refer to MMCD Design Guideline Manual Section 1.4, and Vancouver Coastal Health’s Water Supply System Construction Permit Guidelines and Application Form (see 2.1.4 this section). Installation may be approved provided water pipe is installed above sanitary or storm sewer piping with minimum vertical clearance 0.5 m and water main joints are wrapped. When crossing sanitary sewers at 90° angle, the water pipe shall be encased with 20 MPa concrete of minimum thickness 150 mm. If concrete is not desirable, joints of the water main can be wrapped with heat shrink plastic or packed with compound and wrapped with petroleum tape in accordance with the latest version of the AWWA Standards C217, and C214 or C209.

.3 Minimum 750 mm clearance is required from all other services.

.4 When crossing electric duct bank (crossing shall be done at 90°), run pipe with minimum vertical clearance 150 mm from the bottom of electric duct bank. If crossing of electrical ductbank cannot be done in this manner, then encase water pipe in one larger plastic pipe projecting 500 mm from either side of electric ductbank.

.5 Test and/or bleed points consisting of Corporation cocks, sized to achieve minimum flushing velocity of 0.8 m/s in accordance with AWW C651, to be provided where shown on Contract Drawings or as required by Utilities Mechanical Engineer for pressure testing and flushing.

.6 Requirements for piping into the building’s mechanical room as per drawing 1140-UT-01WaterStationSchematic.

.7 Requirements for replacing cast iron or asbestos cement watermains at utility excavations are to be as shown in drawing 1140-UT-09 Water Mains at Excavations. Where water pipes cross under wall foundations, they must be built of ductile iron for a distance of at least 3 metres on either side of the wall, to avoid settlement cracking.

.8 When excavating over existing A/C or cast iron watermains, only controlled density backfill shall be used. No compaction is permitted.

3.6 Valve Installation

.1 As per MMCD Section 02666.

.2 At every valve and fitting install up to 3 m length of tie rods on each side of valve/fitting and each branch, when pipe couplings are used.

3.7 Hydrants

.1 As per MMCD Section 02666.

.2 For Hydrants not in service, place an orange painted sign, 30 cm x 30 cm, lettered “Not in Service” on the main port.
3.8 Thrust Blocks

.1 As per MMCD Section 02666.

.2 Place concrete thrust blocks between valves, tees, wyes, plugs, caps, bends and undisturbed ground as shown on the Contract Drawings or as directed by Mechanical Distribution Engineer.

.3 Thrust blocks to undisturbed soil shall be provided, complete with bearing area and block volume.

3.9 Pipe Surround and Backfill

.1 As per MMCD Section 02666.

.2 Upon completion of pipe laying and before backfilling, Contractor shall notify SFU Facilities in advance for inspection.

.3 After inspection of work in place, surround and cover pipes.

.4 For trench backfill native backfill material may be used in boulevard and easement areas if free of rock greater than 25 mm. Approval from SFU Facilities is required.

3.10 Cleaning and Preliminary Flushing

.1 As per MMCD Section 02666.

.2 Water may be supplied from SFU fire hydrants upon application for a Hydrant Permit.

3.11 Testing and Flushing Procedures

.1 As per MMCD Section 02666.

.2 Contractor shall notify SFU Facilities well in advance of testing.

.3 Perform all tests in presence of SFU Facilities.

.4 Testing Procedure & Report as per MMCD Section 02666.

.5 A concise, written and signed report shall be provided via facsimile to SFU Facilities.

3.12 Disinfection and Flushing

.1 As per MMCD Section 02666.

.2 Perform disinfection procedure and residual chlorine test in presence of Mechanical Distribution Engineer.

.3 Maintain water chlorinating level (free chlorine concentration mm. 25 mg/L) in new piping for minimum 24 hours.

.4 Before connection to SFU water system, flush piping clean until maximum free chlorine concentration is less than 0.3 mg/L.
3.13 Testing New Mains

1. After disinfection and flushing, the new main is filled with potable water and sampled for total coliform and E. coli bacteria (bug test) every 350 m.

2. If a sample fails the test, the main shall be flushed and the sampling repeated. If flushing does not result in an acceptable test, the main should be disinfected again.

3.14 Shutdowns & Connections

.1 Shutdowns must be requested in writing adhering to SFU’s campus-wide standard shutdown procedures.

.2 Operating valves on the water distribution system shall only be performed by SFU Facilities.

.3 Connections to existing waterworks system may be made by Contractor with approved design and proper notification.

.4 Notify SFU Facilities with a minimum 24 hours in advance of scheduled connection.

.5 Make connections in presence of SFU Facilities. To prevent damage to existing utilities, excavate the last 300 mm over utility by hand.

.6 Hot tapping is generally not accepted. If there are exceptional circumstances, hot tapping may be requested in writing, and done only with prior written permission from SFU Facilities.

***END OF SECTION***
1.1 **GENERAL**

1.2 **Related SFU Technical Requirements**

.1 **33 82 01 CCTV Pipeline Inspection**

1.3 **System Description**

.1 The campus has a dedicated sanitary sewer system connects to the Burnaby sewer system.

2.1 **MATERIAL AND DESIGN REQUIREMENTS**

2.2 **Responsibilities**

.1 SFU is responsible for operation, maintenance, and overall stewardship of the sanitary sewer distribution server on campus.

.2 The project Designer must incorporate all specific requirements for design and materials and execution of this section into the contract drawings in the form of job-specific notes. Only making reference to SFU Technical Requirements in the drawings is not sufficient.

2.3 **Sanitary Sewer Standards**

.1 The latest revisions of the following standards shall apply to sanitary sewers at SFU:

   .1 City of Burnaby Engineering Design Criteria
   .2 BC Master Municipal Construction Documents (MMCD).
   .3 GVRD Sewer Use Bylaw No. 164 - including Schedules A, B, C, and D.
   .4 BC Provincial Health Act.

.2 Should there be discrepancies in the above standards or with this document, the City of Burnaby Design Criteria will prevail with the SFU Facilities Mechanical Superintendents approval.

2.4 **Sanitary Sewer Connections**

.1 The first step to install any new or substantially modified connections to the sanitary sewer system is to seek project approval from SFU Facilities.

.2 Any new connections to the sanitary sewer system will be reviewed for consistency with the existing sewer infrastructure.

.3 A Plumbing Permit is required to meet provisions of the B.C. Building Code Plumbing Provisions. It is preferred all communications with the City of Burnaby be channeled through SFU Facilities.

2.5 **Sanitary Sewer Discharge**

.1 As part of the development design submission, the Designer shall provide the following:

   .1 Estimates on the number and types of plumbing fixtures proposed in the buildings (i.e. low-flow vs. conventional).
.2 The waste stream must be fully characterized by type and quantity.
.3 The design flows must be identified for all pipe reaches.
.4 Any chemical or biological materials must be fully disclosed and addressed in the design.
.5 All waste being discharged shall be in compliance with the GVRD Sewer Use Bylaw No. 164. A materials handling and disposal management strategy report must also be submitted for all waste which is not in compliance.
.6 The sanitary discharge characterization may be included in the drawing notes of the mechanical or civil design drawings for the development.

2.6 Sanitary Sewer Design

.1 Sanitary sewer systems shall be designed using the Peak Wet Weather Flow (PWWF). The PWWF flow shall be the sum of the Peak Dry Weather Flow (PDWF), infiltration flow, and pumped flow.

.2 The PDWF shall be the product of the Average Daily Flow (ADF) and the peaking factor. The minimum ADF rates shown in Table 2.5.2 shall be used:

<table>
<thead>
<tr>
<th>Flow Category</th>
<th>Description</th>
<th>Category Code</th>
<th>Average Daily Flow</th>
</tr>
</thead>
<tbody>
<tr>
<td>Family Residential</td>
<td>Housing for families, post graduate couples, professional, faculty and staff.</td>
<td>RES-F</td>
<td>325 Lpcd</td>
</tr>
<tr>
<td>Student Residential</td>
<td>Housing for students – apartments, dormitories, shared units.</td>
<td>RES-S</td>
<td>230 Lpcd</td>
</tr>
<tr>
<td>Office</td>
<td>Administrative and academic offices.</td>
<td>OFF</td>
<td>90 Lpcd</td>
</tr>
<tr>
<td>Classrooms</td>
<td>Classrooms, lectures, teaching labs, student and community activities.</td>
<td>CL</td>
<td>90 Lpcd</td>
</tr>
<tr>
<td>Research Facilities</td>
<td>Research and processing.</td>
<td>RSH</td>
<td>90 Lpcd</td>
</tr>
<tr>
<td>Mixed Building Use</td>
<td>Mixed use of classrooms, lecture halls, labs, research, administration and academic.</td>
<td>M-RCO</td>
<td>90 Lpcd</td>
</tr>
<tr>
<td>Library</td>
<td>Libraries.</td>
<td>LIBRY</td>
<td>90 Lpcd</td>
</tr>
<tr>
<td>Medical/ Clinical</td>
<td>Clinics, medical sciences research and teaching.</td>
<td>MEDIC</td>
<td>4 L/m²</td>
</tr>
<tr>
<td>Animal Sciences</td>
<td>Livestock holding for research purposes.</td>
<td>ANIMAL</td>
<td>7.5 L/m²</td>
</tr>
<tr>
<td>Assembly</td>
<td>Visitor oriented buildings for conferences, events, and cultural shows.</td>
<td>ASSM</td>
<td>16 L/m²</td>
</tr>
<tr>
<td>Food Services</td>
<td>Dominant floor area designed for preparing and serving food services.</td>
<td>FOOD</td>
<td>100 L/m² dining area</td>
</tr>
<tr>
<td>Hospital</td>
<td>Hospital.</td>
<td>HOSP</td>
<td>680 L/bed or 7 L/m²</td>
</tr>
<tr>
<td>Other Uses</td>
<td>No distinct common use or other than described above.</td>
<td>OTHER</td>
<td>Specifically determined for use.</td>
</tr>
</tbody>
</table>

.3 The ADF values listed above shall be considered minimum values. The varied building uses and activities at SFU may produce unique sewage flow rates. The Developer is responsible to ensure that flow rates are computed in accordance with the specific size and activities of the proposed facility. All pertinent information shall be provided on the design drawings as
described above.

.4 The PDWF shall be computed using the Harmon Peaking Formula.

.5 An infiltration rate of 500 litres per pipe diameter (m) per Length (m) per day shall be added to the PDWF to determine the PWWF.

.6 Sanitary sewer shall flow only by gravity into SFU sanitary system. Only under unique circumstances will pumped sewage be considered, but a request for a permission to do so shall be submitted to SFU Facilities with an explanation why the sanitary sewer cannot run by gravity, the proposed pump capacity (L/s) at operating head (kPa), a diagram showing pump curve with the superimposed piping system curve at operating flow and head and sump dimensions with elevations at which pump starts and stops. Sump volume between pump start and stop elevations shall be sized so that the maximum number of On/Off cycles does not exceed six per hour.

.7 Gravity sewers shall be sized using the Manning’s Formula using an “n” value of 0.011 for PVC or 0.013 for concrete. New gravity sewers shall be sized such that the PWWF depth will not exceed 50% of the full depth of the pipe, with a resulting minimum flow velocity of 0.6 m/s.

.8 Force mains shall be sized using the Hazen-Williams formula using a “C” value of 100. Force mains shall have a minimum pipe size of 100 mm and designed for a minimum velocity of 0.9 m/s.

.9 When extending the existing trunk lines, sufficient size, depth and slope of the sewer shall be maintained to facilitate the future extension of service in accordance with the Sanitary Sewer Master Servicing Plan.

.10 A minimum pipe size of 200 mm shall be used for gravity service mains in residential areas and 250 mm in research / industrial areas. A minimum pipe size of 150 mm shall be used for service connections.

.11 Regardless of pipe slope and capacity, the downstream pipe shall be of equal or larger diameter. No downsizing is permitted.

.12 Manholes at maximum 100 m spacing shall be installed at each branch connection and each change of direction. Top of manholes shall be 150 mm above the ground in all landscaped areas, otherwise flush with surface. Pipe shall be straight between manholes.

.13 All service connections shall connect to the service main with a manhole.

.14 The length of service between the building face to the first sanitary sewer connecting manhole shall be a maximum 75 m.

.15 A minimum 750 mm horizontal clearance is required where the sanitary sewer is installed within a common trench with the storm sewer. If the invert of the sanitary sewer varies significantly from the storm sewer, the Designer shall give special consideration to the horizontal spacing.

.16 When crossing electric duct bank, run pipe below electrical duct bank with minimum 150 mm vertical clearance from the bottom of electric duct bank. Crossing angle shall be between 45° degree and 90° degree.

.17 Where drop manholes are required, drops shall be outside, with clean-outs.
.18 All manholes shall be benched and have a minimum drop of 30 mm. The drop shall be increased to 50 mm for deflection angles exceeding 45° degree.

2.7 Materials

.1 Unless otherwise approved in writing by the City of Burnaby, only the following pipe material shall be used for the gravity sanitary sewer system:

.1 PVC, class SDR 28 (150 mm diameter and smaller) and SDR 35.
.2 Concrete (reinforced C76 required for all pipes 600 mm in diameter and larger).
.3 PVC piping is preferred for all piping 450 mm in diameter or smaller.

.2 Unless otherwise approved in writing by the City of Burnaby, only the following pipe material shall be used for sanitary sewer force mains:

.1 PVC, class C900 (300 mm diameter and smaller) and C905.
.2 Ductile Iron (DI), class C151.
.3 PVC piping is preferred; therefore, DI pipe shall only be approved under unique circumstances.

3.1 EXECUTION REQUIREMENTS

.1 Sanitary sewer works and appurtenances shall be installed in accordance with the current MMCD standards and specification, unless otherwise noted.

.2 If temporary bypass pumping is required, the following items are required:

.1 Contractor to provide notice of work to residents minimum 1 week prior to commencing (date on letter).
.2 Contractor shall install temporary bypass pumping system around the designated sewer sections in accordance with pre-submitted arrangement.
.3 Pumps and bypass lines shall be of adequate capacity to accommodate predetermined flows as specified in the contract documents. A “duplex” pump system is to be used to provide 100% redundancy.
.4 Contractor to take all necessary precautions to prevent spills to the environment or backup of sewerage onto private property. In the event of a spill the Contractor shall be responsible for immediate clean-up operation and remediation of damaged property.
.5 Contractor shall report any spills and back-ups to SFU Facilities immediately.

.3 Minimum cover on all sanitary sewers shall be 1.0 meters in accordance with the MMCD standards. Where no future main line extension or connection of services is required, and where no traffic road exists or in future will exist, minimum cover may be reduced to 600 mm with special approval.

.4 All pipe surround material shall consist of clean granular MMCD Type 1 bedding.

.5 Native backfill may be used in non-traveled area if free of rock greater than 25 mm in boulevards and easement areas only. Approval by SFU Facilities is required.

.6 All gravity sanitary sewer systems shall be low pressure air tested in accordance with the MMCD Section 02731, Clause 3.14.

.7 Prior to covering the pipe, all installed and bedded pipe shall be inspected by SFU Facilities. The Contractor shall provide written notification to SFU Facilities and the City of Burnaby.
.8 Records of pipe sizes and inverts shall be provided to SFU Facilities; in accordance with Sections 01 78 39 Project Record Documents and 33 00 10 Underground Utilities Services of these guidelines.

.9 Where notification requirements are not met, services may need to be re-excavated for inspection and/or testing upon request of SFU Facilities.

***END OF SECTION***
1.1 **GENERAL**

1.2 **Related Technical Requirements**

.1 33 82 01 CCTV Pipeline Inspection

1.3 **System Description**

.1 The campus has a dedicated storm sewer system that connects to the Burnaby Storm system.

2.1 **MATERIALS AND DESIGN REQUIREMENTS**

2.2 **Responsibilities**

.1 SFU is primarily responsible for operation, maintenance, and overall stewardship of the storm sewers system on campus.

.2 The Project Designer must incorporate all specific requirements for design and materials and Execution of this section into the contract drawings in the form of job-specific notes. Only making reference to SFU Technical Requirements in the drawings is not sufficient.

2.3 **Stormwater Objectives and Standards**

.1 The latest revisions of the following standards shall apply to storm sewers at SFU.

.1 City of Burnaby Engineering Design Criteria

.2 B.C. Master Municipal Construction Documents (MMCD).

.3 GVRD Sewer Use Bylaw No.164.

.4 Fisheries Act.

.2 Should there be discrepancies in the above standards or with this document, the City of Burnaby Design Criteria will prevail with the SFU Facilities Mechanical Superintendents approval.

2.4 **Storm Sewer Connections**

.1 The first step to install any new or substantially modify connections to the storm sewer system at SFU is to seek project approval form SFU Facilities.

.2 Any new connections to the storm sewer system will be reviewed for consistency with the existing sewer infrastructure.

.3 A Plumbing Permit is required to meet provisions of the B.C. Building Code Plumbing Provisions. It is preferred all communications with the City of Burnaby be channeled through SFU Facilities.

2.5 **Stormwater Management Plan**

.1 The designer must review and address the latest version of the Burnaby Campus Stormwater Management Plan hosted at [http://www.sfu.ca/fs/planning/stormwater-management-strategy.html](http://www.sfu.ca/fs/planning/stormwater-management-strategy.html).
.2 The storm water management plan must be discussed with and approved as necessary by SFU Facilities as part of the campus infrastructure development plan.

### 2.6 Storm Sewer Design

.1 Control of stormwater quality shall be addressed in the Stormwater Management Plan. Best Management Practices (BMP’s) shall be implemented to protect stormwater runoff quality. A reference document for applicable BMP’s is GVRD’s Best Management Practices Guide for Stormwater. This document should also be consulted for associated design information.

.2 The Designer is encouraged to incorporate methods of biofiltration into the site design to assist with water quality treatment. This includes such features as grassed swales, vegetated buffer strips, french drains, engineered wetlands, etc. Engineered BMP’s described above may be reduced or eliminated if adequate biofiltration measures are incorporated into the site design. If biofiltration is proposed for a development, it shall be included in the Stormwater Management Plan.

.3 Combined data from Confederation Park and WestBurco rain gauges are to be used in designing drainage infrastructure. Rainfall Intensity Duration Frequency (IDF curves) are provided in City of Burnaby Design Criteria Manual.

.4 The Designer shall select a time of concentration (Tc) and run-off coefficient (R) which are appropriate for the proposed development. The “Tc” shall be the sum of the inlet time and travel time. In most cases, the inlet time shall be 10 minutes when the impervious surface flow path length to the storm inlets is 100 meters or less.

.5 Storm water shall flow only by gravity into the SFU storm system. Only under unique circumstances will pumped storm water be considered. Perimeter drains can be pumped into the SFU storm system, but a request for a permission to do so shall be submitted to SFU Facilities with an explanation why the storm water cannot be discharged by gravity, the proposed pump capacity (L/s) at operating head (kPa), a diagram showing pump curve with superimposed piping system curve at operating flow and head and sump dimensions with elevations at which pump starts and stops. Sump volume between pump start and stop elevations shall be sized so that the maximum number of On/Off cycles does not exceed six per hour.

.6 When extending the existing trunk lines, sufficient size, depth and slope of the sewer shall be maintained to facilitate the future extension of service in accordance with the Storm Drainage Master Servicing Plan.

.7 All storm sewer piping shall be designed with a minimum velocity of 0.6 m/s when flowing full or half full, based on the Manning’s formula. Special provisions must be provided for supercritical flow or where the velocity exceeds 3.0 m/s to ensure structural stability and durability concerns are addressed.

.8 The minimum slope shall be 1.0% for CB leads, 0.2% for storm mains smaller than 600 mm in diameter, and 0.1% for storm mains 600 mm in diameter and larger.

.9 All catch basins, lawn drains and inlet shall provide a sump and trash hood in accordance with MMCD standard drawings.

.10 An American Petroleum Institute (API) Oil Water Separator or equivalent product such as Lafarge’s Stormceptor chamber shall be incorporated at the most downstream point of the on-site storm drainage system for all parking facilities providing 20 or more parking stalls.
The system shall be appropriately sized and include a bypass to reduce flushing of contaminants during elevated flows.

.11 Manholes at maximum 100 m spacing shall be installed at each branch connection and each change of direction. Top of manholes shall be 150 mm above the ground in all landscaped areas, otherwise flush with surface. Pipe shall be straight between manholes.

.12 A minimum pipe size at 200 mm shall be used for gravity service mains in residential areas and 250mm in research/industrial areas. A minimum pipe size of 150mm shall be used for all service connections.

.13 The downstream sewer pipe shall be equal or larger diameter.

.14 Where drop manholes are required, drops shall be outside, with clean-outs. For standard details refer to MMCD manhole installation standards.

.15 Catch basins shall be spaced to service a maximum area of 500 m² on grades up to 3%. For grades exceeding 3% the spacing shall be reduced to an area of 350 m². Special consideration shall be given at low spots to ensure that adequate capacity is provided. A minimum pipe size of 150 mm shall be used for CB leads.

.16 The length of service between the building face to the first storm sewer connecting manhole shall be a maximum 75 m.

.17 A minimum 750 mm horizontal clearance is required where the storm sewer is installed within a common trench with the sanitary sewer. If the invert of the sanitary sewer varies significantly from the storm sewer, the Designer shall give special consideration to the horizontal spacing.

.18 When crossing electric duct bank, run pipe below electrical duct bank with minimum 150 mm vertical clearance from the bottom of electric duct bank. Crossing angle shall be between 45° and 90°.

.19 Provide positive slopes away from entrances and exits (not less than 4%) to adequate storm drains or gratings that will allow a ponding depth of at least 100 mm. (This will, in normal cases, give sufficient lead time to remedy flooding situations before interior floor finishes are damaged). Install continuous gratings in lieu of catch basins and drains where broad sheets of water are anticipated to flow down pathways and roads towards entrances. Where possible provide alternate means for water to escape if a drain is plugged such as overflow scuppers, secondary French drains, etc.

2.7 Materials

.1 Unless otherwise approved by the city of Burnaby, only the following pipe material shall be used for the gravity storm sewer system:

   .1 PVC, class SDR 28 (150 mm diam. and smaller) and SDR 35.
   .2 Concrete (reinforced C76 required for all pipes 600 mm in diameter and larger).
   .3 Corrugated HDPE having a minimum pipe stiffness of 320 kPa may be permitted under unique circumstances.
   .4 PVC piping is preferred for all piping 300 mm in diameter or smaller.

3.1 EXECUTION REQUIREMENTS

.1 Storm sewer works and appurtenances shall be installed in accordance with the current
MMCD standards and specification, unless otherwise noted.

.2 Minimum cover on all storm sewers shall be 1.0 meters in accordance with the MMCD standards. Where no future main line extension or connection of services, lawndrains, or catch basins is required, and where no traffic road exists or in future will exist, minimum cover may be reduced to 600 mm with special approval.

.3 Site grading and surface inlets shall be located to ensure that stormwater is contained and controlled within the boundaries of the site.

.4 All pipe surround material shall consist of clean granular MMCD Type 1 bedding.

.5 Native backfill may be used in non-traveled areas if free of rock greater than 25 mm in boulevards and easement areas only. Approval by SFU Facilities is required.

.6 Prior to covering the pipe, all installed and bedded pipe shall be inspected by the City of Burnaby with SFU Facilities present.

.7 Records of pipe sizes and inverts shall be provided to SFU Facilities; in accordance with Sections 01 78 39 Project Record Documents and 33 00 10 Underground Utilities Services of these guidelines.

.8 Where notification requirements are not met, services may need to be re-excavated for inspection and/or testing upon request of the SFU Facilities.

***END OF SECTION***
1.1 **GENERAL**

1.2 **System Description**

.1 Natural gas on campus is owned and operated by SFU Facilities. FortisBC is responsible for main incoming gas service up to and including the central pressure reducing valve.

2.1 **MATERIALS AND DESIGN REQUIREMENTS**

2.2 **Responsibilities**

.1 The SFU Facilities is primarily responsible for operation, maintenance, and overall stewardship of the natural gas distribution system.

.2 FortisBC is not responsible for any part of the gas piping or equipment past the central pressure reducing valve of the main incoming gas service.

.3 The Project Designer must incorporate all specific requirements for metering, design and materials and execution of this section into the contract drawings in the form of job-specific notes. Only making reference to SFU Owners' Technical Requirements in the drawings is not sufficient.

2.3 **Natural Gas Distribution Standards**

.1 The latest revisions of the following standards shall apply to natural gas distribution at SFU:

.1 Canadian National Gas Code.

.2 NACE.

.3 CGA Standard (as applicable).

.4 CSA Standard (as applicable).

2.4 **Natural Gas Service Connections**

.1 Installation of any new or substantially modified connections to the natural gas distribution system at SFU must be coordinated with SFU Facilities.

.2 Any new connections to the gas distribution system will be reviewed for consistency with SFU Owners' Technical Requirements.

.3 Project design drawings shall provide building load (list of appliances with nameplate capacities in m³/hour) and required pressure.

2.5 **Metering**

.1 No specific metering requirements are noted at this time.

2.6 **Seismic Protection**

.1 The decision whether to install seismic shutoff valves is the responsibility of the project consultants. Buildings which meet the following criteria may not benefit significantly by installing a seismic shutoff valve:

.1 Building is structurally designed for current seismic codes.

.2 Restraints installed on all gas equipment (e.g. water heaters, air heating units) and piping.
.3 Flexible connections installed on all gas equipment.

.2 Buildings which use natural gas for emergency power or other emergency needs are recommended not to install seismic valves.

.3 Seismic valves are to be manufactured by Pacific Seismic Products.

.4 Regardless, SFU Facilities requires that seismic restraints be used on all gas equipment (i.e. water heaters) and main gas piping in the building.

.5 SFU Facilities requires that flexible gas connections be used on all gas equipment in the building.

2.7 Design and Materials

.1 Design piping pressure: 415 kPa (60 psig).

.2 Connections shall be to the highest available pressure.

.3 New underground piping shall be SDR11 Series 125 Polyethylene, manufactured to CAN 3-B137.4M86. New underground valves shall be PSV polyethylene shut off valves with butt fusion outlet ends, to accommodate SDR 11 pipe, confirming to ASTM D-2513. Pipe fittings shall be butt heat fusion polyethylene manufactured to ASTM D-3261-85.

.4 New aboveground piping up to shall be minimum Schedule 40, ASTM A53 steel piping. Up to, but not including the gas meter assembly, all piping shall be painted yellow. All piping up to 2” size shall be socket welded, manufactured to ASTM A182. New piping over 2” may be butt welded. All aboveground valves shall be bronze plug-type shutoff valves with threaded outlet ends to accommodate A53 steel pipe, and conforming to ASTM B62.

2.8 Permits

.1 Permits by B.C. Gas Safety Branch and inspections/witness by B.C. Gas Safety Inspector of pressure testing and purging are the sole responsibility of the project.

2.9 Notification

.1 The FortisBC shall be notified in advance of any planned pressure testing of a new gas service pipe. Failure to provide notice may result in installed services to be re-excavated for inspection.

3.1 EXECUTION REQUIREMENTS

.1 Minimum soil cover shall be 600 mm.

.2 Warning tape at 300 mm below grade level shall be provided.

.3 Minimum 750 mm horizontal clearance is required from all other services.

.4 When crossing electric ductbank, run pipe above electrical ductbank with minimum vertical clearance 150 mm from the top of electric ductbank. Crossing angle shall be 90° degree. If crossing of electric ductbank cannot be done in this manner, then encase natural gas pipe in one larger plastic pipe projecting minimum 500 mm from either side of the electric ductbank.

.5 A top tracer wire attached to the underground polyethylene pipe shall be provided.
.6 Continuity of the existing cathodic protection system shall be maintained when any additions or replacements are undertaken.

.7 Hot tapping may be done only with written permission from SFU Facilities.

.8 Purge pipe with nitrogen after new service pipe is installed.

.9 For pipe bedding use clean granular pipe bedding, graded gravel, 10 mm (minus), MMCD type:

   .1 Bottom bedding shall be a quarter of pipe diameter or 100 mm thick, whichever is larger. Top bedding shall be minimum 300 mm thick. Side bedding shall be a minimum 225 mm to maximum 300 mm thick

.10 For trench backfill, native backfill may be used if free of rock greater than 25 mm in easements and boulevards only. Approval by SFU Facilities is required.

.11 No trees shall be planted within 1,200 mm of underground gas piping.

.12 Shutdowns must be requested in writing adhering to SFU's campus-wide standard procedures.

.13 Connections to existing gas distribution system may be made by Contractor with SFU Facilities approval.

.14 Gas distribution valves and meter stations on the SFU natural gas system may only be operated by SFU Facilities.

***END OF SECTION***
1.1 **GENERAL**

1.2 **Related Technical Requirements**

.1 *Division 26 through 33*

1.3 **Coordination Requirements**

.1 SFU Facilities

1.4 **Power**

.1 The main incoming electrical service is dual 64 kV fed overhead up the east side of Burnaby Mountain to a main substation. Two 20 mVA transformers step this down to 12 kV. Three sets of dual 12 kV underground feeders run from the substation to three receiving substations (Transportation Centre, Saywell Hall and TASC1). From there the 12 kV main and transfer feeder daisy chain from building to building using junction boxes to tap off.

.2 Each building has a 12 kV substation fed from the main and transfer feeder through load breaks and 12 kV main breakers. Most building substations use EPE supplied equipment so the architecture and equipment is standardized across the campus. Over time, most of the original 12 kV oil breakers have been upgraded to more reliable vacuum breakers.

.3 The step down transformers are cast coil, a longer lifetime variation of the dry type units. Transformers mostly step down to 480 Volts which is the standard building distribution level. There is virtually no 347/ 600 V distribution at SFU Burnaby. Some transformers step down to 120/ 208 V directly.

There is a capital plan to pro-actively replace substation transformers in the 6 or 7 oldest buildings with new units due to the fact that they exceed their rated lifetime.

1.5 **Power Metering**

.1 Each building substation has a meter installed to measure the total building electrical parameters. This metering is used for monitoring power and detecting anomalies, as well as sending data to a central server to measure power consumption. These meters are connected through Facilities fibre via IP and Modbus to the server. Meters and server are all supplied by Schneider as the approved metering vendor. Refer to *Division 20, Section 20 00 06 Meters*, and *Division 26, Section 26 27 13 Metering* for full details.

.2 Submeters are installed on request by tenants, as well as revenue certified meters for external tenants that are billed for their consumption. They must also be Schneider products. Meters also monitor the status of the 12 kV breakers in each building substation. This allows building power status to be monitored at the Electrical shop metering workstation.

1.6 **SFU Standard Forms**

.1 The following standard forms apply to all utilities for this project, as applicable:

.1 Clearance Permits.
.2 Test and Work Permits.

***END OF SECTION***
1.1 **GENERAL**

1.2 **Related SFU Technical Requirements**

1.3 **Coordination Requirements**

1.4 **Description**

2.1 **MATERIALS AND DESIGN REQUIREMENTS**

2.2 **Design Standards**

2.3 **Trenching**

2.4 **Other Services**

2.5 **Requirements for Ducts**
.2 Communication services: minimum 4 - 125 mm (5") between manholes and 4 -100 mm (4") into buildings.

.3 Ducts shall be sized on the drawings.

.4 Ducts shall be buried at a minimum depth of 900 mm. Duct runs shall be evenly sloped toward duct terminations for drainage.

.5 Ducts shall terminate with bell mouth ends. A 10 mm (¼") pulling line shall be installed in all ducts.

.6 All duct bends shall be long sweep “Utility” bends manufactured to utility pulling specifications.

.7 At building entry seal duct openings with an approved non-hardening putty material for all conduits or ducts entering building to prevent migration of gases into the building.

### 2.6 Requirements for Manholes

.1 Manholes shall be 1830 mm x 3300 mm x 2000 mm high inside dimensions.

.2 Manhole shall be complete with cast manhole cover, frame and brick assembly between manhole and manhole lid.

.3 Materials shall include:

- .1 Pre-cast Manhole Assembly.
- .2 Manhole Frame.
- .3 Manhole Cover.
- .4 Spacer Rings.
- .5 Pulling Irons.
- .6 Ground Rods.
- .7 Sump Cover.

.4 Manholes shall be constructed to the following SFU Utility Standards:

- .1 E 3-1 Standard Electrical Precast Manhole.
- .2 E 3-2 Standard Electrical Manhole Pour in Place.
- .3 E 3-3 Additional Reinforcing for Pour in Place Electrical Manhole.
- .4 E 3-4 Standard Electrical Manhole Cover & Riser Details.
- .5 E 3-5 Standard Electrical Manhole Sump Detail.
- .6 E 3-6 Typical Manhole Grounding & Details.
- .7 E 3-7 Typical Manhole Separation.

.5 Pre-cast Manhole using BC Hydro 4212 Chamber may be substituted as an alternate.

.6 Concrete shall not be placed in foundations until the soil breaking has been reviewed by the Engineer.

.7 All manholes shall have a sump with positive drainage. Manhole drains shall be connected to the storm water system.

.8 Testing costs for compaction and concrete tests shall be paid for by the project.

### 2.7 Requirements for Concrete Encased Duct Bank

.1 All Service Ducts shall be concrete encased.
.2 All Civil Work associated with Duct Bank shall be to MMCD Specifications.

.3 Duct Banks shall be constructed in accordance with SFU Standards Drawings:
   .1 E2-1 Standard Concrete encased Electrical Duct.
   .2 E2-3 Standard Electrical Duct Bank.

.3 Forms must be used on the walls of the duct bank.

.4 Duct connectors shall be staggered so they are never adjacent to another coupling. Manufactured intermediate spacers shall be used throughout the length of the duct run every 2 meters.

.5 Concrete shall have maximum 200 mm (3/4") aggregate, minimum 20 MPA strength at 28 days, and shall contain “Anti-Hydro” mixed as recommended by the additive Manufacturer.

.6 Immediately after installation, ducts shall be tested for blockages and cleaned as necessary. Prior to completion the ducts shall be swabbed and mandrel led.

2.8 Requirements for Warning Tape During Construction

.1 During construction a warning tape (yellow) imprinted “CAUTION BURIED ELECTRICAL LINE” shall be installed at all duct banks and buried conduit.

.2 Warning tape shall be laid in the trench midway between duct bank and finished grade.

***END OF SECTION***
1.1 **GENERAL**

1.2 Related Technical Requirements

.1 *Section 33 00 10 Underground Utilities Services*

1.3 **CCTV Pipeline Inspection – Specifications**

.1 All projects must provide CCTV Pipeline inspections for all storm and sanitary services.

.2 Work shall conform to all applicable regulations of WorkSafeBC. The contractor shall confirm training compliance in confined space entry, ventilation, atmospheric monitoring and personal protective equipment.

.3 Inspections should be of high quality color imagery, providing view of all laterals and deficiencies.

.4 Camera shall be equipment with an inclinometer to record the slope of the inspected pipe.

.5 Sample inspection videos are to be submitted for review by SFU Facilities before proceeding with complete inspection.

.6 Upon completion of underground piping camera inspections, videos/ pictures must be turned over to SFU Facilities.

***END OF SECTION***