DALHOUSIE UNIVERSITY

Div 26 - Electrical Design Guidelines 2023 09 25 (4)

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Dalhousie University Design Guidelines provide assistance to consultants during the planning, and design phases of the University's expansion and renovations. The Guidelines do not relieve a consultant from any professional responsibility, duty or due diligence to design elegant, functional, efficient and low maintenance facilities.

Facility owners have preferred materials and requirements that make the task of maintaining facilities less costly. Dalhousie understands this is a balance between capital and operating cost. The Guidelines are not intended to be the only acceptable solution. Dalhousie expects consultants to bring modern and innovative ideas, materials and methods to the University. If these Guidelines do not allow these new ideas, then the consultant is to make a request in writing to the Dalhousie Project Manager for an exception to the guidelines. Necessary reasoning and or calculations shall accompany the request. The exception request will be reviewed internally and either rejected or accepted. The consultant will document this rational and/or justification for each exception in the Basis of Design. The University Guidelines may be updated subsequently.

These documents provide design guidelines only, and are not intended for use, in whole or in part, as a specification. Do not copy the guidelines verbatim in specifications or in notes on drawings. Refer questions and comments regarding the content and use of these documents to the Dalhousie University Project Manager. The Guidelines are intended to be read in conjunction with the local codes and regulations, and in no way are to be considered as a code replacement. The codes and regulations represent the minimum acceptable standard. Where the technical design requirements differ from the building codes and other applicable codes and standards, the more stringent of the codes shall be applied.

Maintaining the Standards/Guidelines

The Design Guidelines are created and maintained by Dalhousie's Facilities Management Department. Any enquiries about the Guidelines should be directed to Facilities Management, Director of Projects, Central Services Building. Dalhousie encourages design specialists and other interested parties to provide their input and suggestions based on their experience.

ELECTRICAL CONSULTANT COMPLIANCE CHECKLIST

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	C	NC	NA
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5. Placement of Equipment And Equipment Access			

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31 00 01	Multiplex Fire Alarm System			

(C – Compliant; NC – Non-Compliant; NA – Not Applicable)

*Net Increase in Building Electrical Load (in kVA) =*_____

The Engineer has verified the existing building systems are adequate for additional capacity noted above

_____

Consultant Name Consultant Signature Date YYYY MM DD

_____

Project Manager Name Project Manager Signature Date YYYY MM DD

Note: If the Guidelines or part of cannot be attained or fulfilled (i.e. NC or NA) during the design process, the Consultant should provide reason(s) why such Guidelines are not met. Any modification or alterations to the design guidelines will need to be agreed/accepted by Facilities Management prior to inclusion in the design.

General Requirements

1. **Warranties**

1.1. Standard 12 month warranty for a project begins at Substantial Performance. Systems and or equipment that is not considered complete at the time of the project's (or trade's) Substantial Performance shall be noted as such on the Substantial Performance Certificate's Punch List. Warranty for this equipment (or system) shall be one year from the date upon which it is removed from the Punch List.

1.2. Extended warranties are available for many pieces of equipment and/or products from the manufacturer at no cost. Dalhousie requires suppliers/manufacturers to provide such extended warranties directly to the Owner in the name of Dalhousie University. A list of such warranties will be reviewed with the Owner at time of shop drawing submission.

1.3. The designer shall recommend any extended warranties (including labour) and/or service agreements to the Owner. In all cases, these shall be listed as alternative prices to the base project on the bid form.

2. **Energy Efficiency**

2.1. Variable speed drives should be used for all 3 phase motors that would traditionally require a starter. Specification must state that the associated rebate is to be payable to the University.

3. **Efficiency Nova Scotia Rebates**

3.1. Energy efficiency must be considered and equipment specifications must align with those identified by Efficiency Nova Scotia as eligible for Business Energy Rebates. The rebates include but are not limited to the following categories:

- Hot Water Heating
- Variable Speed Drives
- Lighting
- Transformers

The specifications identified by Efficiency Nova Scotia are available on their website https://www.efficiencyns.ca/business/products/

The designer shall specify that that the Owner will be applying for all applicable efficiency rebates, through Efficiency NS, in collaboration with the successful proponent. The Owner (Dalhousie) will receive these rebates directly. The successful proponent will not apply or receive any manufacturer's instant rebates for any products provided through the project.

4. **Equipment Isolation**

4.1. All equipment shall be able to be individually electrically isolated.

5. **Placement of Equipment And Equipment Access**

5.1. As necessary the Designer shall summarize all work necessary to place equipment or systems into existing spaces. Including but not limited to: wall removals, door removals, special cranes, knock down equipment.

5.2. The ability to service equipment, including necessary permanent platforms, shall be reviewed with the Project Manager as part of the shop drawing review/approval. Exceptions to the manufacturer's recommended clearance requirements, shall be identified during the shop drawing review/approval stage by the designer.

5.3. The internal dimension of all access doors and panels must be a minimum of 12" x 18". Access doors shall be hinged with a positive locking mechanism.

5.4. Equipment shall not be placed closer than 3 meters (2 meters from the roof edge plus 1 meter for servicing room) from the edge of any roof. If this is not possible, appropriate engineered barriers shall be provided.

5.5. Equipment should be located with consideration of snow accumulation, entry into equipment and removal. As well as protected from University snow removal operations. Where snow accumulation is inevitable, designer is to complete a structural analysis.

5.6. Equipment to be placed on the roof must include a detailed drawing of sleepers, penetrations, etc. It is the responsibility of the Designer to ensure the detailed drawing is signed off by a qualified roofing professional and ensure roof warranties are not voided by works carried out.

26 05 00 Common Work Results For Electrical

1. **General Electrical Requirements**
   1.1. Equipment, regardless of who supplies it for the project, shall inspected by the University, the consultant and the contractor, jointly, upon arrival to the site
   1.2. Electrical supply to any new building or facility shall be provided from the existing central distribution system.
   1.3. A radial connection directly from the NSPI distribution system must be justified, on a life cycle cost basis, by the designer and approved by the Project Manager.
      1.3.1. *Studley & Carlton Campuses*
         1.3.1.1. All primary electrical equipment supplied from the Dalhousie 23kV underground distribution system shall be rated for a minimum of 25kV. Transformers shall have a nominal rating of 24.94kV with two 2 ½ % taps above nominal and four 2 ½% below nominal.

2. **Permits & Inspections**
   2.1. The project specifications shall state that projects executed by outside contractors shall require an electrical permit issued by the Authority Having Jurisdiction. All inspections and reports shall be submitted to the Project Manager. An annual maintenance agreement, established by Nova Scotia Power Inc, Tariffs & Regulations, provides the following statements

      2.1.1. An annual maintenance permit shall be issued for an establishment to cover all minor repairs as required under sections 4(a) (B), (2) and (3) of the regulations

      2.1.2. made by the Fire Marshal pursuant to the Electrical Installation Act.

      2.1.3. Such a permit does not entitle the holder to effect major electrical alterations or additions.

      This annual maintenance agreement shall not be utilized by outside contractors.

   2.2. The electrical consultant shall submit drawings to the NSPI electrical plans review before the tender of the project.

3. **Single Line Diagrams**

   3.1. Single Line Diagrams shall conform to the University's format. Format is obtained through the University Project Manager and Electrical Planner.

3.2. Device designations on all single line diagrams will conform to the Dalhousie University Electrical Equipment Labeling Standard.

3.3. Nominal voltage of the system and full load current rating for all electrical devices must be indicated on all single line diagrams.

3.4. Fault interrupting ratings of all busses must be indicated on all single line diagrams.

3.5. The specification shall state that any changes to the single line diagram in an existing building, or a new building, will require a copy of the updated building main power distribution single line diagram be provided, under Plexiglas, in main electrical room.

3.6. If applicable to the project, the specification shall state that any changes to the campus wide electrical distribution system must be reflected in an updated campus wide single line diagram, and supplied to Dal PM who provides to Dal Electrical planner for review and posting at point of delivery.

3. **Electrical System Studies**

3.1. The Engineer shall provide an electrical system study at conceptual design stage for the project as outlined below:

3.1.1. Study must encompass all system components from the utility supply point through to and including the new 208-volt level.

3.1.2. Study must include

3.1.2.1. All data associated with the basis of design equipment to produce a model for the study

3.1.2.2. A Short circuit analysis

3.2. The Engineer shall provide an electrical system study at 90% design stage for the project as outlined below:

3.2.1. Study must encompass all system components from the utility supply point through to and including the new 208-volt level.

3.2.2. Study must include

3.2.2.1. All data associated with the basis of design equipment to produce a model for the study

3.2.2.2. A Short circuit analysis

3.2.2.3. Arc Flash calculations for all main switchgear.

3.2.2.4. Protection Co-ordination Study and settings for all relays and protective devices from the NSPI supply point to the largest downstream device on all the feeder secondary distribution levels.

3.2.2.5. The report shall also include protection coordination diagrams, fuse data and protective device settings. The report shall be submitted to Dalhousie University Electrical Planner for review and comment.

3.3. The Engineer shall provide an updated electrical system study at completion of the project that reflects as built conditions.

3.3.1. Study must include

3.3.1.1. All data associated with the installed equipment to reproduce a model for the study

3.3.1.2. Short circuit analysis

3.3.1.2.1. Arc Flash calculations and appropriate labels shall be provided for all equipment rated 208-volt and above, excluding motors or end of line devices. Engineer to specify that the contractor shall produce and apply the labels. Below are examples of the requirements for Arc Flash Labelling. These plus adding the consultant name that created the label are the minimum requirements. No other logos are to be added to any label without permission in writing from the University.

3.3.1.3. Protection Co-ordination Study and settings for all relays and protective devices from the NSPI supply point to the largest downstream device on all the feeder secondary distribution levels.

3.3.1.3.1. The basis for the feeder and equipment protection settings shall be provided for equipment rated 208V and above.

3.3.1.4. The report shall also include protection coordination diagrams, fuse curves and protective device settings. The report to be submitted to Dalhousie University Electrical Planner for review and approval.

3.3.1.5. A final report shall be submitted to the University Project Manager for project record purposes.

3.3.1.6. The software files of the model shall be turned over to the University.

4. **Electrical Vaults and Electrical Rooms**

4.1. Reminder of code - no liquid carrying infrastructure is to be installed in or above electrical vaults or switchgear rooms.

4.2. Electrical vaults and switchgear rooms are not to be located under any room that is a source of water supply or drainage. It is important that electrical vaults and switchgear rooms are not to be located under podium areas, parking garages, custodial closets, washrooms, labs, or staff lounges.

4.3. Electrical vaults and electrical rooms containing transformers must not be located adjacent to areas where people work or study such as classrooms, offices, etc.

4.4. All electrical vaults must be above grade.

4.5. All ventilation or air conditioning ductwork for electrical vaults or switchgear rooms shall be sloped out of the room so as to prevent water infiltration into those areas.

4.6. Electrical vaults and switchgear rooms shall be provided with sufficient ventilation capacity (thermostatically controlled), to maintain no greater than 30 C at any time. If the electrical room has a UPS, or other battery containing device, the room shall be maintained to no greater than 20 C.

4.7. Electrical rooms are not to be used as thoroughfare to access any other room(s). e.g. mechanical rooms, tunnel, etc.

4.8. The building's main electrical service point (typically the vaults) is to be provided with a dedicated telephone extension.

4.9. All electrical vaults should have card access to enter.

5. Electric Motor Equipment and Controls

5.1. All equipment specific convenience receptacles shall have separate/dedicated power source.

5.2. All controls equipment shall be separated or shielded from wiring above 24V.

5.3. Running lights for MCC, standalone starters and VFDs:
- 5.3.1. Green – Stopped
- 5.3.2. Red – Running

5.4. Voltage rating for motor and heating load
- 5.4.1. Motors 2 HP and less shall be 208V, three phase
- 5.4.2. Motors greater than2 HP shall be 600V, three phase
- 5.4.3. Heaters over 2 kW shall be 600V.
- 5.4.4. Heat pumps should be designed to connect to 600V, where this equipment is available.

5.5. In general Variable Frequency Drives (VFDs), installed within view of the motor, are preferred over a starter in a Motor Control Center.

5.6. VFD Guidelines.

5.6.1. General

	Application				
Options	**Pump**	**Supply Fan**	**Return Fan**	**Exhaust Fan**	**<Critical System>*** **
Line Reactors	Yes	Yes	Yes	Yes	Yes
Load Reactors*	No	No	No	No	No
Mechanical By-Pass/Redundant VFD	No	No	No	No	Yes
VFD Disconnect (at enclosed VFD)**	No	No	No	No	No
* Use of load reactors shall be justified with an explaination that is approved by the University					
** Where not installed in an MCC the VFD shall be in an appropriate NEMA enclosure and have a Non Fused Disconnect					
***Complete list of Critical Systems:	Animal Care Airhandlers				

5.6.2. VFDs are to be installed in mechanical or electrical rooms, within line of sight of the equipment they are controlling.

5.6.3. VFDs are to be open drives, installed without a cabinet, with their enclosure rated NEMA 12.

5.6.4. A non-fused disconnect on the line side of the circuitry.

5.6.5. If the load is remote of the VFD, such as a cooling tower, a non-fused disconnect switch, complete with position feedback is to be supplied and installed by the electrical contractor. The feedback wiring from this disconnect switch to the VFD is to be wired by the Controls contractor.

5.6.6. Connections are to be made at the bottom of the cabinet only so as to avoid any fluid entering the cabinet and coming in contact with the electronics

5.6.7. The on board VFD cooling fan is to cycle based on the electronics' temperature.

5.6.8. VFD Switching Frequency - Normal switching frequency is 1.5 KHz. VFD supplier shall be responsible for adjusting the switching frequency if the VFD created noise from the motor is found to be unacceptable by the building occupants. Changes shall be made in collaboration with FM Utilities shop so as to not result in VFD over heating or motor damage.

5.6.9. Motor Ratings/Features

5.6.9.1. ONLY motors that comply with NEMA std MG1-2009, Part 31 are permitted to be connected to a variable frequency drive (VFD). This requirement is to be specified not only in the electrical section of the project specification but also in any section where an equipment's motor is to be connected to a VFD.

5.6.9.2. Inverter rated and inverter ready motors are not acceptable and are not to be used.

5.6.9.3. In retrofit applications care must be taken to ensure that the minimum motor winding insulation class rating is Class F. Under no circumstances should motors with insulation class C and below be connected to a VFD.

5.6.9.4. All motors shall have shaft grounding rings to preserve the bearings

5.6.10. Motor Lead Length (MLL) Motor lead length must be controlled in order to insure long motor life especially for motors under 10 HP. As an example, the JCI VFD has built in protection for up to 300 feet of MLL for inverter duty motors. No motors are to be installed at a distance greater than 300 feet from the VFD

5.6.11. VFD Cable. The load side of all VFD installations shall use VFD cable. This shall be the case regardless of its mechanical protection system.

5.6.12. Motor Underload or Torque (Broken Belt or Coupling Indication). The Motor Underload or Torque feature is to be used on all single motor applications.

5.6.13. Multiple motor applications shall have a current switch installed for each motor and wired to the Building Management System (BMS) Field Controller. When the ability to customize the objects that are exposed to the SA Bus is available, on a case by case basis we will determine if these current switch DI's can be connected to the VFD's DI's

5.6.14. Circuit Breaker (CB). The engineer is responsible for selecting a circuit breaker suitably rated for the protection of the VFD with an appropriately sized and featured panel mounted Circuit Breaker that meets all applicable codes.

5.6.15. Fusing. There shall be no fuses anywhere in the electrical circuitry feeding the VFD.

5.6.16. Redundant Drives/Mechanical By-Passes.

5.6.16.1. No system shall have a Mechanical By-Pass or Redundant Drive unless it has been deemed a critical system and the basis of its criticality has been formally documented within the project.

5.6.16.2. Should a system be deemed critical;

5.6.16.2.1. Variable flow systems shall receive a redundant VFD

5.6.16.2.2. Constant flow systems shall receive a mechanical by-pass

6. **Electric Receptacles**

6.1. The following are to be specified as acceptable:
Leviton CR 20 for 20amp circuits
Leviton CR 15 for 15 amp circuits

Hubbell 5252aw for 15 amp circuits
Hubbell 5352aw for 20amp circuits

Pass and Seymour CR15 for 15 amp circuits
Pass and Seymour CR20 for 20 amp circuits

26 05 00 2.6 Equipment Identification

1. Identification shall be applied prior to equipment being energized.

2. All equipment and outlets are to be provided with “lamacoid” nameplates as further described herein. Care is to be taken to ensure that all nameplates are affixed true and level, and plumb in all instances. In no instance shall the nameplate cover manufacturer’s model and serial numbers and similar information.

3. Nameplates are to be affixed to all “metal” surfaces with steel type “pop-rivets”.

4. Nameplates are to be affixed to other types of surfaces with contact type cement, or industrial grade two-sided tape.

5. Nameplates are to be affixed to building “exterior” surfaces with nylon inserts and self-tapping screws unless specifically indicated otherwise.

6. Lamacoid nameplates installed on distribution panel boards, motor control centre, splitter troughs, transformers, etc. shall indicate the following:
    1. Designated name of equipment.
    2. Amperage of overcurrent protection device.
    3. Voltage(s), number of phases and wires.
    4. Designation of power source.

    See Elec Equipment Labelling Example for examples, at the end of this section.

7. Lamacoid nameplates installed on combination starters, magnetic starters, variable frequency drives, manual starters, and all various system controls, control panels, disconnect switches, etc. shall contain the following information.
    1. Designated name of equipment.
    2. Designated name of power source.
    3. Branch circuit breaker number(s) where possible.
    4. Voltage(s).

    See Elec Equipment Labelling Example for examples, at the end of this section.

8. Lamacoid nameplates installed on fusible type disconnect switches are to also indicate maximum designated/designed fuse size.

9. Lamacoid nameplates are to be installed on all junction and/or pull boxes sized 6" x 6" and larger indicating name of system, designated panel name and electrical characteristics where applicable.

10. Lamacoid nameplates are to be installed adjacent to each overcurrent devices located in switchboards, Central Distribution Panel (CDP). They need only indicate designated name and/or number of equipment they feed. Unused Over Current (O.C.) devices are to be identified as spare(s). This shall not apply to Branch Circuit Panels.

11. Lamacoid nameplates installed on “main” service entrance switches, or “main” entrance switchboards to indicate the following information on minimum size 6" x 2" plate complete with two lines of 1/2” high lettering. Size #8 nameplate.

    Example:

    F200-SBX04-CB004
    MAIN BREAKER
    400A/347/600V/Imax=50kA
    FROM: F200-SBX03-TX001

12. Install an additional “lamacoid” nameplate on all, or any piece of electrical equipment, or apparatus (i.e.: main switchgear, switchboard, CDP panels, branch circuit panels, motor control centers, etc.) that may contain overcurrent devices, i.e. circuit breakers and/or fuses, that have been designed for, and incorporate interrupting capacity sized “larger” than 10 kaIC.

    Example:

    Minimum interrupting
    capacity of breakers
    installed in this panel shall
    be greater than 25kaIC.

Minimum interrupting capacity of fuses installed in this MCC shall be greater than 25kaIC.

13. Lamacoid nameplates are to be installed above all types of receptacles and abutted directly to the top of their respective device plates. Identification is to indicate respective panel source complete with associated circuit breaker number(s).
    1. (1/16") thick x (1/2”) high complete with (1/8”) black letters on white face, directly above all flush receptacles. (Plate to be identical width as finish device plate).

    Example:

BBXXXX-CCCDDD -20

14. Lamacoid nameplate(s) for Cable T.V. and voice/data outlets are to be installed above the outlets and abutted directly to tops of their respective cover plates. See Communications Design Guideline for specifics.

15. Allow for forty letters for each lamacoid nameplate.
    1. Lamicoid (1/8”) thick plastic engraving sheet, black letters, white face, for all electrical systems except fire alarm and emergency power systems which shall have white letters on red face.
    2. (1/16") thick nameplates above receptacles as previously indicated, with top left and right corners to be rounded off.
    3. Lettering on lamacoid nameplates shall not “start” or “end” nearer than (3/8”) from either, or both ends of said plates. Size of lettering, including overall lengths of various plates shall be as indicated in the following chart.

	Nameplate Sizes	

Size 1	(3/8” x 2”) 1 line	(3/16”) high letters
Size 2	(1/2” x 3”) 1 line	(1/4”) high letters
Size 3	(5/8” x 3”) 2 lines	(3/16”) high letters
Size 4	(3/4” x 3.5”) 1 line	(3/8”) high letters
Size 5	(1.5” x 3.5”) 2 lines	(1/2”) high letters
Size 6	(1” x 4”) 1 line	(1/2”) high letters
Size 7	(1.5” x 4”) 2 lines	(1/4”) high letters
Size 8	(2” x 6”) 2 lines	(1/2”) high letters

16. Some examples of electrical apparatus that could have (identical types) of removable covers, and will require to have their lamacoid nameplates installed on wall(s) adjacent to control, rather than directly to their covers are the following.
    1. Magnetic starters.
    2. Manual TOL switches.
    3. Magnetic contactors.
    4. Relays.

17. Lamacoid nameplates shall be provided and installed on, or adjacent to, all various systems’ control panels and/or cabinets, etc. complete with information as indicated. Plates are to reflect system’s assigned name, and where applicable, shall also indicate both, designated panel name and associated branch circuit breaker number(s).
    1. Fire alarm panels.
    2. Security (intrusion) panels.
    3. Energy management panels.
    4. Television cabinets.
    5. Communication panels.

18. Control Transformers:

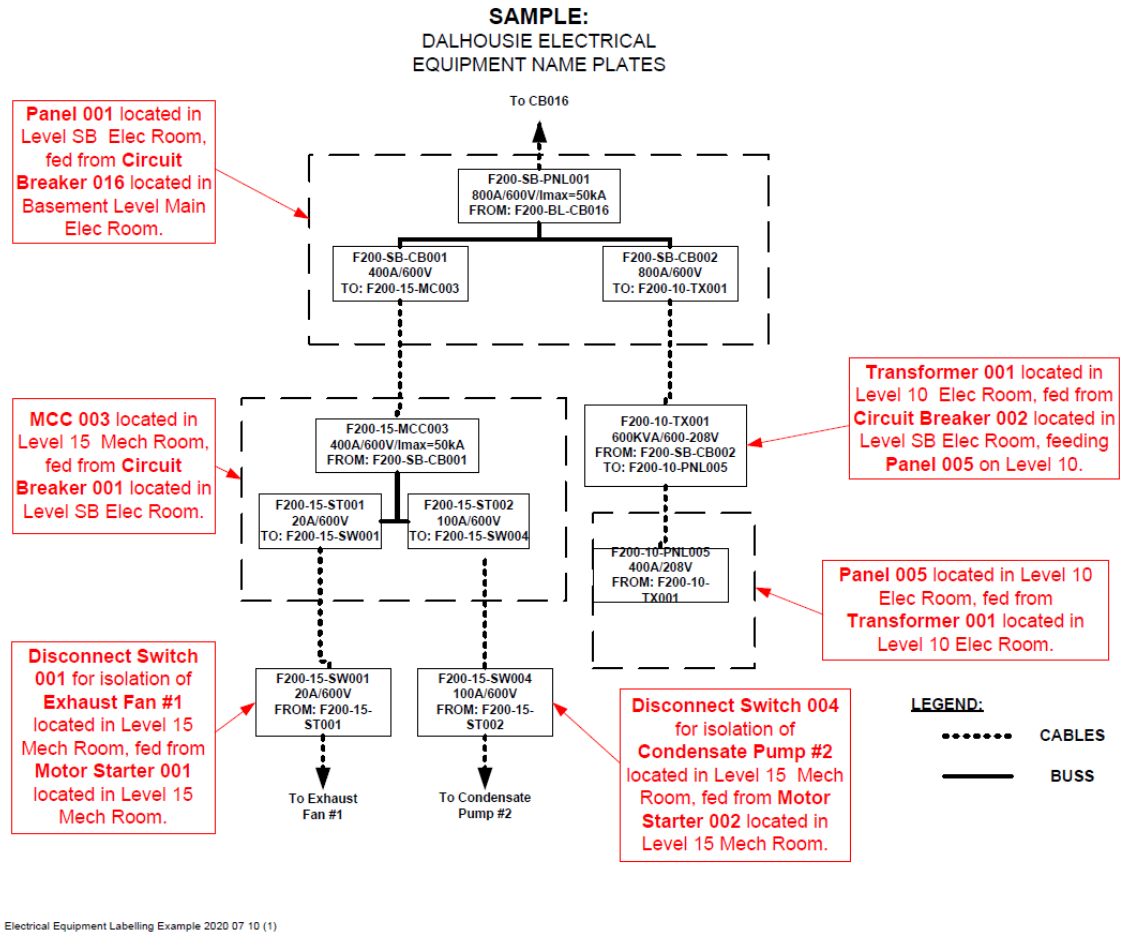
1. Concealed control transformers located within ceiling spaces are to have lamacoid nameplates installed adjacent to same indicating their identified system, primary power source including designated panel name, and associated branch circuit breaker number(s).
2. A second plate with identical information is to be installed on underside of room grid system or access opening frame so as to identify concealed location of same control transformer.
3. All control transformers installed in control cabinets, and/or on walls adjacent to same, are to be identified with lamacoid nameplates containing information as previously indicated.

19. Schedules shall be installed on the back of each door for panels, neatly arranged and mounted in frame under transparent cover. Schedules shall show system voltage, which outlets are on each circuit, location of outlet, and any special information necessary. Schedules shall be typewritten and of a permanent nature.

20. All various pieces of mechanical equipment are to be identified with identical information as indicated on electrical equipment nameplate feeding same mechanical equipment.

21. Where fire alarm devices (duct type smoke detectors, relays, zone modules, etc.) are located above finished ceiling systems a lamacoid nameplate shall be located directly below the device indicating type and address.

FA: Relay Module ADD: 0105



Electrical Equipment Labelling Example 2020 07 10 (1)

EQUIPMENT NUMBER FORMAT AAA-BBXXXX-CCCDDD	EXAMPLES C260-BT-CB003 = Circuit Breaker #3, Basement Level, Dunn Bldg
AAA = Dalhousie Building Code	C260 = Dunn Bldg F200 = Tupper Bldg J100 = C Bldg
BB = Floor Number	Should Mimic Building Floor Designations SB = Sub-Basement Level BL = Basement Level GL = Ground Level ML = Mezzanine Level 01 = Level 1/1st Floor 02 = Level 2/2nd Floor 10 = Level 10/10th Floor PH = Penthouse Level
XXXX = Room Number	If it exists, this would be the room number without duplicating the floor number. Example: Tupper building - Sub-basement - Room SBB10 Example: F200-SBB10-SP001
CCC = Equipment Type	2 or 3 Characters In Length CB = Circuit Breaker ESP = Essential Services Panel FS = Fuse EG = Emergency Generator MCC = Motor Control Centre MS = Motor Starter PNL = Electrical Panel SP = Splitter SW = Switch (Fused or Unfused) SWG = Switchgear ATS = Auto-Transfer Switch TX = Transformer VFD = Variable Frequency Drive UPS = Uninterruptable Power Supply EX1 = Exit sign, with battery EX2 = Exit sign, without battery EL1 = Emergency light, with battery EL2 = Emergency light, without battery Should specific equipment not be in the list above,

	the designer shall make a request of the Project Manager for a new acronym.
DDD = Sequential No. for Equipment Type	001 - 999

26 05 00 2.7 Wiring Identification

1. Labeling of all branch circuit phase and neutral conductors to be done on both ends of all circuit conductors plus in “all” junction and/or pull boxes located in between. Use write-on, selfLife laminating labels sized as necessary. To be installed in a “flagged” manner around individual conductor(s).
2. Indicate panel and circuit number of all phase conductors i.e.: "Panel "A" - cct 3". Identify all neutral conductors bonding and ground conductors to indicate the phase conductor with which they are associated.
3. Earthing and Grounding Cables: To indicate to which equipment they are connected to (i.e. MCC-1)
4. Color code: to CSA C22.1.

   All of the following conductors are to have their insulation colors identified as indicated:

Phase A	Red
Phase B	Black
Phase C	Blue
Neutral	White/Grey
Bond	Green
Ground	Green
Isolated Ground	Green c/w Yellow Strip

   1. Color code conductor insulation and others as per the following:
      1.1. All sizes of phase conductors up to and including #2 AWG.
      1.2. All sizes of neutral, bond and/or ground conductors, up to and including #3/0 AWG.
   2. Approved colored tapes in lieu of insulation coloring may be used to identify conductors that exceed sizes as indicated above, and is to take place on both ends of runs for a minimum of 300 mm or 12" from where terminations take place.
5. Underground Cables: Cable markers to be tied to cable ends indicating (From source – To Destination and type of cable) (i.e. MV- from H Hall Elect Vault – To NAB Elect Vault)
6. Use colour coded wires in communication cables, matched throughout system.

26 05 00 2.8 Conduit & Cable Identification

1. Cover plates for junction and/or pull boxes located above finish ceilings housing branch circuits are to have panel and each branch circuit number neatly identified on cover plate. Felt marker-pen may be used for this purpose.
2. All junction and/or pull boxes, conduit fittings (and covers), etc., complete with their respective cover plates are to be color coded as per the following:

Various System	Primary [3/4" Disc]	Auxiliary [1/4" Disc]
241 to 600 volts	Orange	
51 to 240 Volts	Yellow	
Fire Alarm	Red	
Telephone	Black	
Security	Brown	
Ground or Bond	Green	
Cable Television/CCTV	Yellow	White
Energy Management	Red	White
Computer	Black	White
Data	Blue	White

Boxes are to be colored both inside and outside, where "one" color only is required. Boxes are to be colored on inside only where "two" colors are required. Metal cover plates are to have both colors applied diagonally where "two" colors are required. Complete plate is to be painted where one color only is required.

3. When specifying to paint conduits and junction boxes to match the wall colour, the above elements shall still be painted according to the colour coding.

4. Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 50" intervals.

5. All various systems concealed junction and/or pull boxes located within ceiling spaces are to have their locations identified on room side of T-bar grid spline or access cover frames with appropriate color coded, circular shaped, self-adhering discs. Discs are to be both, (¾") and (¼") in diameter, as described in the above legend, with (¼") discs being centered in the middle of (¾") discs.

6. A legend of color coding used is to be provided under plexiglass and located in the main electrical room, (24" x 24") minimum size frame.

7. Manhole Covers: Use Metallic Label to identify type of service inside manhole

26 05 14 Power Cable and Overhead Conductors (1001 V)

1. All underground duct banks, carrying cables over 750V, shall be encased in concrete and supplied with 100% spare conduit(s).

2. All cables over 750V shall be installed in Rigid Galvanized Steel Conduit indoors.

3. All cables rated for system voltage of 4160V and above shall be tested by VLF – Tan Delta when installed. The reports shall be submitted to the Electrical Planning Engineer. The reports must include the test location, configuration and settings so that the test can be duplicated at a future date.

26 05 20 Wire and Box Connectors (0-1000 V)

26 05 21 Wires and Cables (0-1000 V)

1. All electrical cables are to be copper conductor. Neutral conductors are to be oversized where significant third harmonic generating equipment is to be installed.

2. NUAL is not acceptable.

3. All electrical cables are to be installed in Electrical Metallic Tubing (EMT) or Rigid galvanized steel conduit, sized to allow for 30% spare capacity. The spare capacity does not replace the

code fill requirements. The requirement is that after the installation the University can add 30% more and stay within the code fill requirements.

3.1. Acceptable Exceptions:
- 3.1.1. Cable Tray for power, low voltage or communication cables. Multiples of low voltage and communication cables are permissible in the same tray with a physical barrier between, not power cables.
- 3.1.2. Flex Conduit in cavities and as a final connection to equipment
- 3.1.3. Armoured Cable from centrally located junction boxes to final equipment connections.
- 3.1.4. J Hooks for low voltage or communication cables from main raceways to final connections
- 3.1.5. Free air secured to permeant building structure for low voltage or communication cables in ceiling plenums or open ceilings. Cables are not to be supported from mechanical or electrical infrastructure.
- 3.1.6. Low voltage controls wiring to be run free air in ceiling spaces. Wiring must be in J-hooks and or neatly tie wrapped to permanent building structure above the ceiling space. Controls wiring to be in armored flex inside walls. Controls wiring to be installed in EMT in mechanical or electrical rooms.
  - 3.1.6.1. Low voltage cables and Network cables in walls may be unarmored.

4. Power & lighting loads are permitted to have a common neutral for up to three circuits.
   - 4.1. Exceptions being that circuits intended to service specialized equipment such as that used in research are to have dedicated circuits including its own neutral.
   - 4.2. Common neutral sizing rational shall be documented in the Basis of Design

26 05 22 Connectors and Terminations

26 05 27 Grounding – Primary

26 05 28 Grounding – Secondary

26 05 29 Hangers and Supports for Electrical Systems

1. All supports and hardware (including but not limited to hangers, racks and fastenings) shall be galvanized. Stainless steel supports and hardware shall be specified for exposed exterior, wet environment.

26 05 31 Splitters, Junction, Pull Boxes and Cabinets

1. Junction boxes for parking garage lighting and electrical installations to be flush mounted and installed prior to concrete pour.

2. Enclosures, panels and junction boxes in exterior, wet, or corrosive environments shall be stainless steel and rated for such environments.

26 05 32 Outlet Boxes, Conduit Boxes and Fittings

1. All service areas (electrical, mechanical, custodial rooms) shall have stainless steel face plates on all outlets. For surface mounted boxes use flush fitting plates to avoid a cutting hazard.

26 05 33 Raceway and Boxes for Electrical Systems

26 05 33.01 Surface and Lighting Fixture Raceways

26 05 34 Conduits, Conduit Fastenings and Conduit Fittings

1. Use of EMT as a bond. This is not permitted.

2. Conduit sleeves in concrete slabs are to protrude 53mm (2 inches) above slab.

26 05 36 Cable Trays for Electrical Systems

26 05 37 Wireways and Auxiliary Gutters

26 05 38 Cellular Metal Floor Raceway Fittings

26 05 39 Underfloor Raceways for Electrical Systems

26 05 43.01 Installation of Cables In Trenches and In Ducts

1. All electrical cables operating above 600V shall be in a concrete encased ductbank for buried trenches or ducts.

26 05 80 Fractional Horsepower Motors

26 05 81 Motors: 0.746 To 149 Kw

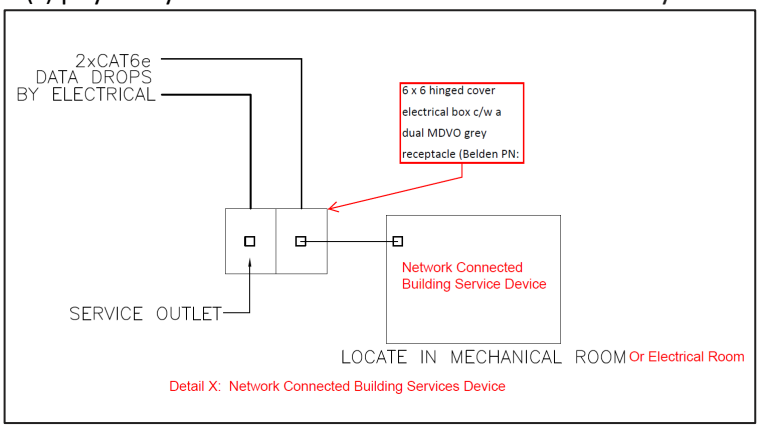
26 06 31 Diesel Electric Generating Units Appendix A - Technical Data Form

26 09 23.01 Metering and Switchboard Instruments

1. All utility expenditures in new buildings shall be metered and connected via electronic data conversion to the applicable University Electrical Power Metering Monitoring (Schneider Electric, Power Monitoring Expert [PME]), University Building Management and Control System (Johnson Controls Metasys or Delta EnteliWEB) and the University's Energy Management Information System (EMIS).

2. These are the units and their compulsory units of measurement;
   2.1. Electricity Demand Kilowatts kW
   2.2. Electricity Consumption Kilowatt hours kWh

3. Applications
   3.1. Electricity
   3.2. ION meter(s) physically installed and connected to the University Network via:



   3.2.1. ION meter added to Schneider SQL server
   3.2.2. C&E finds the ION meter and adds to EMIS (Creates Entelliweb BACnet points for kW & kWh)
   3.2.3. JCI (Metasys) finds the points in the C580-B600-ebMGR01 location and adds to Metasys
      3.2.3.1. All current electrical meters (in Metasys) are found at: NAE-10>Bacnet IP1>C580-B600-ebMGR01.

4. Electrical energy metering shall be included on the building primary distribution switchboard to measure total electrical demand and monitor power quality.

5. Power Measurement ION Meter shall be Dal's standard with three element metering (i.e. 3PTs & 3CTs) and shall be used as indicated below:
   5.1. Main building service within one of the University's electrical networks shall have an ION PM9000 meter.
   5.2. All submetering within a building shall be an ION PM8000 meter.

6. All metering within a building shall be supplied with:
   6.1. 2 x 4-20ma analogue inputs.

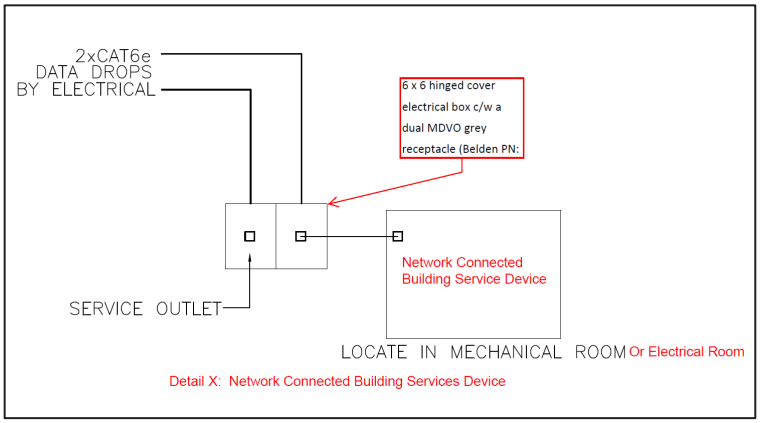
6.2. 1 x Ethernet port.
6.3. Power supply fused terminal blocks.
6.4. CT and PT shorting blocks.

7. Where there is a generator there shall be a meter on the load side of each transfer switch. The power supply for these meters shall be provided by the essential power distribution system.

8. Where the electrical service is directly connected to NSPI's system, a standard meter base will be provided by the construction contract and the University will make arrangements with NSPI for an ION 8650A meter in lieu of NSPI's standard meter. In addition to the Dal required network cable, this meter shall have a dedicated telephone line, installed in conduit to the metering cabinet, to allow NSPI to remotely interrogate the meter.

9. Main service CTs shall always be revenue grade multi ratio. Minimum of four ratios, the minimum being ¼ of the service size. Specify current transformers are to meet Measurement Canada Revenue grade specifications.

10. For all new meter installations an Ethernet line shall run, in EMT, from the nearest available Dalhousie data network switch to a 6 x 6 box with the contents as per the below diagram. Dalhousie's Network Group will terminate the Ethernet line. An Ethernet cable with male connectors will be run in EMT from the network port in the box to the meter cabinet to allow connection to the meter's Ethernet port.



11. When a new meter is being installed but existing switchboards are not being replaced, the ION meter will be provided by the supplier already installed in self-contained metal metering cabinet that can be mounted on a wall or surface mounted on the existing switchboard.

12. Special Procedures for Third Party Equipment Integration Into Campus BMS:
    12.1. Division 01 35 13.01 to 13.03 deals with third party equipment that has a microprocessor based controller whose information is to be integrated into the campus' Building Management System (BMS); Johnson Controls Metasys for Halifax campuses and Delta Controls enteliWEB for Bible Hill. The mechanical and/or electrical consultant are responsible to identify equipment that is to be integrated and make reference to these three Division 1 sections in that equipment's specification section so M&E suppliers do not miss this critical information.

13. In each equipment's specification section the consultant shall;
    13.1. Identify the objects that are to be integrated for the equipment that the design is based on.
    13.2. Preceding the list shall be a statement of "including but not limited to. The owner reserves the right to modify the list if the equipment supplied is different than that which the design is based on, or the software that the design is based on has changed, or during the mockup information provided during the design is inconsistent with what comes through the integration."

14. In the Shop Drawing section include the statement:
    14.1. At the supplier's cost, including that of the Campus BMS Company, Supplier must install/mock up a live installation and integrate it into the Campus BMS to demonstrate that it meets the BACnet specification. Failure to integrate successfully will result in rejected shop drawings.

15. Process for defining objects to be integrated:
    15.1. BMS Contractor will work with the Consultant and the University to:
        15.1.1. Obtain the object list from the University's inventory of previous integrations
        15.1.2. For Equipment / Systems not previously integrated, Building Management System (BMS) Contractor shall facilitate the following process and when

completed, turn over to the University the outcomes for archiving and future implementation.

15.2. Obtain from the Equipment / System supplier a summary of what information can be integrated complete with detailed descriptions of what each piece of information means.

15.3. Obtain from the Equipment / System supplier the Sequence of Operation for each System that is to be integrated.

15.4. The University will review Items 1 & 2 and advise BMS Contractor what is to be integrated and displayed on Graphics.

15.5. If BMS Contractor needs to integrate more information than requested by the University, it shall be placed in the All Items Tab of the BMS.

15.6. Facilitate and participate in joint training with the supplier for the Integrated Equipment / System to ensure what was integrated is understood, appropriately documented and displayed in the BMS.

The above process shall apply for any firmware/software changes to previously integrated equipment. In this case, only the 'changes' are to be submitted for the University's consideration.

26 09 23.02 Lighting Control Devices – Photoelectric

26 09 23.03 Lighting Control Devices - Incandescent Dimming

26 09 23.04 Lighting Control Devices - Fluorescent Dimming

26 09 24 Lighting Control Devices - Low Voltage

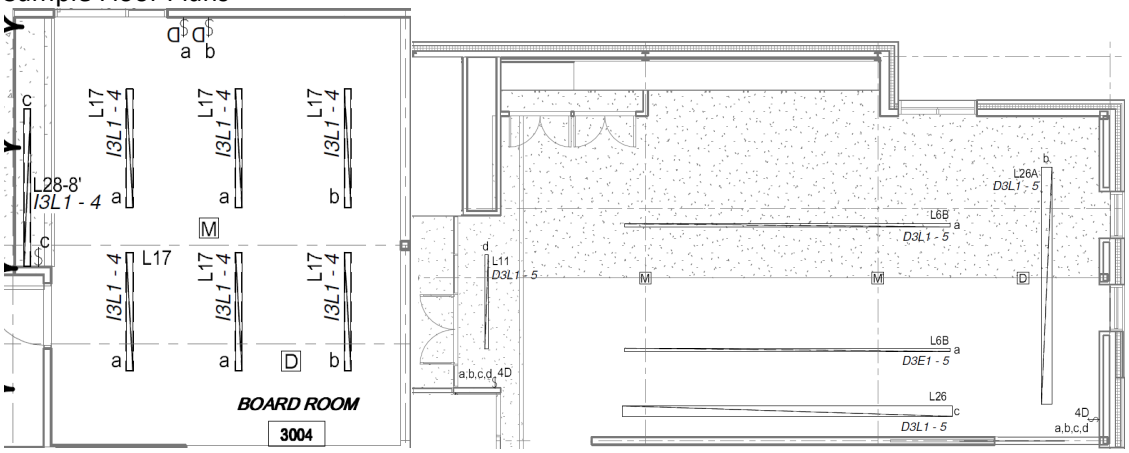
1. Lighting floor plans to have lower case letter designations on switches, light fixtures, occupancy sensors, and daylight harvesting sensors for zoning. Where more than one lighting relay is used to control fixtures of a specific zone, those relays and fixtures are to have a further numerical designation. For example; a1, a2, a3 if there are three relays for zone a. In single zone/room applications, the first letter shall always be 'a'. Final labelling to be assigned by the engineer at the shop drawing review stage.

Sample Legend:

ELECTRICAL LEGEND

$^{\#D}$	SINGLE-GANG, MULTI-ZONE LOW VOLTAGE (NETWORK) 0-10V DIMMER SWITCH. '#' INDICATES QUANTITY OF ZONES CONTROLLED. MOUNTED 42" AFF..
M	LOW VOLTAGE (NETWORK) OCCUPANCY SENSOR. CEILING MOUNTED UNLESS INDICATED OTHERWISE.
D	LOW VOLTAGE (NETWORK) DAYLIGHT SENSOR. CEILING MOUNTED UNLESS INDICATED OTHERWISE.
a b	'a', 'b', ETC INDICATES SWITCHING, CONTROL OF FIXTURES.
L3 a / L1 a	LIGHTING FIXTURES – MOUNTED AS INDICATED. UPPER CASE LETTER INDICATES TYPE. LOWER CASE LETTERS INDICATES SWITCHING. SEE LIGHTING FIXTURE SCHEDULE FOR DESCRIPTION
L7 a	LIGHTING FIXTURE – MOUNTED AS INDICATED. UPPER CASE LETTER INDICATES TYPE. LOWER CASE LETTER INDICATES SWITCHING. SEE LIGHTING FIXTURE SCHEDULE FOR DESCRIPTION
A a / A a	LIGHTING FIXTURES – WALL MOUNTED. UPPER CASE LETTER INDICATES TYPE. LOWER CASE LETTER INDICATES SWITCHING. SEE LIGHTING FIXTURE SCHEDULE FOR DESCRIPTION.
$	SINGLE GANG ON/OFF SWITCH – MOUNTED 42" A.F.F.
D a	DIMMER SWITCH – MOUNTED 42" A.F.F. TYPE TO SUIT LIGHTING FIXTURE BEING CONTROLLED. LOWER CASE LETTERS INDICATES SWITCHING.
OC a	OCCUPANCY SENSOR – CEILING MOUNTED. LOWER CASE LETTERS INDICATES SWITCHING.
OC a	OCCUPANCY SENSOR – WALL MOUNTED. LOWER CASE LETTERS INDICATES SWITCHING.
DL a	DAYLIGHT SENSOR – CEILING MOUNTED. LOWER CASE LETTERS INDICATES SWITCHING.

Sample Floor Plans



Final Legend & floor plan configurations to be approved by the University Project Manager.

26 09 24.1 Exterior Lighting Control Devices - Low Voltage

On an “Exterior Lighting Control” graphic, for each exterior lighting zone, provide the following objects in a dialog/dropdown box:

<Exterior Zone Description>	
Central Services Building Photo Cell	Day / Night
Zone X Astrological Clock	Day / Night
Lighting Control Relay Output	On/Off

The lighting Control Relay would control the Lighting Control Contactor, that is to have a Hand-Off-Auto switch , which is to remain in Auto for operation and Hand can be used for testing.

Via the Astrological Clock Object (or the Metasys Solar Clock Object) the zone-specific object can be tuned for pre/post sunrise/sunset adjustments.

Programming:

A single Photocell (fail closed and installed on the North Side of the CSB) is installed and connected to the BMS

This is the first indicator for lights ON or OFF.

The second indicator for lights ON or OFF is an Exterior Lighting Zone specific Metasys Astrological/Solar Clock Object for each exterior lighting relay/contactor. This is so the exterior lighting zone can be tuned for its specific requirements in terms of advanced action prior to scheduled Sunset or after scheduled Sunrise.

A Metasys Digital Output Relay shall be wired to the auto side of the exterior lighting contactor’s Hand/Off/Auto switch.

The Metasys relay shall turn the exterior lights ON based on the Photocell or Clock, which ever triggers first. It shall turn the lights OFF based on the Clock.

If the photocell is ON continuously for greater than 24 hours, a Metasys Alarm shall be generated indicating that maintenance/repair is required.

Astrological/Solar Clock Object:

Location:

GMT	-4
Longitude	63° 35’16.29” W or -63.587812°
Latitude	44° 38’11.10” N or +44.636373°

Offset:

Defines an offset to the computed Sunrise and Sunset times. The offset value is used to compute Present Value. A positive value makes the day longer and a negative value makes the day shorter for ‘both’ sunrise & sunset times.

Initially; -30 minutes for each zone. Meaning if raw calculation Sunrise = 07:00, then offset makes Sunrise = 07:30 (shorter day), if raw calculation for Sunset is 19:00 then offset makes Sunset 18:30 (shorter day)

26 09 43 Network Lighting Controls

1. All new buildings shall have a low voltage Lighting Control System (LCS) that includes occupancy controls. Remote dimming can be used in specialized rooms such as those with audio visual equipment. All rooms with remote dimming must be approved by the Project Manager.

2. Daylight harvesting shall be utilized on a room by room justification basis as approved by the Project Manager. Day light harvesting is only to be provided in public, large spaces. None shall be provided in private offices or lab spaces.

3. In certain instances the lighting control system shall be network based, including but not limited to:
   3.1. Research facilities
   3.2. Others as approved by the Project Manager based on space utilization forecasting.

4. Any networked LCS shall be integrated with the Building Management System (Johnson Controls “Metasys”)

5. Any unshielded twisted pair (UTP) cable used by the LCS for non-Dalhousie network purposes shall be green colour.

26 11 00.01 Outdoor Substation To 15 Kv

26 11 13.01 Unit Substation To 15 Kv

26 12 13 Liquid Filled, Medium Voltage Transformers

26 12 16 Dry Type, Medium Voltage Transformers

Medium voltage (Primary voltage from 4.16kV to 25kV) dry type transformers shall be equipped with:

1. IR windows to allow for both HV and LV terminals to be scanned while energized.
2. Temperature monitoring with local and remote signaling capabilities (standard of acceptance: Qualitrol or equivalent in the opinion of the Electrical Planning Engineer).
3. Fans and controls for cooling should the ambient temperature exceed the nameplate rated temperature, and to provide additional capacity.

26 12 16.01 Dry Type Transformers Up To 600 V Primary

26 12 16.13 Pad-Mounted, Dry-Type Transformers for Airfield Visual Aids

26 12 19 Pad Mounted, Liquid Filled, Medium Voltage Transformers

Medium voltage (Primary voltage from 4.16kV to 25kV) dry type transformers shall be equipped with:

1. IR windows to allow for both HV and LV terminals to be scanned while energized.

2. Dal owned pad mounted liquid filled transformers shall have a kirk-key interlock with the upstream disconnect switch to prevent access to the termination section when energized. This requirement does not apply to NSP owned pad mount transformers.
3. Separate enclosure to house the oil temperature and level gauge.
4. Separate enclosure to house the oil drain with sampling port.
5. Both separate enclosures shall have appropriate rating for outdoor equipment exposed to all environmental elements common to the area and shall have a lockable handle.

26 12 21 Transformer Vault Equipment To 15 Kv

26 13 01 Isolating Switches To 15 Kv

26 13 16 Medium-Voltage Fusible Interrupter Switchgear

26 13 18 Primary Switchgear Assembly To 27 kV

Medium voltage (Primary voltage from 4.16kV to 25kV) primary switchgear assemblies to 27kV shall be equipped with:

1. IR windows to allow for HV terminals to be scanned while energized.
2. The main breaker shall be equipped with remote tripping.
3. The control power shall be supplied from a 125Vdc system.
    a. A valve regulated lead acid battery, a charger and a 125Vdc panelboard shall be provided for the switchgear trip, close protective relay power and metering.
4. Breakers in 25kV, 4.16kV and 600V switchgear, shall maintain the closed position during a power outage.
5. .

26 18 26 Medium Voltage Reclosers

26 18 39.01 Motor Controllers - 2000 To 5000 V (Non-Hazardous)

26 18 41 Interlock Systems

1.

26 22 19 Control and Signal Transformers

26 23 00 Low Voltage Switchgear

26 24 01 Service Equipment

26 24 02 Service Entrance Board

1. All service entrance boards shall have Long Short Instantaneous & Ground (LSIG) protection on the main breaker (regardless of amperage rating).
2. See 26 09 23.01 for metering requirements.

26 24 13 Switchboards

26 24 13.01 Generator Switchboard To 600 V

26 24 13.02 Generator Switchboard Over 600 V

26 24 16.01 Panelboards Breaker Type

3. Breaker panels are to be equipped with:
   3.1. main breaker
   3.2. 25% spare breakers installed
   3.3. space for an additional 25% more breakers

4. 600 V and above Electrical panels and equipment must be installed in dedicated walk in electrical rooms and should not be combined with a mechanical room. Electrical panels and equipment is not to be installed in custodial or other closets. Motor Control Centers are an exception and should be installed in mechanical rooms with their associated motors.

5. All floor mounted panels and equipment must be mounted on 53mm (2 inch) concrete housekeeping pads.

6. Feed thru lugs shall not be used.

26 24 16.02 Panelboards Switch and Fuse Type

1. This type of configuration is not permitted.

26 24 19 Motor Control Centres

26 25 00 Enclosed Bus Assemblies

26 27 10 Modular Wiring System

26 27 16 Electrical Cabinets and Enclosures

26 27 19 Multi-Outlet Assemblies

26 27 23 Indoor Service Poles

26 27 26 Wiring Devices

26 27 73 Door Chimes

26 28 13.01 Fuses - Low Voltage

26 28 13.02 Outdoor Load Break Switches and Fuses

26 28 16.01 Air Circuit Breakers

26 28 16.02 Moulded Case Circuit Breakers

26 28 18 Ground Fault Equipment Protection

26 28 20 Ground Fault Circuit Interrupters - Class A

26 28 22 Load Break Switches

26 28 23 Disconnect Switches - Fused and Non-Fused

1. HVAC Primary Equipment
   1.1. When a VFD is applied, the University desires it to have an integral, lockable, disconnect switch and that it be installed in the same room and within eyesight of the equipment that it services.
   1.2. In the event that this is not possible, a remote disconnect switch adjacent to the equipment, with position feedback to the VFD (via a “make before break type auxiliary contact), will be considered on a case by case basis, as part of the original design. Further, this remote disconnect switch is to have the following lamacoid label – “Ramp Down to Off the VFD Prior to Opening” on its cover.

2. The University does not want:

2.1. VFDs, or equipment installed starters, fed from a MCC. This simply adds cost and complication.
2.2. The VFD should be fed from a breaker.

3. HVAC Terminal Equipment with Electrical Componentry
3.1. Each terminal unit shall have its own dedicated breaker, where practical.
3.2. Each terminal unit shall have a lockable disconnect switch on the equipment. If this is not feasible, then have the lockable disconnect switch within eyesight of the equipment. If neither is feasible and the lockable disconnect switch is to be located in another room, ensure that mechanical & electrical trades have access to the room.
3.3. Each terminal unit shall have thermal overloads and current overloads built into the circuitry for circuit protection

26 29 01 Contactors

26 29 02 Fire Pump Control

26 29 03 Control Devices

26 29 10 Motor Starters To 600 V

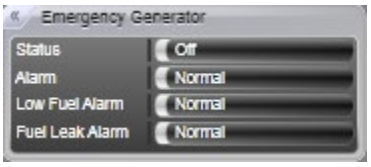
26 32 13.01 Power Generation Diesel

26 32 13.02 Power Generation To 30 Kw

26 32 13.03 Installation of Electric Power Generating Equipment

1. Where an emergency generator is required, the unit shall be configured as follows:
1.1. The generator shall be sized for 80% of the design connected load.
1.2. The generator shall be commercial or industrial grade (No Residential or Residential grade generators).

1.3. The generator shall be a standalone, noise abated, and fully enclosed outdoor unit.
1.4. The generator and any associated equipment shall be secured by a 1.83 m (6 foot) high fence.
1.5. A fuel tank having capacity to supply the generator at 80% of full load for 24 hours. The fuel tank shall have ability to be refueled as the generator is running. This timeframe is to be identified to the client of each project for their, in advance of tendering, agreement. Variances must be approved by the AVP Facilities Management.
1.5.1. Generators for residences must have a fuel tank capacity to supply the generator at 80% of full load for 48 hours.
1.6. Fuel Type listed in order of preference:
1.6.1. Natural Gas (NG) when the generator has been located near a NG source.
1.6.2. Diesel
1.6.3. Propane for a generator less than 50kW and only when approved by the Project Manager.
1.7. Equipped with a non-corrosive service platform(s) for maintenance purposes, which allows safe access to all devices in the main control cabinet.
1.8. Equipped with onboard output breaker(s) (house & fire pump, if applicable) that can be locked in the open position for maintenance purposes.
1.9. Capable of sharing the following information electronically with the Building Management System:



2. The following loads, as a minimum, shall be connected to emergency power:
2.1. Residences to have full back-up power.
2.2. If emergency power is available:
2.2.1. All life safety equipment.
2.2.2. IT networking equipment. In addition, the network switches shall have a UPS with a minimum of 30 minute run time.
2.2.3. Elevators.
2.2.4. Central emergency lighting systems with batteries and inverters.

26 32 13.04 Diesel Electric Generating Units (Liquid Cooled)

26 32 13.05 Diesel Electric Generating Units (Air Cooled)

26 32 13.07 Diesel Electric Generating Units Appendix B Factory Test

26 33 16 Battery Racks

26 33 43 Battery Chargers

26 33 44 Electric Car Charging Stations

1. A Level Two charging station is the acceptable Dalhousie standard, with input voltage 208/240VAC, and input current of 50A.

2. Charging stations shall not be attached to exterior building walls.

3. Retractable cords are preferred for indoor stations.

4. Retractable cords are not permitted for outdoor stations.

5. All cord lengths must be 5m.

26 33 53 Static Uninterruptible Power Supply

26 33 54 Hospital Operating Rooms Isolated Power Supply

26 35 33 Power Factor Correction Equipment

26 36 23 Automatic Transfer Switches

1. Automatic transfer switches shall be configured as follows:
   1.1. Equipped with an external bypass to allow periodic maintenance or replacement. Interlocking between bypass circuit breakers shall be provided (eg: Kirk-Key).
   1.2. An ION submeter will be installed on the load side of each transfer switch.
   1.3. Equipped with dedicated lockable circuit breaker on the normal supply, emergency supply, and load.

26 41 00.01 Primary Lightning Arresters

26 41 00.02 Secondary Lightning Arresters

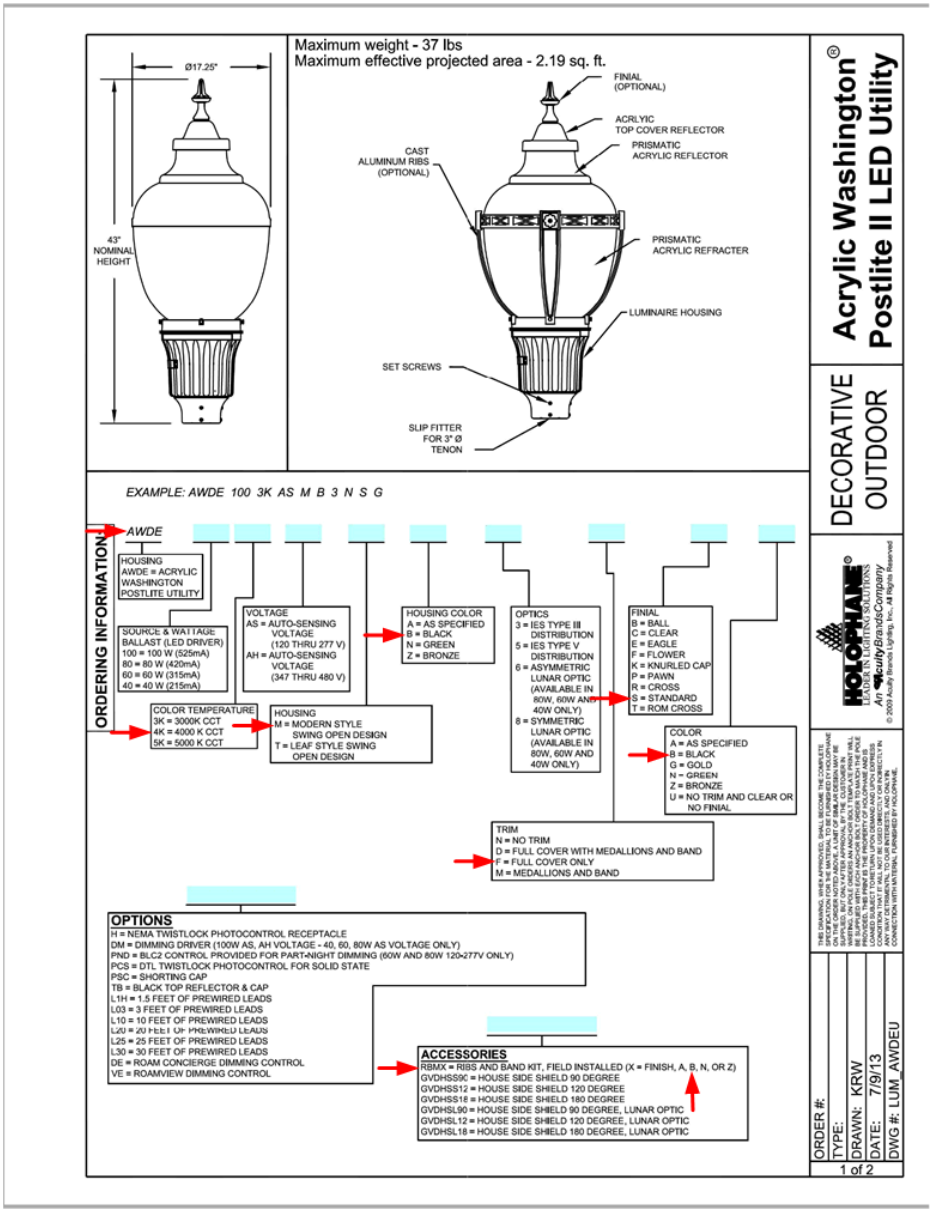
26 41 13 Lightning Protection for Structures

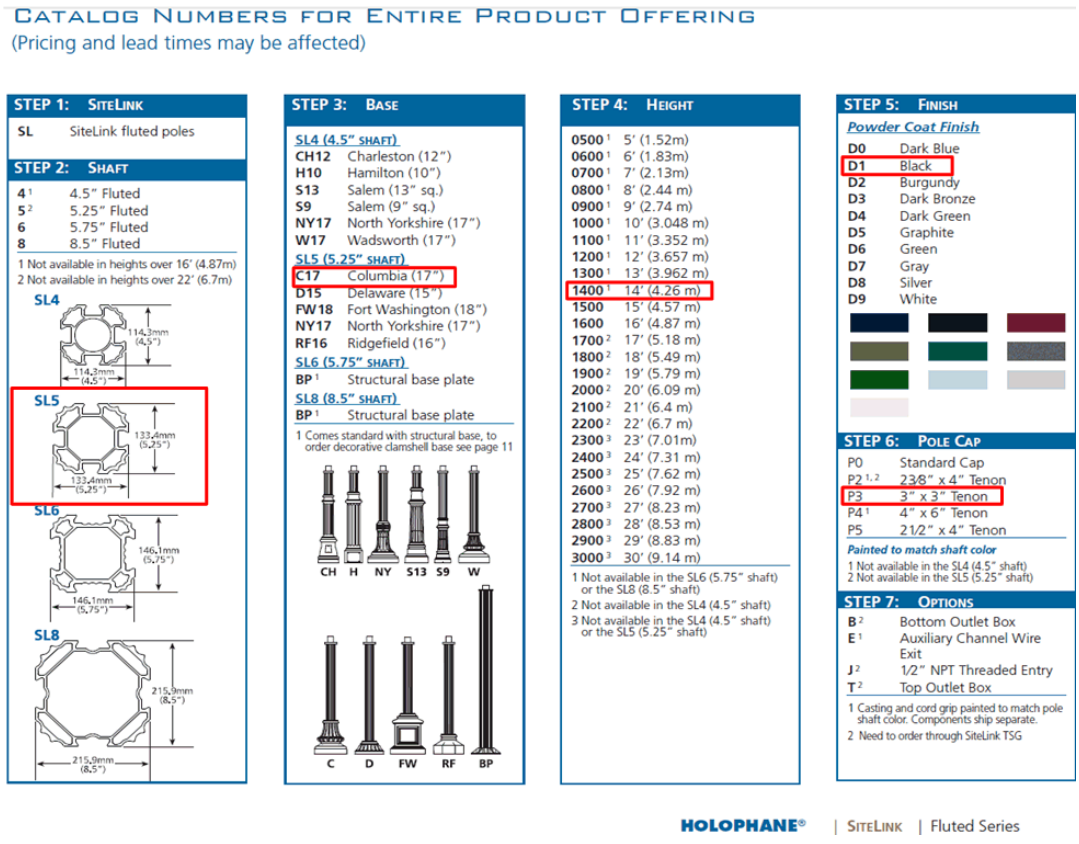
26 42 00 Cathodic Protection

26 42 00.01 Telethermics - Cathodic Protection

26 50 00 Lighting

1. All exterior building lighting will utilize high efficiency LED fixtures.
   1.1. On all campuses, lighting for all driveways, walkways, parking areas, shall be antique style equipped with LED fixtures and frosted lenses. The Dal standard consists of:
   1.1.1. "Holophane Washington Postlite Utility" AWDE model LED fixture fitted with the with options as noted in sketch 16.4.1-1a & 16.4.1-1b;





CATALOG NUMBERS FOR ENTIRE PRODUCT OFFERING
(Pricing and lead times may be affected)

STEP 1: SITELINK

SL	SiteLink fluted poles

STEP 2: SHAFT

4[1]	4.5" Fluted
5[2]	5.25" Fluted
6	5.75" Fluted
8	8.5" Fluted

1 Not available in heights over 16' (4.87m)
2 Not available in heights over 22' (6.7m)

SL4
114.3mm (4.5")
114.3mm (4.5")

SL5
133.4mm (5.25")
133.4mm (5.25")

SL6
146.1mm (5.75")
146.1mm (5.75")

SL8
215.9mm (8.5")
215.9mm (8.5")

STEP 3: BASE

SL4 (4.5" SHAFT)

CH12	Charleston (12")
H10	Hamilton (10")
S13	Salem (13" sq.)
S9	Salem (9" sq.)
NY17	North Yorkshire (17")
W17	Wadsworth (17")

SL5 (5.25" SHAFT)

C17	Columbia (17")
D15	Delaware (15")
FW18	Fort Washington (18")
NY17	North Yorkshire (17")
RF16	Ridgefield (16")

SL6 (5.75" SHAFT)

BP[1]	Structural base plate

SL8 (8.5" SHAFT)

BP[1]	Structural base plate

1 Comes standard with structural base, to order decorative clamshell base see page 11

CH H NY S13 S9 W

C D FW RF BP

STEP 4: HEIGHT

0500[1]	5' (1.52m)
0600[1]	6' (1.83m)
0700[1]	7' (2.13m)
0800[1]	8' (2.44 m)
0900[1]	9' (2.74 m)
1000[1]	10' (3.048 m)
1100[1]	11' (3.352 m)
1200[1]	12' (3.657 m)
1300[1]	13' (3.962 m)
1400[1]	14' (4.26 m)
1500	15' (4.57 m)
1600	16' (4.87 m)
1700[2]	17' (5.18 m)
1800[2]	18' (5.49 m)
1900[2]	19' (5.79 m)
2000[2]	20' (6.09 m)
2100[2]	21' (6.4 m)
2200[2]	22' (6.7 m)
2300[3]	23' (7.01m)
2400[3]	24' (7.31 m)
2500[3]	25' (7.62 m)
2600[3]	26' (7.92 m)
2700[3]	27' (8.23 m)
2800[3]	28' (8.53 m)
2900[3]	29' (8.83 m)
3000[3]	30' (9.14 m)

1 Not available in the SL6 (5.75" shaft) or the SL8 (8.5" shaft)
2 Not available in the SL4 (4.5" shaft)
3 Not available in the SL4 (4.5" shaft) or the SL5 (5.25" shaft)

STEP 5: FINISH

Powder Coat Finish

D0	Dark Blue
D1	Black
D2	Burgundy
D3	Dark Bronze
D4	Dark Green
D5	Graphite
D6	Green
D7	Gray
D8	Silver
D9	White

STEP 6: POLE CAP

P0	Standard Cap
P2[1,2]	23/8" x 4" Tenon
P3	3" x 3" Tenon
P4[1]	4" x 6" Tenon
P5	21/2" x 4" Tenon

Painted to match shaft color

1 Not available in the SL4 (4.5" shaft)
2 Not available in the SL5 (5.25" shaft)

STEP 7: OPTIONS

B[2]	Bottom Outlet Box
E[1]	Auxiliary Channel Wire Exit
J[2]	1/2" NPT Threaded Entry
T[2]	Top Outlet Box

1 Casting and cord grip painted to match pole shaft color. Components ship separate.
2 Need to order through SiteLink TSG

HOLOPHANE® | SITELINK | Fluted Series

1.2. Building, stairway, and bollard mounted exterior lighting shall be full cut-off to avoid light pollution and avoid bright light sources in pedestrian line of site.

1.3. All outdoor area lighting applications are to be controlled by an electrically operated contactor complete with hand-off-auto (HOA) switch.

2. All interior lighting will utilize high efficiency LED fixtures.

2.1. All fixtures shall have the following characteristics:

2.1.1. Dimmable to 10% without tunable features.

2.1.2. a replaceable driver.

2.1.3. 4100 Deg Kelvin for office/classroom/public spaces

2.1.4. 3000-3500 Deg Kelvin for residences

2.1.5. Color Rendition Index (CRI) 80

3. The preferred lighting supply voltage is 120 volts.

4. Location of light fixtures must not interfere with maintenance access of other equipment, and wherever possible should not be located in areas that require mechanical lifts or staging for bulb or ballast replacement.

5. Ceiling lighting in parking garages must maintain, at minimum, 150 mm (6 inches) greater ground clearance than indicated at the garage entrance.

6. All sinks and desk spaces in residence bedrooms, will have separately switched LED task lighting installed directly above.

7. Three-way light switching will be provided for all rooms having two or more entrances

8. Custodial closet lights must be provided with protective cage.

9. Lighting Control
   9.1. Mechanical room lighting control – no occupancy sensors or timers.
   9.2. Stairwell and hallway lighting control – must stay on, may be controlled by occupancy sensors for Occupied (High), Unoccupied (30% adjustable) levels.
   9.3. Existing Building Retrofits:
      9.3.1. Lighting control requirements shall be dealt with on a case by case basis

26 52 00.01 Lighting - Central Emergency System

26 52 13.13 Emergency Lighting

1. Emergency lighting located on designated means of egress routes shall be on self-diagnostic and remote wirelessly monitored battery packs, or a central inverter system. Electrical design engineers shall consult with the Electrical Planning Engineer for direction on which shall be used on each project.
   1.1. Regardless of the chosen system, the installing company shall have a local (within HRM) presence and three years of experience supporting it, including but not limited to all programming.

2. Central battery emergency lighting systems.
   2.1. Each panel shall have an external by-pass switch
   2.2. Shall have a general alarm connected to the building fire alarm panel as a trouble alarm. The fire alarm panel will communicate out, through the dialer, to the 3rd party monitor agent and to the security office that the panel has a trouble.
   2.3. A motion sensor shall not be used to control emergency lighting.
   2.4. Central or mini-inverter emergency lighting systems will be fed from the essential services bus, where there is an emergency generator installed.

3. Self-diagnostics and remote wirelessly monitored battery packs.

   3.1. Should the building not have an existing monitoring system or if the building has more than 200 monitored devices, a new monitoring gateway will need to be added. All gateways shall be hard wired to the Dalhousie network. Refer to section 26 09 23.01 Clause 10 (single cable only).
   3.2. Each device shall be labelled as per guideline section 26 05 00 2.6.
   3.3. Monitoring gateways shall be located in an accessible hallway and above the ceiling. For fixed ceilings, a mechanical hatch shall be installed. Regardless of ceiling type, the ceiling shall be labelled to identify the location of the gateway.

26 52 13.16 Exit Signs

1. Running Person signs only.

2. Photoluminescent signs shall not be permitted.

3. Signs shall be powered by adjacent emergency lighting.

4. In the event of a remote wireless monitoring system, the Engineer shall be responsible for determining if exit signs, powered by 120V with internal battery, will be required for network coverage.

5. Each device shall be labelled as per guideline section 26 05 00 2.6.

26 53 13 Photoluminescent Signage

26 55 36.13 Medium-Intensity (M.I.) Red Flashing Obstruction Lighting

26 55 36.16 Medium - Intensity (M.I.) White Flashing Obstruction Light

26 55 36.19 Low-Intensity (L.I.) Red Obstruction Lighting

26 56 19 Roadway Lighting

31 00.01 Multiplex Fire Alarm System

1. General
   - 1.1. Transmission signals from new fire panels shall be compatible with ULC 561 signaling receiving hardware.
   - 1.2. The transmitting device installed as part of 1.1 shall be via both network & telephone line connect to Campus Security's Receiver and Dalhousie's 3rd party monitoring agent to advise of any signals including but not limited to; alarms, troubles, warnings, others. Contact Dalhousie PM for information regarding the 3rd party monitoring agent.
     - 1.2.1. The contractor shall include one year of monitoring by Dalhousie's 3rd party monitoring agent.
     - 1.2.2. Transmitter shall be DSC NEO.
     - 1.2.3. The data and voice cables shall be installed with mechanical protection. Interlocking armoured cables will be accepted with cables supported from building structures only.
   - 1.3. Acceptable manufacturers shall be (others may be presented to the Project Manager for approval):
     - 1.1.1. Simplex
     - 1.1.2. Edwards
     - 1.1.3. Notifier
   - 1.4. New installations shall utilize active field devices, using analog addressable technology. Full building renewals shall also utilize this technology. If budget permits, renovations shall also utilize this technology.

1.1.4. *The device wiring* shall be configured in a *DCLA* style as defined by CAN/ULC-S524-M91.

1.5. System installation shall conform to the latest edition of CAN/ULC-S524

2. Addressable Fire Systems
   2.1. All fire alarm systems must be addressable to provide for the ability to block operation of individual, or selected groups, of sensors/alarm devices.
   2.2. A fire alarm riser diagram shall be included on the appropriate design drawings and the latest copy of the drawings shall be left at the panel.
   2.3. A Building Directory shall be mounted adjacent to the fire alarm annunciator panel located at the main entrance, which shows the location of all fire exits, fire extinguishers, sprinkler rooms and alarm devices.
   2.4. A list of fire alarm device addresses, complete with locations, shall be provided to Dalhousie Facilities Management, in electronic format (Excel & PDF), and placed within the fire alarm panel, by the Contractor.
   2.5. An identification address label is required at all remote devices connected to the fire panel that matches the address in the fire panel.
   2.6. All fire alarm modules for sprinkler supervision shall be identified as such and labeled appropriately (Refer to Dalhousie University Equipment Labeling Guidelines).
   2.7. All ventilation (intake & exhausts) and gas supplies shall be shutdown when a fire alarm is activated unless deemed required to maintain the building structure.
   2.8. For computer server rooms a pre-action two stage sprinkler system is required.
   2.9. Fire alarm system batteries are to have ten year warranty.
   2.10. Zone and active field device descriptions for annunciation & LCD programming are to be coordinated with Dalhousie.
   2.11. Maglocks will not be permitted to be installed on any exit door.
   2.12. Signalling Appliances: 24VDC, parallel wired. Continuously vibrating bells shall be installed in building with existing vibrating bells. Strobe shall be added throughout the building. Horns shall be used in new buildings and when renewing a building fire alarm system.

3. Fire Alarm Devices
   3.1. For HVAC return ducts, the smoke detector shall be a duct type smoke detector with a sampling tube, such as the Edwards SIGA-SD Intelligent Duct Smoke Detector.

3.2. For combination fire/smoke dampers, a combination fire smoke damper with an integral smoke detector, such as the Price FSD-AF-OW with the Optional Duct Smoke Detector, or a standard fire smoke damper with a field installed spot type smoke detector shall be specified.

4. Motor Controls for Smoke Evacuation Fans and Stair Pressurization Fans
   4.1. In both applications, the motor starter shall not have hand-off-auto capabilities.
   4.2. For each smoke evacuation fan, on-off selector switch, for firefighter manual control, shall be located in the same secure fire alarm cabinet as the fire alarm annunciation panel.
   4.3. For each stair pressurization fan, on-off operation shall ONLY be automatically controlled through a fire alarm system relay. Electrical code requirements shall still be met. All associated disconnect switches shall be secured in the 'on' position using nylon cable ties.