

## **INTEGRATED INFRASTRUCTURE SERVICES**

Facility Engineering Services  
Facility Planning & Design  
Facility Infrastructure Delivery



Edmonton Tower  
10111 - 104 Avenue  
Edmonton, Alberta  
T5J 0J4

# **Facility Design & Construction Consultant Manual**

**Volume 2**

**COE-IM-GUIDE-0002**

**Technical  
Guidelines  
v06**



**Date of Issue: 2025-02-10**



## INTENT OF USE

This section was developed for establishing guidelines for the City of Edmonton expectations in designing their facilities. The greatest care has been taken to confirm the accuracy of the information contained herein. The views expressed herein do not necessarily represent those of any individual contributor. Building and building system design continually evolves, and practices change and improve over time, so it is necessary to regularly consult relevant technical standards, codes, and other publications rather than relying on this publication exclusively. The City of Edmonton, authors, and members of the review committee, want to convey that this document does not constitute a project specific design. As such, no part of this guideline alleviates the responsibility of the professionals retained to design and construct specific projects from taking full responsibility and authenticating their designs in accordance with APEGA, AAA, Alberta Building Code, and any other statutory or safety requirements.

Please note all additions and changes made to the Consultant Manual Volume 2 in this revision have been highlighted in orange.

VER	Date	Revision Summary
06	2025-02-10	Additions / revisions highlighted in orange
05	2021-09-10	Additions / revisions highlighted in green
04	2019-07-26	Additions / revisions highlighted in yellow
<i>Printed or downloaded copies of this document are not controlled and may not be the <a href="#">current version</a>.</i>		



<b>Professional Work Product (PWP) Responsibility Matrix</b>		
<b>Authenticator (Seal)</b>	<b>Validator (Permit)</b>	<b>Section(s)</b>
Structural		4.8 - Building Structure
Mechanical		4.6.10 - Irrigation Systems 4.12.4 - Acoustic Considerations: Mechanical 4.16 - Mechanical 4.19 - Pool Systems and Other Water Treatment 4.20 - Arenas  Appendix A - 1. Mechanical Equipment Appendix G - Gas Detection Guideline Appendix H - Spray Park 1.4.4, 1.8
Electrical		4.12.5 - Acoustic Considerations: Electrical 4.17 - Electrical 4.19.1.29 - Natatorium Lighting 4.19.1.30 - Equipotential Bonding 4.19.1.33.1 - Chlorine Room Hazardous Assessment Appendix A - Section 2 Electrical Equipment Appendix B1 - Standard Network Access Room Layout Appendix C - Security and Card Access System Design Guidelines Appendix C1 - Standard Security Drawings Appendix C2 - Security Specifications Template Card Access Appendix C3 - Security Specifications Template Non-Card Access Appendix D - Video Surveillance System Design Guidelines Appendix F - Fire Alarm Communication Design Guidelines Appendix F1 - Standard Fire Alarm Dialer



		Drawings Appendix G - Guideline for Gas Detection System Sections 2.3.20, 2.4.7, 2.12.9 Appendix H - Spray Park Section 1.4.3, 1.9 Electrical
Electrical		Appendix E - Arc Flash Design Guidelines Appendix I - Electric Vehicle Charger Appendix Ia - Electric Vehicle Charger Drawings Appendix J - Uninterruptible Power Supply Appendix K - Distributed Generator Appendix L - Hazardous Classification Study



# Contents

<b>Contents</b>	<b>4</b>
<b>4. Technical Guidelines</b>	<b>11</b>
4.1. Introduction	11
4.2. General	11
4.3. Definitions	12
4.4. Renewals	12
4.4.1. System Integration	12
4.5. Facility Maintenance	13
4.5.1. References	13
4.5.2. Access, Serviceability and Maintenance Planning	13
4.5.3. Facility Maintenance Equipment Commonly Used:	13
4.6. Site Design	14
4.6.1. References	14
4.6.2. Site Selection	14
4.6.3. Site Access	14
4.6.4. Site Grading and Water Management	15
4.6.5. Roads, Sidewalks, Walkways, Pathways and Parking	16
4.6.6. Utilities	16
4.6.7. Waste	17
4.6.8. Exterior Landscape Development	18
4.6.9. Low Impact Development (LID)	18
4.6.10. Irrigation Systems	18
4.6.11. Interior Landscape Development	19
4.6.12. Plant Maintenance Considerations	19
4.6.13. Site Fixtures, Furnishings and Equipment (FF&E)	19
4.7. Environment	21
4.7.1. References	21
4.7.2. Hazardous Materials	21
4.7.3. Fuel Storage Tanks	22
4.8. Building Structure	22
4.8.1. Design Loads	22
4.8.2. Foundations	23
4.8.3. Structure	23
4.8.4. Coordination with Other Disciplines	24
4.9. Building Envelope	26
4.9.1. References	26
4.9.2. General	26

4.9.3. Envelope Performance Criteria	26
4.9.4. High Interior Humidity	27
4.9.5. Air/Vapour Barrier	28
4.9.6. Insulation	28
4.9.7. Roofs	28
4.9.7.1. References and Related Sections	28
4.9.7.2. General	29
4.9.7.3. Rooftop Work Zones	30
4.9.7.4. Rainwater Leaders:	30
4.9.7.5. Near-Flat Roofs	31
4.9.7.6. Steep Roofs	32
4.9.7.7. Green Roofs	32
4.9.7.8. Equipment on Roofs	33
4.9.7.9. Re-Roofing	34
4.9.8. Exterior Walls	35
4.9.9. Windows, Doors, and Glass	36
4.9.10. Skylights and Sloped Glazing	36
4.9.11. Concealed Spaces	37
4.10. Interior Construction	37
4.10.1. Inclusive Universal Washroom and Change Room Facilities	37
4.11. Furniture, Fixtures, and Equipment (FF&E)	40
4.11.1. Signage	40
4.11.2. Furniture	42
4.11.3. Custodial Fixtures	42
4.12. Building Acoustics	42
4.12.1. References	42
4.12.2. Acoustically Critical Spaces	42
4.12.3. Acoustic Considerations: Architectural	42
4.12.4. Acoustic Considerations: Mechanical	44
4.12.5. Acoustic Considerations: Electrical	46
4.13. Doors and Hardware	46
4.13.1. Coordination with Security	46
4.13.2. Lockset and Keying Standards	46
4.13.3. Door Installation Tolerances	46
4.13.4. Door Naming Convention Standards	47
4.13.5. Door Hardware	47
4.13.6. Maintenance Access Doors	48
4.13.7. Overhead Doors	48

4.14. Millwork	48
4.15. Coatings	49
4.16. Mechanical	50
4.16.1. References	50
4.16.2. General	50
4.16.3. Design Criteria	53
4.16.4. Plumbing	53
4.16.5. Hydronic Systems	56
4.16.6. Heating	57
4.16.7. Cooling	59
4.16.8. Air Handling Systems	60
4.16.9. Variable Frequency Drives	62
4.16.10. Roof Drainage Systems	65
4.16.11. Radon Mitigation	65
4.16.12. Controls	67
4.16.13. Fire Suppression Systems	71
4.17. Electrical	71
4.17.1. References & Client Specific Requirements	71
4.17.2. Existing Building Electrical Systems	72
4.17.3. Service and Power Distribution	74
4.17.4. Motor Protection and Control	86
4.17.5. Surge Protective Devices	88
4.17.6. Branch Wiring	88
4.17.7. Life Safety, Emergency, and Security Systems	90
4.17.8. Lighting	97
4.17.9. Communication Equipment	103
4.17.10. Audio Visual Systems (A/V)	103
4.17.11. Miscellaneous	104
4.18. Energy Modelling Guidelines	106
4.18.1. Acceptable Energy Modeling Software	106
4.18.2. Energy Model Requirements / Objectives	106
4.19. Pool Systems and Other Water Treatment	106
4.19.1. General	106
4.19.2. Salt Sourced Chlorine Pools	112
4.20. Arenas	112
4.20.1. General	112
4.20.2. Refrigeration System	113
4.20.3. Dehumidification	115

4.20.4. Controls	115
4.20.5. Ice Resurfacing Requirements	116
4.20.6. Heating	116
<b>APPENDIX A - COLOUR CODING REQUIREMENTS</b>	<b>118</b>
1. Mechanical Equipment	119
1.1. Concealed Equipment within Ceiling Spaces	119
1.2. Piping	119
1.3. Labeling	120
1.4. Designation of Colours	121
1.5. Ductwork	124
2. Electrical Equipment	126
<b>APPENDIX B - IT INFRASTRUCTURE DESIGN GUIDELINES</b>	<b>127</b>
1. General	128
2. Technical	129
2.1. Utility Services	129
2.2. Horizontal and Backbone Cabling	130
<b>APPENDIX B1 - STANDARD NETWORK ACCESS ROOM LAYOUT</b>	<b>137</b>
<b>APPENDIX C - SECURITY AND CARD ACCESS SYSTEM DESIGN GUIDELINES</b>	<b>139</b>
<b>1. GENERAL</b>	<b>140</b>
1.1. Overview	140
1.2. References	140
1.3. Responsibilities of the Consultant	140
1.4. Submission Requirements:	141
<b>2. TECHNICAL</b>	<b>141</b>
2.1. General	141
2.2. Intrusion Detection Systems (Non-Card Access)	142
2.3. Card Access & Intrusion Detection Systems (C-Cure 9000/IStar)	142
2.4. Wire and Conduit	144
2.5. Field Devices	144
2.6. Programming, Testing and Training	147
2.7. Design & Specifications	147
<b>APPENDIX C1 - STANDARD SECURITY DRAWINGS</b>	<b>148</b>
<b>APPENDIX C2 - SECURITY SPECIFICATIONS TEMPLATE CARD ACCESS</b>	<b>154</b>
<b>APPENDIX C3 - SECURITY SPECIFICATIONS TEMPLATE NON-CARD ACCESS</b>	<b>163</b>
<b>APPENDIX D - VIDEO SURVEILLANCE SYSTEM</b>	<b>171</b>
1. GENERAL	172
1.1. Overview	172
1.2. References	172

1.3. Responsibilities of the Prime Consultant	172
1.4. Submission Requirements:	172
2. TECHNICAL	173
2.1. System Architecture	173
2.2. Raceway/Cable Infrastructure	173
2.3. Cable	173
2.4. Termination/Certification	173
2.5. Head End Equipment	174
2.6. Camera Mounting	174
2.7. Equipment Specifications	174
2.8. Commissioning	178
2.9. Documentation and Training	178
<b>APPENDIX E - ARC FLASH DESIGN GUIDELINES</b>	<b>179</b>
1. General	180
1.1. Overview	180
1.2. Approved softwares:	180
1.3. Consultant and City Interactions:	180
1.4. Submission Requirements (Study Deliverables)	181
2. Study Methodology Basis: Minimum Requirements	183
3. Submission Requirements	185
4. Special Considerations:	186
5. Software Generated Time Current Curves (TCCs)	188
6. Arc Flash and Shock Label Requirements	193
<b>APPENDIX F - FIRE ALARM COMMUNICATION DESIGN GUIDELINES</b>	<b>196</b>
<b>APPENDIX F1 - STANDARD FIRE ALARM DIALER DRAWINGS</b>	<b>207</b>
<b>APPENDIX G - GUIDELINES FOR GAS DETECTION SYSTEMS</b>	<b>210</b>
Table of Contents	211
1. Background	212
2. General	213
3. Carbon monoxide (CO) - Repair garages, specified mechanical rooms, fire station apparatus bays	225
4. Carbon monoxide (CO) - Storage garages / parking garages	226
5. Nitrogen dioxide (NO <sub>2</sub> ) - Repair garages, specified mechanical rooms, fire station apparatus bays	227
6. Nitrogen dioxide (NO <sub>2</sub> ) - Storage garages / parking garages	228
7. Chlorine (Cl <sub>2</sub> )	228
8. Hydrocarbons – i.e. natural gas and methane (CH <sub>4</sub> ), propane (C <sub>3</sub> H <sub>8</sub> ), acetylene (C <sub>2</sub> H <sub>2</sub> )	229
9. Refrigerants (i.e. Ammonia [NH <sub>3</sub> ], R-22, R-422B, R-410A, R-134a)	231
10. Ozone (O <sub>3</sub> )	236
11. Carbon dioxide (CO <sub>2</sub> )	237

12. Hydrogen (H2) - Generated via pool sanitization equipment	238
13. Hydrogen (H2) - Vehicle Storage Garages / Maintenance Areas	240
Table 1 – Alarm and ventilation activation concentrations	243
Table 2 – Visual alarm, label, and sign colours	244
Table 3 – Occupational exposure limits and lower explosive limits	245
<b>APPENDIX G1 - GAS DETECTION CONTROLLER AND SYSTEM SUPPORTING SKETCH</b>	<b>246</b>
<b>APPENDIX H - WATER SPRAY PARK DESIGN GUIDELINES</b>	<b>248</b>
<b>1. Technical Guidelines</b>	<b>249</b>
1.1. Introduction	249
1.2. Definitions	249
1.3. General	249
1.4. Spray Deck Equipment	250
1.4.1. References	250
1.4.2. General	250
1.4.3. Bonding	250
1.4.4. Equipment Selection and Delivery	250
1.5. Site Services	251
1.5.1. References	251
1.5.2. Site Selection	251
1.5.3. Site Survey Plan and Site Plan	251
1.5.4. Geotechnical	252
1.5.5. Roads, Walks and Parking	252
1.5.6. Utilities	252
1.6. Landscape Development	253
1.6.1. References	253
1.6.2. Exterior Landscape Development	253
1.7. Civil	253
1.8. Mechanical	254
1.8.1. References	254
1.8.2. General	254
1.8.2.1. Drawings	254
1.8.2.2. Accessibility	254
1.8.2.3. Winterization	255
1.8.3. Design Criteria	255
1.8.3.1. General	255
1.8.4. Water System	255
1.8.4.1. General	255
1.8.4.2. Fixtures and Equipment	255

1.8.4.3. Drainage	256
1.9. Electrical	257
1.9.1. References	257
1.9.2. Service and Power Distribution	257
1.9.2.1. Utility Service	257
1.9.2.2. Load Calculation	257
1.9.2.3. Single Line Drawing	257
1.9.2.4. Protection and Control	258
1.9.2.5. Panelboards Switching and Overcurrent Devices	258
1.9.2.6. Transformers	259
1.9.2.7. Feeders	260
1.9.2.8. Arc Flash and Shock Hazard Labelling	260
1.9.3. Lighting	260
1.9.3.1. General	260
1.9.3.2. Exterior Lighting	260
1.9.3.3. Drivers and Ballasts	261
1.9.3.4. Control	261
1.9.4. Branch Wiring	262
1.9.4.1. General	262
1.9.4.2. Provisions for Mechanical	262
1.9.5. Miscellaneous	262
<b>APPENDIX I - ELECTRIC VEHICLE CHARGING</b>	<b>265</b>
<b>APPENDIX Ia - ELECTRIC VEHICLE CHARGING DRAWINGS</b>	<b>288</b>
<b>APPENDIX J - UNINTERRUPTIBLE POWER SUPPLY (UPS)</b>	<b>298</b>
1. Uninterruptible Power Supply	299
<b>APPENDIX K - DISTRIBUTED GENERATOR (DG)</b>	<b>318</b>
1. Distributed Generators (DG):	319
<b>APPENDIX L - HAZARDOUS CLASSIFICATION STUDY</b>	<b>339</b>

## 4. Technical Guidelines

### 4.1. Introduction

- 4.1.1. This document is Consultant Manual - Volume 2 of 2, and contains Section 4 – Technical Guidelines. This document is intended to be used with Volume 1 of 2 to form a complete manual.
- 4.1.2. [The Consultant Manual – Volume 1 of 2](#) contains the following sections:
- Section 1 – Introduction. Establishes the scope of the document and gives general contact information.
  - Section 2 – Design Process. Describes the information flow on a typical project, standard deliverables expected at each design phase and an overview of minimum document and CAD standards to be followed.
  - Section 3 – Design Guidelines. Describes policies and design guidelines, and their relative administrative procedure requirements specific to the City buildings as specified by contract.
- 4.1.3. No content in either volume of this manual is designed for verbatim specification use and in general, content should not be copied directly into a book spec for any project unless the consultant is explicitly so instructed. Note: this does not apply to Fire Alarm Dialer and typical security and card access details in this Volume.

### 4.2. General

- 4.2.1. This section contains technical guidelines to follow when designing new buildings or major renovations for the City of Edmonton as specified by contract.
- 4.2.2. The requirements have been developed by consolidating best practices information, from the position of knowledgeable owner, as well as subject matter experts. They are based on components and systems which have proven to be reliable and efficient, to meet the needs of the users, and to have acceptable life cycle costs. These guidelines are to be used in conjunction with professional judgment to ensure that they are followed only to the extent they are appropriate. Consultants remain ultimately responsible for the design.
- 4.2.3. More specifically, the intent of this section is to:
- Describe the minimum requirements for various building components, assemblies, and systems that have an impact on serviceability and anticipated life cycle of the facility.
  - Alert consultants to design aspects that historically have been problematic.
  - Provide solutions or problem avoidance techniques that have been developed through experience and have proven to be practical and effective.
  - Provide a vehicle for communicating design standards to consultants in an effective and expedient manner.
  - Indirectly, provide a basis for evaluating designs.
- 4.2.4. No attempt is made to address every conceivable condition. Rather, common sense solutions are provided where experience has indicated that problems commonly arise. This experience can be applied to new designs as a preventative measure, and to existing buildings to address problems



that are attributable to design and/or execution that does not conform to these technical design requirements.

- 4.2.5. Where this section does not address a technical design issue that arises on a project, it is the consultant's responsibility to address it.
- 4.2.6. When a requirement, though normally applicable, may not be appropriate for a specific project, the consultant should propose an alternative for consideration by the City
- 4.2.7. When a deviation from this section is required City approval shall be documented in writing..
- 4.2.8. Innovative designs or products are encouraged after thorough consideration of potential benefits and risks, value analysis, and life cycle cost. Consult project team members and persons with expertise in facility operation and maintenance.
- 4.2.9. Other potentially applicable design and construction guidelines and standards are available on [edmonton.ca](http://edmonton.ca).
- 4.2.10. The Consultant is expected to follow professional judgment as well as all applicable codes, regulations, and laws. Where the technical design requirements contained herein differ from building codes and other applicable codes and standards, apply the more stringent requirements.

### 4.3. Definitions

- 4.3.1. Unless otherwise specified, words used in this document have the same meaning as defined in the Facility Design & Construction Consultant Manual - Volume 1.
  - 4.3.1.1. **Mandatory vs. Non-Mandatory:** These guidelines include both mandatory and non-mandatory recommendations. Applications of these guidelines are based on the use of the following terminology:
    - Must and/or Shall - denotes a mandatory City of Edmonton requirement,
    - Should - denotes a recommended but non-mandatory City of Edmonton requirement,
    - May - denotes an optional City of Edmonton requirement

### 4.4. Renewals

#### 4.4.1. System Integration

New systems shall be fully integrated with all other systems already in operation.

Integration means ensuring specific minimum requirements will be met:

- .1 Environmental and topological considerations:
  - .1 The space scheduled to receive the new equipment / system(s) can accommodate new equipment.
  - .2 The operational requirements of both existing and new systems will be factored in the design choices, including but not limited to normal mode(s) of operation, alternate mode(s) of operation, mode(s) of failure, commissioning requirements, etc.
  - .3 The new system will be able to operate normally within the facility and it will not modify the facility's environment (i.e.: vibration, noise, Electromagnetic Fields (EMF),

heating, cooling, hazardous classification),

- .4 The maintenance and access requirements for existing adjacent systems will be factored in the design choices.
- .5 The existing fire detection and suppression systems will be sufficient to accommodate the installation of the new system(s).
- .6 The installation of a new system will not compromise the performance of another type of equipment (e.g.: Compromising existing lightning protection system due to adding solar panels on roofs, increase of harmonic distortion, etc...).
- .7 Also refer to Mechanical and Electrical sections for additional information on connecting and designing to existing building systems.

## 4.5. Facility Maintenance

### 4.5.1. References

- 4.5.1.1. Occupational Health and Safety Act

### 4.5.2. Access, Serviceability and Maintenance Planning

- 4.5.2.1. Any building elements in the vicinity of stairs, atria greater than 9 m, etc. shall be evaluated for serviceability so as not to require scaffolding, bosun's chair harnessing, specialty lifts, or other extraordinary means.
- 4.5.2.2. Any elements including but not limited to luminaires that require a lift to service must have a clearly planned and reserved serviced corridor to bring in a lift. This includes double doors, ramps, turning radii, etc. The installation and replacement height shall also be limited as follows;

### 4.5.3. Facility Maintenance Equipment Commonly Used:

- .1 **Lifts - Maximum height for lift service 9 m.**
  - .1 Genie Z-30/20N, Z-30/20 RJ, S-40/S-45, Z-34/22 IC
  - .2 JLG 340AJ, 400S
  - .3 Skyjack SJIII 3226
- .2 **Ladder(s) - Maximum height for ladder service 4 m (3m ladder with a worker 1m working above.)**
- .3 **Bucket Truck:**
  - .1 Utility body, aerial devices mounted on a Ford F450, regularly used in Arenas.
  - .2 Aerial: Versalift TEL- 29-N
  - .3 requires a 12' high entrance.
  - .4 The overall dimensions of the body are to be:
    - a) 6.655 m (262") in length, including the rear bumper.
    - b) 2.388 m (94") in width, excluding drip rails, handles, lamps and mirrors

**.4 P2042 specifications:**

- .1 Unit: 2011 E350 van low roof with aerial lift
- .2 Aerial: TEL-29-N
- .3 Ground to bottom of bucket: 29ft
- .4 Working height 34 ft
- .5 Wheelbase: 138 inches
- .6 GVWR: 4309 kg
- .7 Length: 216.7 inches + 24 inches (for the rear platform)
- .8 Height: 118 inches (including aerial)
- .9 Width: 79.4 inches + mirrors

**.5 B2954 specifications: (Newer Aerial Van Unit)**

- .1 Unit: 2021 Transit 350 low roof with aerial lift
- .2 Aerial: TEL-29-N
- .3 Ground to bottom of bucket: 29ft
- .4 Working Height: 34ft
- .5 Wheelbase: 148 inches
- .6 GVWR: 4309 kg
- .7 Length: 237.6 inches + 36 inches (for the rear platform)
- .8 Height: 118 inches (including aerial)
- .9 Width: 81.3 inches + mirrors

## **4.6. Site Design**

### **4.6.1. References**

- 4.6.1.1. City of Edmonton landscape requirements as per Zoning Bylaw 12800.
- 4.6.1.2. [Swept Path Analysis. Edmonton Fire Rescue. July 15, 2021](#)
- 4.6.1.3. Manual of Uniform Traffic Control Devices, Sixth Edition

### **4.6.2. Site Selection**

- 4.6.2.1. Where sites may be impacted by climate risk (flooding) building elevation requirements shall be above the floodplain.

### **4.6.3. Site Access**

- 4.6.3.1. Site access' shall consider:
  - .1 separation distances, access types, widths, throat lengths etc. for any site accesses in

accordance with the [Access Management Guidelines \(current edition\)](#).

- .2 Garbage Collection and maneuvering, refer to [Waste](#). All backing up maneuvers must be entirely within the property, and not encroach on the road right of way,
- .3 Edmonton Fire Rescue Aerial Truck turning radius. Refer to [Swept Path Analysis. Edmonton Fire Rescue. July 15, 2021](#),
- .4 Pedestrian, public transportation and bike connections
  - .1 a dedicated bike path to any allocated bike parking infrastructure
  - .2 a sidewalk connection from any public transportation stop to the main facility entrance.
- .5 Deliveries, loading, and ambulance.
- .6 Note that the Project may include design and delivery of off-site improvements to City Owned Assets immediately adjacent to the site, as a condition of the development. All infrastructure, new and existing, must be combined into a coordinated, visually coherent, legible urban realm. Any alley, boulevard or sidewalk damage occurring as a result of construction traffic must be restored.

Offsite improvements to City owned assets outlined as part of the Project Development Permit are within the scope of this project and may include sidewalks, curbing, drive aisles, planting beds and bike lane extensions all off-site work to City assets must meet the City of Edmonton Complete Streets Design and Construction Standards the City's Design and Construction Standards which are available at the following URL:  
[https://www.edmonton.ca/city\\_government/urban\\_planning\\_and\\_design/city-design-construction-standards.aspx](https://www.edmonton.ca/city_government/urban_planning_and_design/city-design-construction-standards.aspx).

4.6.3.2. The Project team may request a Permit pre-application meeting to discuss interpretations, challenges and alternatives for alternatives for site access with the City of Edmonton Transportation Department.

#### 4.6.4. **Site Grading and Water Management**

- 4.6.4.1. A positive sloped surface is to effectively drain water away from the foundation walls. Minimum grade requirements are:
  - .1 10% for 2 meters (Foundation with basement) – Minimum 20 cm drop for final grade on soft landscaping;
  - .2 5% for the first 2 meters (Slab-on-grade) – Minimum 10 cm drop for final grade on soft landscaping; Increased grading may be required where Facilities are prone to climate risk (flooding).
  - .3 2% for concrete, asphalt, or other impervious surface treatment. Increased grading may be required where Facilities are prone to climate risk (flooding).
- 4.1.1.1. Where rainwater leaders are permitted to splash to grade, address potential ponding, erosion, and icing problems. Rainwater leaders splashing to grade shall stop 457mm above grade and extend a minimum of 915mm away from the building. Provide splash pads and locate rain water leaders away from building entrances and exits.
- 4.1.1.2. Permeable paving selections shall be easy to clear of sand, gravel, leaf drop etc. Avoid systems

where the surface is too open, like permeable asphalt or concrete, or too sensitive to clean, like polymeric sands for paver jointing material. Permeable slabs are preferred. Basis of Design: Romex.

#### 4.6.5. Roads, Sidewalks, Walkways, Pathways and Parking

4.6.5.1. [City of Edmonton Design and Construction Standards](#) are applicable for design of roads, sidewalks, walkway, pathways and parking.

- .1 Particular attention should be made to the City's [Complete Streets Design and Construction Standards \(CSDCS\)](#), Section 3.3.4.5 Pedestrian Through Zone at Driveways. All need to be designed to ensure that sidewalks are maintained in level, colour and materiality across driveways to provide the highest level of convenience and safety for pedestrians;
- .2 consider adding raised table pedestrian crossings in locations throughout the parking areas and other important locations to provide a higher level of convenience and safety for pedestrians crossing at these locations;
- .3 Specialized loading (in addition to barrier free stalls) adjacent to the facility may be required for Public. Contact your Project manager to understand DATS, daycare, library and other short term parking needs.

4.6.5.2. Parking:

- .1 Parking stalls shall be designed so that vehicles do not encroach on the path of travel or potentially impact parking signage and block heater outlets (e.g., providing wheel stops). Refer to "Block Heater Outlets"

4.6.5.3. Snow Clearing:

- .1 Lay out parking lots and walkways and locate parking fixtures, benches, bike racks, flower beds, etc to facilitate snow clearing and removal and to avoid damage from snow moving equipment.
- .2 Provide adequate width and turning radii for snow moving equipment.
- .3 Provide allowances for snow storage on site from snow clearing of walks and pathways and ensure drainage of these areas during melting.

4.6.5.4. Design pavement structures based on loads anticipated (fire lanes/heavy duty trucks).

4.6.5.5. Mitigate risk of vandalism, by limiting 0mm-300mm aggregate near building windows.

#### 4.6.6. Utilities

4.6.6.1. All utility service providers are to be contacted to obtain the following information:

- .1 Existing active and abandoned utilities that may affect or be affected by the construction.
- .2 Proposed utilities that may affect or be affected by the construction.
- .3 Determination of the responsibility for relocation and notice timeline requirements (as per existing agreements with the City).

4.6.6.2. Where utilities are to be connected to municipal systems, confirm with the City of Edmonton and

utility companies the adequacies of their systems to service the site.

- 4.6.6.3. Ensure specification instructs the contractor to provide horizontal and vertical GPS locations of all utilities.
  - 4.6.6.4. Early in the design, confirm with the City about any restrictions on stormwater discharge to the stormwater drainage system and confirm any impacts that the new development will have on the existing stormwater drainage system or stormwater management facilities. If applicable, provide on-site stormwater storage solutions in cases of limited stormwater drainage system capacity (i.e. storm water retention, bioswales, etc).
  - 4.6.6.5. Early in the design, confirm that the existing level of building and/or site fire flows are adequate. Efforts must be made to ensure adequate levels of fire protection.
  - 4.6.6.6. Contact the utility provider to confirm the municipal water pressure, and fire flow capacity. Determine whether on-site boosting is required for a fire sprinkler system.
  - 4.6.6.7. On large sites, locate utilities in utility corridors, keeping in mind any potential for future development.
  - 4.6.6.8. Utilities within integrated sites and park areas with multiple buildings are typically managed and maintained by the City. Assistance from utility companies and cadastral information may not be available. In the absence of information, perform CI/ASCE 38-02 or similar – Level D to Level A collection and depiction of existing subsurface utility data.
  - 4.6.6.9. Perform a complete review of all utilities, including exterior lighting, when developing a site within an Integrated Site or park area. Necessary upgrades to existing utility distribution or service connections are to be included as part of the new development.
  - 4.6.6.10. Where possible, provide single service connections to each property or integrated site. Size service connections for anticipated future needs.
- 4.6.7. **Waste**
- 4.6.7.1. Refer to [Contractors Environmental Responsibilities package for Consultants, May 2022](#), Section 7.10- 7.11 for Waste Management practices during construction
  - 4.6.7.2. Refer to the City Zoning Bylaw, Section 55.5(6) provides information on waste storage area screening requirements.
  - 4.6.7.3. All City facilities and open spaces must use City Waste Services for waste collection.
    - .1 Underground Bins:
      - .1 Front loading underground bins (Earthbin or similar) are serviceable by City Waste.
      - .2 Currently crane loaded underground Bins are not serviceable.
      - .2 All City of Edmonton facilities shall support sorting three streams of waste (garbage, recycling and food scraps).
  - 4.6.7.4. The City Project manager should contact [wasteplanning@edmonton.ca](mailto:wasteplanning@edmonton.ca) to confirm the waste setout area requirements for City facilities and ensure City of Edmonton Waste is involved

during the development phase of projects to ensure the City facilities can be serviced.

4.6.7.5. Contact [wasteplanning@edmonton.ca](mailto:wasteplanning@edmonton.ca) to provide;

- .1 quantity of bins and required sizes,
- .2 preferred enclosure designs and paved approaches,
- .3 waste collection truck dimension, weight, and turning radius,
- .4 Confirmation the facility will be participating in the Corporate Three Stream Waste Program, and size of organics bin recommended (Note all new occupied facilities will be part of the program),

4.6.7.6. Refer to [Site Fixtures, Furnishings and Equipment \(FF&E\)](#) for intermediate garbage collection containers.

- .1 Construction dust control and clean-up procedures should be implemented to ensure building occupants are not overexposed to dust. Controls would include dust barriers, negative air pressure within the construction area, and sealing mechanical ventilation ductwork. Clean-up procedures would include HEPA vacuuming, wet wiping techniques, and ductwork cleaning.

#### 4.6.8. **Exterior Landscape Development**

4.6.8.1. Refer to City of Edmonton Design and Construction Standards, Volume 5 – Landscaping.

4.6.8.2. Coordinate landscape development with Open Spaces Planning and Design (OSPD)

#### 4.6.9. **Low Impact Development (LID)**

4.6.9.1. The City of Edmonton will consider the use of LID's adjacent to facility infrastructure. Discuss specific implementations with City Facility and Geotechnical Engineering resources.

4.6.9.2. Educational Signage may be requested to be installed to support understanding and correct maintenance of LID facilities.

#### 4.6.10. **Irrigation Systems**

4.6.10.1. Consult with the City before considering irrigation systems for on-grade plant material. Irrigation should not be considered unless the establishment of plant material is threatened or the program requires it. See also [Green Roofs](#)

4.6.10.2. Where geotechnical information indicates the presence of highly plastic clay, avoid locating irrigation outlets close to buildings. Changes in moisture content in this type of clay result in volume changes and movement that can damage floors and foundations.

4.6.10.3. Provide exterior hose bibs on buildings at every 50 m along building walls.

4.6.10.4. Consider providing a separate water meter for large irrigation systems in order to avoid sewage treatment charges based on water consumption.

4.6.10.5. Where practical, contain all irrigation systems and equipment within the property lines of the



project.

- 4.6.10.6. Provide pipe sleeves for irrigation systems under roadways and sidewalks. Ensure complete coverage of landscape areas. Design irrigation systems to allow for emptying water from distribution pipes.
- 4.6.10.7. Incorporate rain sensors in irrigation systems to prevent over watering
- 4.6.10.8. Preferred location of the irrigation controller is mounted on the exterior of the facility within sight of the sprinkler heads it controls. The controller should be in a stainless steel cabinet locked by a padlock and hasp.
- 4.6.10.9. Any irrigation alarms are to be visual or audible. Consult with City Facility Engineering prior to specifying remote capabilities for the irrigation controller.
- 4.6.10.10. The level of complexity of the irrigation controller should be approximately equivalent to the Rain Bird EXP-LSD, Toro TDC series, or Hunter ACC2.
- 4.6.10.11. Specify that the contractor must provide a laminated as-built drawing on site and provide a training video for operations.

#### 4.6.11. **Interior Landscape Development**

- 4.6.11.1. Plan for drainage, maintenance access (including water approx. every 15m), and lighting needs for all planting material.

#### 4.6.12. **Plant Maintenance Considerations**

- 4.6.12.1. Design to minimize maintenance requirements. Consider irrigation, mowing, trimming, pruning, fertilizing, pesticide application, and general clean-up requirements.
- 4.6.12.2. **CPTED:**
  - .1 Conifers may be trimmed up 6ft from grade
  - .2 Shrubs are ideally no higher than 2ft, selecting species that meet this height is recommended, to avoid over trimming.

#### 4.6.13. **Site Fixtures, Furnishings and Equipment (FF&E)**

- 4.6.13.1. **Durability:**
- 4.6.13.2. If combustible materials are selected for site furnishings, the product shall utilize a minimum size of lumber and/or fire retardant coatings which would deter vandalism.
  - .1 Consider maintenance requirements of materials. If a custom wood fixture, nominal wood with readily available fasteners are preferred.
- 4.6.13.3. **Exterior Signage:** Refer to [Signage](#)
- 4.6.13.4. **Bollards**
  - .1 PVC wrapped pipe is preferred in lieu of painted concrete, where consistent wear and tear



is seen (ie) fire halls. Where Steel pipe is used rust inhibitory shall be applied.

**4.6.13.5. Bike Racks**

- .1 Bike racks are to be durable hoop or inverted U-type/staple racks, with two connection points which will provide a safe and secure rack for all users. A taper plate is preferred for visually impaired persons. Basis of design: Special Metal Fabricating Hoop or Staple, DERO Hoop Rack or Sheffield Stand.
- .2 Projects shall assess the feasibility of expanding public bike parking facilities to include secure parking (bike lockers with/without zephyr locks, covered enclosures, surveillance, etc.)
- .3 Based on the Project gender-based analysis design shall consider storage and infrastructure requirements for E Bikes, scooter racks, bike trailers, recumbent bikes etc. to align with [The City's Bike Plan](#).

**4.6.13.6. Waste, Recycling and Food scraps Collection Containers**

- .1 Refer to the Corporate Waste - Internal Waste Sorting Station and Accessories Catalogue for common containers. Alternate containers may be specified, however the following design elements shall be considered:
  - .1 The three main cues that help users sort properly, whether inside or outside, are colour-coding, labels (stream name and icons) and opening shape. A rule of thumb is to at least have two of these cues.

Colour coding	Consistent colour coding supports correct sorting behaviour. The City standard is blue for recycling, black for garbage, and green for food scraps. *If the body of the container isn't colour coded, the top plate or lid should be.
Centralizing the location	All three streams should be grouped together. This will encourage people to sort properly.
Covered openings	Reduces pests from entering receptacles, protects material from rain and snow.
Opening shapes	Wide openings without flaps/obstructions. Opening shape designs discourage contamination of recycling stream and disposal of bagged household garbage. *Food scraps and garbage (full opening), recycling (circle with rectangular slot), beverage containers (circle).
Angled fronts	Angled fronts allow labels to be visible on approach, providing more time for users

	to identify correct streams for sorting.
Materials and coating	Durability and ease of maintenance in place by staff, able to be pressure-washed.
Modular units	Each receptacle is manufactured as a stand-alone unit allowing flexibility in configuration depending on location or future changes to collected material streams.
Locks/door design (for outdoor containers only)	Select a design that does not require locking. E.g., if the container has a door, the door is able to be closed or secured with a latch rather than a lock. This will reduce damage to containers e.g., container can be opened and easily accessed by individuals picking bottles, and eliminates the need for servicing staff to manage keys.

- .2 Contact Custodial Services to ensure serviceability of alternate containers being specified.

## 4.7. Environment

### 4.7.1. References

- 4.7.1.1. City of Edmonton Division 01 Specification Template
- 4.7.1.2. Contractors [Environmental Responsibilities package for Consultants, May 2022.](#)

### 4.7.2. Hazardous Materials

- 4.7.2.1. The City may undertake a hazardous materials audit to support Project needs.
- 4.7.2.2. The Consultant will work with the City to develop the level and intensity of hazardous materials testing required. All testing at all project phases requiring Hazardous Material Reports and any destructive testing, are to be completed by qualified environmental consultants experienced with facility hazardous materials identification, testing, and remediation processes that meet all local authorities having jurisdiction requirements.
- 4.7.2.3. When selecting materials for a new building or an existing building renovation, asbestos containing materials shall be avoided. Typical asbestos products manufactured today are considered non-friable materials (i.e. board and pipe products only).
- 4.7.2.4. Wherever possible avoid the potential for harmful chemical off-gassing when selecting materials for a new building or an existing building renovation. Examples include materials or products such as carpeting, glues, paints, particleboard furniture, etc. that may contain formaldehyde or

volatile organic compounds. These materials or products should be off-gassed off site, prior to installing them in the building

#### 4.7.3. Fuel Storage Tanks

Refer to [Contractors Environmental Responsibilities package for Consultants, May 2022](#), Section 7.9 Fuel Storage/Dispensing Tank Management.

Comply with the requirements of Alberta Environmental Protection: [Risk Management Guidelines for Petroleum Storage Tank Sites](#)

Consider using day tanks for emergency generators.

When tanks are required, above ground tanks are preferred.

Tanks are to be double-walled complete with leak monitoring of interstitial space between tank walls.

The City has a custom fuel fillport and control panel - refer to [Fuel Fill Port and Control Panel Storage tank permits](#) are required to remove, install or alter Flammable and Combustible Liquid Storage Tanks located within the City of Edmonton. Edmonton Fire Rescue Services is the Authority Having Jurisdiction (AHJ) in the City of Edmonton for the installation, removal or alteration of flammable and combustible liquid storage tanks. This includes:

- .1 Outside aboveground storage tanks (AST)
- .2 Underground storage tanks (UST)
- .3 Inside building storage tanks
- .4 Waste oil storage tanks

### 4.8. Building Structure

#### 4.8.1. Design Loads

4.8.1.1. The following design loads shall be a minimum.:

- .1 Multi-service facilities: minimum floor occupancy live load 4.8 kPa or 9 kN concentrated, whichever produces the more critical effect.
- .2 General Office Areas: minimum floor occupancy live load 4.8 kPa or 9 kN concentrated, whichever produces the more critical effect.
- .3 Records Storage Areas: design live load - to be based on type and layout of the proposed storage system, but not less than 7.2 kPa.
- .4 Mechanical Loads: minimum floor live load 3.6 kPa. Discrete loads from equipment shall be obtained from mechanical and electrical consultant where applicable. In mechanical rooms, allow for a minimum of 100 mm thick concrete housekeeping pads. Effects of vibration should be considered.
- .5 When there is a known plan to change the usage of an area in the future, design for the more stringent of current and future live loads.
- .6 Maintenance and Equipment Loads: when the need for heavy equipment due to

maintenance and replacement of various components is anticipated, an access path will be designated to accommodate these loads. Refer to [Facility Maintenance](#).

#### 4.8.2. Foundations

- 4.8.2.1. The Geotechnical Engineer of record shall review and approve aspects of design and construction that depend on soil or groundwater conditions.
- 4.8.2.2. Maintain the integrity of existing structures and service lines adjacent to the Work.
- 4.8.2.3. Do not incorporate “tie-back” earth retaining systems as an essential part of the permanent structure.
- 4.8.2.4. Screw piles are acceptable for landscaping elements, unheated park shelters, garbage enclosures, and miscellaneous security pedestals.
- 4.8.2.5. The Consultants shall complete a cost benefit analysis with the aid of the assigned Structural & Geotechnical Engineer of record to determine if pile load testing is cost recoverable. The results of this analysis will inform the Project and allow for appropriate direction. The City will coordinate and pay for pile loading testing. The results of the pile load testing shall be incorporated into the design prior to tendering this portion of the project.

#### 4.8.3. Structure

- 4.8.3.1. Do not use un-bonded post-tensioned reinforcement as an essential reinforcing element of a structural member.
- 4.8.3.2. Design exterior slabs at doorways to avoid interference with outward door swings as a result of upward movement of slab caused by soil and frost heaving. Provide structural stoop where necessary.
- 4.8.3.3. Structural Systems for Car Parking: design according to CSA S413M, Parking Structures. Provide protection against corrosion of reinforcing steel, including a positive slope, passive cathodic protection system, surface protection membrane, and drainage system with adequate allowances for construction tolerances and deflections.
- 4.8.3.4. Provide protection against corrosion for structural elements that may be subject to spills or leaks of corrosive solutions (i.e. mechanical floors supporting brine tanks and water softeners).
- 4.8.3.5. Design expansion joints, including those between existing and new structures, so that an abrupt change in floor elevation is prevented. Wheelchairs and carts must be able to pass over these joints with ease.
- 4.8.3.6. Self-leveling or caulked expansion joint sealants are not accepted for use on slab-on-grade or structural slabs. Preformed joints shall be specified.
- 4.8.3.7. In major renovations of existing buildings, investigate safety with respect to current seismic loading in areas where this is applicable. Upgrade as deemed appropriate for the specific project. At a minimum, ensure adequate lateral support for all non-structural components.
- 4.8.3.8. Provide drain holes to allow the release of water in all HSS sections.
- 4.8.3.9. Design shall allow for welding to be limited as much as is practically possible to shop fabrication.

- 4.8.3.10. Design structural steel floors to prevent transient footstep induced vibration from exceeding the annoyance threshold. Refer to CISC Handbook of Steel Construction – Appendix G, Guide for Floor Vibrations and the National Building Code of Canada – Commentary A – Serviceability Criteria for Deflection and Vibrations.
- 4.8.3.11. When floor slopes are relied upon for drainage of surface water, a minimum slope of 2.0% shall be used when runs are greater than 3.0 m. In no case shall floor slopes be less than 1.5%.
- 4.8.3.12. Drainage trenches shall slope a minimum of 2% in all cases. Dissimilar metals and galvanic reactions should be considered when specifying embedded metals, drainage covers, and grating.
- 4.8.3.13. Expansion/friction anchors will not be accepted in areas exposed to the elements, pools, or elements supporting or fixing vibration generating equipment.
- 4.8.3.14. Special consideration will be provided on renovations and new construction where gaseous chlorine or salt chlorination systems are used.
  - .1 Concrete will be specified to accommodate C1 chloride exposure as defined by CSA A23.1
  - .2 Crack control of concrete will be held to the higher standards set by water retention structures.
  - .3 Refer to [Coatings](#).
  - .4 PVC waterstops will be used.
- 4.8.3.15. Bentonite waterstops will only be used upon City's approval.
- 4.8.3.16. Below grade, concrete structure penetrations where water infiltration is an issue, sleeves with integral waterstop flanges will be used.
- 4.8.3.17. Bonded Fiber Reinforced Polymer (FRP) composites will only be used upon City's approval. Upon approval, all installations:
  - .1 Shall receive fire protection suitable to the classification of the space.
  - .2 Shall be clearly labelled, "Do Not Drill."
  - .3 Will not be used in wet locations where moisture and chlorides can infiltrate the concrete matrix and accelerate the deterioration of the reinforcement within the element, behind the FRP installation.
  - .4 Will not be used in locations easily impacted/damaged by normal operations within the facility.
- 4.8.3.18. Columns and lateral bracing elements within natatoriums shall be installed on moisture protected concrete pedestals, elevated out of splash zones. Steel may be coated, but will not clad with materials that will trap moisture.

#### 4.8.4. **Coordination with Other Disciplines**

- 4.8.4.1. Structurally design and detail the fastening, support, and backup systems for exterior walls, brick veneers, cladding, fenestrations, and attachments. Specify galvanizing of steel

connections outside the air barrier.

- 4.8.4.2. In the design of exterior wall back-up systems, limit deflections according to the properties of the cladding or veneer material being used. Coordinate with cladding systems design to accommodate movement.
- 4.8.4.3. Design canopy structures to be outside of the building envelope.
- 4.8.4.4. All structural penetrations through the roof, including but not limited to roof guardrails, travel restraint, and fall arrest systems, shall be coordinated with building envelope requirements.
- 4.8.4.5. Coordinate any expected movements of the structure, including those due to deflection, shrinkage, settlement, and volume changes in the soil. Provide adequate allowances in all affected elements, including partitions and mechanical systems.
- 4.8.4.6. If the expected movements of a grade-supported floor slab cannot justifiably be accommodated or tolerated, use a structural slab. Structural slabs constructed over a degradable void-form shall not be used where a significant amount of buried piping will be provided below the floor. The piping shall be protected within trenching or other means to isolate the piping from the soil. If there is a significant amount of piping, a crawl space should be considered.
- 4.8.4.7. Specify concrete floor flatness that is consistent with the flooring material to be applied and the architect's aesthetic requirements.
- 4.8.4.8. Coordinate final rebar inspection prior to installation of hydronic heating lines.
- 4.8.4.9. Access routes for heavy equipment removal and installation shall accommodate structural [design loads](#).
- 4.8.4.10. IT/Server rooms shall be designed to accommodate worst case loading of a fully loaded server rack. Server rack specifications as per [APPENDIX B - IT INFRASTRUCTURE DESIGN GUIDELINES](#).
- 4.8.4.11. Special fitness use areas, such as Olympic lifting, medicine ball use, or any other high impact exercises shall be:
  - .1 Assessed accordingly to accommodate impact loading, vibration, and noise isolation.
  - .2 Located on grade supported structure OR on elevated concrete structure. The use of steel, steel composite deck, or OWSJ is not permitted. The zone of use will be isolated from surrounding structure.
- 4.8.4.12. Coordination will be required to address crack control, aesthetics and serviceability limits, for the following concrete structures:
  - .1 Water retention tanks.
  - .2 Architecturally finished concrete.
  - .3 Skate parks and other high performance surfaces.

## 4.9. Building Envelope

### 4.9.1. References

- 4.9.1.1. Building Envelope Thermal Bridging Guide, v1.6, 2021.
- 4.9.1.2. City of Edmonton Commissioning Consultant Manual: Vol. 2 - Building Envelope Commissioning Process and Guidelines, latest adopted version.
- 4.9.1.3. City of Edmonton Division 01 - "Section 01 83 16 Exterior Enclosure Performance Requirements"
- 4.9.1.4. National Research Council of Canada ["Guide for design of flood-resistant buildings, 2022-05-19"](#)

### 4.9.2. General

- 4.9.2.1. Building envelope assemblies separate spaces requiring differing environmental conditions by controlling the flow of air, water, and energy. The separation between spaces that have a differential of more than 10°C or that have dissimilar environments (i.e. differences in temperature or humidity) must be controlled with environmental separations.
- 4.9.2.2. The building envelope is to be designed using rainscreen principles to minimize moisture deteriorating the building envelope due to ingress of exterior bulk moisture and trapping of condensation from relatively humid air introduced into the envelope by air exfiltration.
- 4.9.2.3. Detail the building envelope to ensure that water, snow, and ice sheds safely from exterior surfaces and is not trapped or allowed to build up or enter the assembly to cause deterioration or staining.
- 4.9.2.4. Materials used in the building envelope assembly should be suitable for the environmental conditions to which each will be exposed, including during the construction period. Materials should provide a service life defined in the OPR, and be consistent with accessibility for maintenance of building components and planned building life.

### 4.9.3. Envelope Performance Criteria

- 4.9.3.1. Request the most recent version of the City's 01 83 16 Exterior Enclosure Performance from Project Manager. This specification template is a draft and may be edited to suit Project specific needs.
- 4.9.3.2. Refer to City of Edmonton Policy C627 for specific envelope performance criteria, related to TEDI targets and Energy performance for policy applicable buildings.
- 4.9.3.3. Water Leakage Criteria:
  - .1 Each Project shall identify a tolerance for water leakage in relationship to cost. In locations where the building envelope shall not have any water leakage, the Project Team shall consider envelope commissioning to demonstrate adherence with the requirement via water penetration resistance testing.



- .2 Warehouses, mechanical rooms, penthouses and below grade service spaces *may* tolerate small amounts of leakage - check with Project Manager.

4.9.3.4. **Air Leakage Criteria:**

- .1 New Construction envelopes shall have no significant air leakage through assembly. Coordinate and get input on air leakage criteria with the mechanical engineer and the Commissioning Provider . All materials, components, and accessories making up the air barrier system must be able to prevent air flow.
- .2 City of Edmonton New Construction shall comply with NECB 2020 3.2.4. Air Leakage criteria at minimum. Review with current best practices and Project Team to determine if more stringent requirements are appropriate.

4.9.3.5. **Security:**

- .1 Envelopes should be durable, cleanable and maintainable.
- .1 Consider graffiti coating for high risk locations.
- .2 Design should reduce climbability to roof areas and concealed spaces.
- .3 Consider eliminating gaps/joints in public areas where there is increased potential for people hiding illicit drugs behind (ie) transit stations, other high risk locations
- .4 Consider withstanding a vehicle forced entry, specifically at glazed entrances or where ATMs are visually present (recreation centres, other high risk locations).

4.9.3.6. **Reliability and Climate:**

- .1 Emergency Response facilities: Fire and police are essential services and must remain operational during future major climate events.
- .1 Design durable roofing systems with exterior features strongly affixed for 2050 wind loads. Consider CAN/CSA-S37-18 Antennas, towers, and antenna-supporting structures
- .2 Design roof geometries to manage heavier snow loads and prevent moisture ingress into building materials (e.g. safe space for snow to slide off, avoid roof features that could restrain and accumulate snow loads).
- .3 Consider solar shading (e.g. louvres) for 2050 extreme heat projections.

4.9.4. **High Interior Humidity**

- 4.9.4.1. Where high humidity space cannot be “buffered” from the building envelope, design building envelope assembly to prevent surface condensation. This includes within the wall system and also on interior surfaces such as walls, ceiling spaces, and bulkheads. Refer to [Mechanical](#).
- 4.9.4.2. Mould resistant products shall be preferentially used where applicable.
- 4.9.4.3. Where high indoor humidity levels are maintained, consider providing more robust air barrier



systems such as thicker torch applied membranes or thicker self-adhesive membranes with fusible laps.

#### 4.9.5. Air/Vapour Barrier

- 4.9.5.1. The air/vapour barrier typically consists of a number of materials acting together as a system. Minimize the number of materials used to form this system. Do not consider plastic film or spun-woven fiber film as an air sealing element.
- 4.9.5.2. Air/vapour barriers with self-sealing properties are preferred.
- 4.9.5.3. Spray foam insulation and sealant are not to be relied on for air/vapour barrier continuity where possible.
- 4.9.5.4. Minimize changes of plane in the air/vapour barrier system. Air/vapour barrier detail continuity and constructability must be given particular attention at:
  - .1 Window and door frames
  - .2 Mechanical and electrical penetrations
  - .3 Wall/roof connections
  - .4 Base of wall
  - .5 Changes in plane
  - .6 Building expansion and movement joint locations
- 4.9.5.5. Ensure that the air barrier and vapour barrier are positioned properly in the wall system. Avoid double vapour barriers, such as at parapets.

Design air/vapour barrier elements to minimize detrimental effects caused by exposure to:

  - .1 UV radiation
  - .2 extreme temperature fluctuations
  - .3 moisture
  - .4 thermally induced movement of building elements and connected barriers

#### 4.9.6. Insulation

- 4.9.6.1. Place insulation so as to minimize thermal bridging within the wall or roof assembly.
- 4.9.6.2. Place insulation directly against the air/vapour barrier.
- 4.9.6.3. Ensure structural elements are insulated and detailed to reduce the risk of condensation.

#### 4.9.7. Roofs

##### 4.9.7.1. References and Related Sections

- .1 Consultant Manual Vol. 2 - [Mechanical - Roof Drainage Systems](#)
- .2 Alberta Roofing Contractors Association (ARCA) Roofing Application Standards Manual,

## Product Listing, and Technical Notices

.1 [Ecoroofs in Alberta: Resources and Case Studies - 2020.](#)

.2 Other Applicable Standards - Photovoltaics

### 4.9.7.2. General

- .1 All new roofing and re-roofing technical details, products and specifications and installer qualifications should meet or exceed the guidelines required for an ARCA 5 year warranty certificate, within the latest edition of the (ARCA) Roofing Application Standards Manual.
- .2 Provide slope through the roof structure. Sloped insulation to only be used for back-slopes.
- .3 Prepare roof plans showing elevations for slopes to drain. Indicate locations of drains, roof mounted equipment and roof penetrations. All roof top units and curbs shall be kept away from roof drains, so as not to restrict flow of water to the drain.
- .4 Provide membrane below all metal roofing and flashings. Consider metal roofing and flashings to be water shedding only, not waterproofing.
- .5 Provide main access to the roof from inside the building. Provide full stairs to roof access where possible; however, fixed ship ladders are an acceptable alternative in locations where the current building code does not require stairs. Where practicable, connect additional separate roof levels with external wall-mounted ladders designed to meet or exceed safety regulations. Where external access between roof levels is not possible, provide access from inside the building.
- .6 Where practicable, do not locate rooftop access hatches adjacent to mechanical rooftop units, exterior parapets, clerestory walls, or any areas where it is anticipated that snow will accumulate (as per the structural engineering snow loading diagrams). Ensure hatches are located to allow adequate room to safely access and egress.
- .7 Ensure all rooftop penetrations, such as HVAC, electrical, and drains, are aligned so they do not restrict the roof from draining.
- .8 Do not group mechanical, electrical or structural penetrations together and allow room for detailing. Ensure all penetrations are sealed at the air barrier and vapour barrier.
- .9 Where practicable, do not locate rooftop equipment so that service areas are adjacent to parapets or other changes in roof level.
- .10 **Extended Warranty:** Unless otherwise stated in the Owner's Project Requirements, provide a 5 year security for extended warranty for new roofing systems. Security for the extended warranty shall be as follows;

### 4.9.7.3. Rooftop Work Zones

- .1 Roofs with slope >4 degrees:
  - a. Frequent Access: If work zones are permitted on sloped roofs, and maintenance access is required on a frequent basis; a permanent guardrail system is preferred. Where guardrails are not practicable, fall protection systems may be considered upon City approval.
  - b. Infrequent Access: If work zones are permitted on sloped roofs and maintenance access is required on an infrequent basis, the City may consider using temporary controls to comply with OH&S - this should be demonstrated using a high level Cost Benefit Analysis.
- .2 Roofs with slope <4 degrees: No work zone shall be permitted within 4 m of an unguarded edge unless permission is granted by the City of Edmonton. The 4m setback eliminates the fall hazard, rather than using engineering controls to mitigate the fall hazard, eliminating hazards is the best approach to workplace safety.
  - a. Should the building be permitted to have a work zone within 4 m of an unguarded edge, provisions shall be made for an OH&S compliant control zone with a raised warning line.
- .3 Min. 1 m shall be provided for the working side of maintainable equipment, therefore provide 5 m clearance from the working side face of equipment to any unguarded edge.
- .2 Min. 1 m shall be provided for the working side of maintainable equipment, therefore provide 5 m clearance from the working side face of equipment to any unguarded edge.

### 4.9.7.4. Rainwater Leaders:

- .1 Locate eavestroughs and rainwater leaders so they are accessible for maintenance and will not cause leakage into the building, either from rain, freezing, or melting.
- .2 Size eavestroughs to accommodate water from contributory roof and wall areas and to resist expected snow and ice loads. Off-the-shelf eaves troughs typically do not provide adequate resistance to dynamic loads from ice and snow. Eaves troughs to be a minimum of 125 mm wide.
- .3 Locate rainwater leaders and direct discharge at grade so that water does not flow onto walks or paved areas where it could freeze, or onto areas where it could cause erosion damage. Provide splash pads at landscaped areas.
- .4 New construction rainwater leaders shall not re-enter the building envelope.
- .5 Refer to “Mechanical - [Roof Drainage Systems](#)” for additional requirements.

- .6 Where a roof joins a wall extending above the roof, wall cladding, window sills, door thresholds, louvers and other wall penetrations shall be located a minimum of 300 mm above the finished roof level, or as determined appropriate by snow accumulation studies

#### 4.9.7.5. Near-Flat Roofs

- .1 The roofing membrane should consist of two-ply modified bitumen roofing membranes.
- .1 To request an alternate system a life cycle cost analysis shall be provided demonstrating capital and operating costs over the buildings life vs. a two ply system. Below are considerations when specifying single-ply thermoplastic systems;
  - .1 inclusion of a high density cover board and minimum 80mm thickness to resist damage from hail, dropped tools etc.
  - .2 Snow guards on sloped portions to prevent ice sliding/tearing.
  - .3 fully adhered
  - .4 non slip walking surfaces for all serviceable routes
  - .5 Consideration for public views onto the surface, if the product discolors.
- .2 Slope roof surfaces to drains, including valleys and transverse slopes across top of parapets. Provide minimum slope to drain of 1:50 for field of roof, if backslopes are provided, they shall be double the field slope
- .3 Each roofing area is to have a minimum of 2 drains. Ensure drains are accessible for maintenance.
- .4 Drains shall be set in a sump measuring 1.2m x1.2m and the slope of the sump shall be 4% toward the drain.. The sloped insulation should have a minimum depth of 50 mm at the roof drains.
- .5 Refer to “Mechanical - [Roof Drainage Systems](#)” for additional requirements.
- .6 The maximum thickness of a top layer of sloped insulation should be 150 mm. The limitation of sloped roofing primary insulation maximum thickness may require additional roof drains.
- .7 Where practicable, maintain a constant elevation along the perimeter of contained roof areas. If a varying perimeter elevation cannot be avoided, provide dimensioned details indicating low and high perimeter conditions.
- .8 Penetration curbs are preferred and are to be at minimum 200 mm above the adjacent finished roof surface. Provide minimum 1.0 m clearance around penetrations to facilitate roofing application and drainage.

- .9 Roof curbs for hot pipes, such as standby engine exhaust or other hot roof penetrations, should have metal curbs and additional clearances to combustible construction.
- .10 Design transitions from roofs to walls projecting above roofs as protected membrane transitions. Protected roofing membrane detail shall include exterior insulation and metal flashing at the base of all walls.
- .11 Provide removable precast paver units around curbs (greater than 3 m any side) and for access paths.
  - .1 Pavers are to be free draining, and placed on insulation blocks or sleepers.
  - .2 Pavers, sleepers, etc. are isolated from the roof membrane
  - .3 Access paths using membrane cap sheets should be avoided.
- .12 When the exposed surface of a roof assembly, i.e. plaza type decks, is required to be cast-in-place concrete, provide the following:
  - .1 Drains at both deck and membrane levels, designed to allow for differential movement between those levels.
  - .2 Geotechnical type filter fabric between concrete and insulation below, to prevent concrete penetrating into the insulation layer.
  - .3 A drainage mat between the insulation layer and membrane. This acts as both an uninhibited drainage plane, as well as a separator sheet between the insulation and membrane.

**4.9.7.6. Steep Roofs**

- .1 Design steep roofs (slopes greater than 1:6) with the plane of waterproofing membrane/air barrier following the plane of ventilated roofing.
- .2 Configure steep roofs and perimeters so that snow, ice, and rainwater will not create safety, maintenance, or appearance problems. Design to prevent ice and snow from sliding onto areas intended for use by vehicles or pedestrians.
- .3 Where equipment or openings occur on sloped roofs, provide crickets to keep drainage paths away from the equipment or openings.

**4.9.7.7. Green Roofs**

- .1 Plants should be low maintenance, native to the region, or adapted to the local climate zone. Plants must not require water beyond what is typically available in the climate zone (except for the initial placement and nurturing for the first 90 days). Plant material shall be self sustaining.
- .2 All green roofs shall be designed and constructed in accordance with the latest issue of

the [ARCA Standards Manual - Section 11 - Vegetative \(Green\) roofing](#).

- .3 Where protective materials applied to assemblies to provide the required protection from precipitation are part of a green roof they shall be resistant to root and rhizome penetration.
- .4 Leak Detection:
  - .1 The completed roof membrane system shall be tested for water tightness prior to and following the installation of green roof components and membrane protection layer. Non destructive electronic leak detection systems shall be completed on green roofs, and specified in accordance with the latest issue ARCA standards.
  - .2 Irrigation Requirements
    - .1 Review sun exposure, climate, weather and wind uplift. These factors will help determine whether irrigation is advised. The City recommends that roofs shall be provided with irrigation for initial establishment and future drought conditions to assist operations. At minimum hose bibs shall be provided at 15m intervals.
  - .3 Maintenance Requirements
    - .1 Extensive green roofs shall accommodate access for periodic inspection.
    - .2 All green roofs shall provide access without the need for fall arrest.
    - .3 Operation and Maintenance manual shall include at minimum;
      - a. Plant Material requirements
      - b. Weed and Pest Management requirements
      - c. Tool and maintenance procedures
      - d. Succession plan of how to remove dead material and/or replant new material.
      - e. Prohibited tools, chemicals etc.
  - .4 Design Professional Requirements
    - .1 The City may engage a Green Roof Professional “GRP” to provide Project support for technical reviews, installation reviews and/or maintenance training.

**4.9.7.8. Equipment on Roofs**

- .1 Coordinate equipment installation with building envelope details. Seal all equipment to prevent moisture intrusion and air leakage.
- .2 Provide a minimum of 610 mm clearance between mechanical curbs. Ensure areas below

mechanical equipment are capable of drainage.

- .3 Under normal building humidity and operation, sleepers should be specified to support mechanical rooftop equipment as recommended by ARCA.
- .4 Systems and equipment placement will be in locations where engineered guardrails, travel restraint, and fall arrest are not necessary. Approval from the City to bypass this restriction is necessary. Should approval be provided, the preferred option will be guardrails.
- .5 Architectural screens shall be located a minimum of 1500 mm away from any roof top equipment. Additional clearance shall be provided where required by the equipment manufacturers.
- .6 Consultation with a Structural Engineer is required when replacing any ventilation unit located on a roof. Potential snow drifting and deflections need to be addressed. Consult with a Structural Engineer to accommodate snow drifting and deflection when locating any mechanical equipment on a roof.
- .7 Elevated mechanical equipment installed above roof top surfaces on structural frames shall ensure bird access through the bottom of the unit is restricted. If maintenance activities require access above the screening, screening shall accommodate access of personnel and equipment.

#### 4.9.7.9. Re-Roofing

- .1 A pre-design review report from a qualified roofing consultant is required. Cut tests are to be conducted in each different roofing assembly and roof zones to confirm roof composition.
- .2 All re-roofing drawing details and specifications should meet or exceed the guidelines within the latest edition of the ARCA Roofing Application Standards Manual.
- .3 Review actual depths of ponding water on roof and locations of roof deck depressions prior to designing a new sloped insulation roofing system.
- .4 A roof loading assessment by a structural engineer is required to determine how the contractor can load the roof during construction.
- .5 On structurally sloped roofs the re-roofing design may consider leaving existing primary insulation and cover panels in place if they are found to be in a dry condition and the insulation is determined to be adequate. The existing vapour barrier must be equivalent to two plies of built-up roofing and must be tied into adjacent wall air seals or vapour barriers. The metal decks are to be protected with a levelling surface.
- .6 Where required, build new parapets or extend the existing parapets to accommodate new insulation.



- .7 Re-roofing should include slopes of 1:50 unless there are restrictions of wall details or limitations of raising parapets to accommodate the new sloped insulation. Consider additional drains if required to improve roof slope.
- .8 Determine if the roof to wall tie-ins have an adequate air seal. If the existing wall air seal membrane is not sufficient to prevent air leakage, provide the roof to wall connection membrane stripping that could be tied into if the wall is re-cladded at a later date.
- .9 Sleeved re-roof drains with u-flow connectors are not to be used.
- .10 Existing roof drain and piping insulation shall be assessed for Hazardous Materials.
- .11 If the existing rainwater leaders direct water to grade through an exterior wall, check that there are no freezing problems associated with the existing construction. Correct construction as required.
- .12 Remove and reinstall all mechanical rooftop equipment to accommodate re-roofing (rooftop units, roof drains, associated piping, etc.). Raise curbs, ductwork, mechanical piping, and electrical services to accommodate sloped insulation.
- .13 Reinstall mechanical rooftop units and pipe supports on precast pavers or curbs. Ensure pavers are free draining.
- .14 For walkways, install raised precast pavers on roofs that can accommodate the load. Provide removable precast paver units around curbs (greater than 3 m any side) and for access path. Pavers are to be free draining, and placed on insulation blocks or sleepers.
- .15 Alternatively, for roofs that cannot accept the load, install a membrane cap sheet in a contrasting colour for walkways around mechanical rooftop units and in direct lines to stairwell or roof hatches. Leave 25 mm gaps in the MBM cap sheet walkway every meter to not impede drainage to the roof drains.
- .16 Where pitch pans (gum boxes) are eliminated, install insulated curbed roof openings with metal enclosures (dog houses) that have removable tops that will allow adding or deleting mechanical equipment. Ensure penetrations are air and water tight.
- .17 Include mechanical instructions for removal and replacement of roof top units.
- .18 Specify removal of all redundant rainwater leader piping and hangers if any roof drains are abandoned during the re-roof.
- .19 Remove curbs and repair penetrations from demolished equipment.

#### 4.9.8. Exterior Walls

- 4.9.8.1. Provide openings in the cladding at the top and bottom to permit drainage and pressure equalization of the air space.
- 4.9.8.2. Compartmentalize air spaces in the wall cavity to restrict air flow around corners and not more



than 4 m in any direction within the cavity generally. Detail and show the location of control joints and compartmentalization baffles in cladding.

- 4.9.8.3. Allow for deflection where walls are associated with structurally framed systems (as opposed to load-bearing systems). Locate and detail the deflection joints where deflection is expected in the structure. Design cladding assemblies to include through-wall flashing at regular intervals and at all cladding system changes to promote drainage in the assembly.

#### 4.9.9. **Windows, Doors, and Glass**

- 4.9.9.1. Specify window performance to prevent condensation from forming on window frames or glass.
- 4.9.9.2. The design of the curtain wall should have mechanically keyed gaskets in the box section and pressure plate. Anchors for the framing would be located within the vertical tube sections or as strap anchors so they do not interfere with adhesion of the membrane from the wall directly to the tube face of the aluminum frame. Mechanically retain the membrane with the anti-rotation channel.
- 4.9.9.3. All windows are to have internal drainage.
- 4.9.9.4. Design main floor windows on curbs to mitigate exposure to moisture.
- 4.9.9.5. Wherever practicable, do not project the main mass of window frames beyond the exterior plane of the air/vapour barrier (such as past the roof line in a parapet). Bridge the cavity of the wall as required to provide support to the membrane. Do not caulk cover caps to flashings.
- 4.9.9.6. Design windows, window treatment, and interior surroundings to allow uniform, unobstructed movement of heated room air across glass and frame.
- 4.9.9.7. Provide vestibules at building entrances, intended for public access, to avoid the possibility of interior humidity causing frost build-up on doors and frames and to avoid depressurization of the building.
- 4.9.9.8. Coordinate the selection of glazing with lighting and mechanical systems to avoid glare and solar overheating.
- 4.9.9.9. Consider how glazing units will be replaced when determining glazing unit systems and sizes of units, especially those at ground level where damage is most likely to occur.

#### 4.9.10. **Skylights and Sloped Glazing**

- 4.9.10.1. When light is to be introduced through the roof, vertical clerestory glazing is preferred over skylights and sloped glazing. Such designs allow for better control of overheating, condensation control, and solar glare.
- 4.9.10.2. If, after considering the risks and alternatives, designers still opt for skylights or sloped glazing and the City accepts the risks associated with them, the following design notes are offered to help minimize adverse consequences:
  - .1 Consider engaging a qualified building envelope consultant for thorough review of design detail and to inspect construction installation.

- .2 Slope glazing minimum 30 degrees from horizontal.
- .3 Design air seal connections to skylight and sloped glazing curbs and adjacent walls to be fully accessible and not dependent on construction sequence.
- .4 Design skylights and sloped glazing so that they are accessible for maintenance and cleaning from interior and exterior. Refer to [Facility Maintenance Equipment](#).
- .5 Make provision to drain water entering the glazing rabbet of the system back to the exterior, during all seasons. Water may enter the glazing system from the exterior. The skylight system should be designed to contain water in the glazing rabbet and drain it in an overlapped shingled fashion. Water should not contact caulked joints or seals.
- .6 Provide an interior condensation gutter system. In high humidity buildings, it may be necessary to drain the collected condensation at the sill to the mechanical system rather than relying on evaporation. This requirement should be addressed at the initial design stage.
- .7 Use mechanically keyed in dry glazing seals for the interior and exterior of the system. Do not depend on sealants.
- .8 Glazing should be minimum heat strengthened exterior lite, 12 mm airspace, 0.060 PVB laminated interior lite.
- .1 If skylights are located on a near flat roof, they shall be installed with a minimum height of 457mm (18in) above the highest point of the finished roof surface where the skylight is located, or 457mm (18in) above the nearest overflow drain.

#### 4.9.11. Concealed Spaces

- 4.9.11.1. Avoid sealed cavities and “dead space” as part of or adjacent to the building envelope. Enclosed spaces inside the envelope require heat and air circulation to avoid the formation of condensation. Unheated cavities are to be vented to the exterior. Spaces beneath or adjacent to roof mounted mechanical components must be accessible for maintenance.

Provide access to heated concealed spaces, i.e. heated overhangs, from the building interior.

Provide access to unheated ventilated concealed spaces from the exterior, i.e. unheated soffits with recessed lights, from the building exterior.

### 4.10. Interior Construction

#### 4.10.1. Inclusive Universal Washroom and Change Room Facilities

- 4.10.1.1. The City is committed to creating inclusive spaces for different identity factors including gender, age and disability.
- 4.10.1.2. Conventional gender-segregated facilities sometimes lack privacy and may discourage comfortable and safe use for gender-diverse communities, persons with disabilities and caregivers, children and families etc. Inclusive facilities promote increased privacy, choice, efficiency, and flexibility in meeting user needs.

4.10.1.3. Room Naming Conventions; use the following room naming conventions;

**Washroom:** Single or Multi-user room with toilets and sink for everyone.

**Universal Change Room:** Single or Multi-user room with change areas for everyone.

4.10.1.4. Signage Conventions

.1 In most cases a pictogram with code-compliant tactile signage is enough to sign a washroom or universal change room however flexibility is permitted to make a context-based decision on whether a pictogram should be complemented with a text based room names or some other explanatory wording.

.2 The goal is to:

- ensure people are confident they are entering into the washroom or change room they want (male, female or universal)
- get to the place where we can simply say 'Washroom' and for everyone to understand it as a space for all.



4.10.1.5. Minimum design standards;

.1 Province of Alberta '[Accessibility Design Guide 2024](#)' ,

.2 City of Edmonton Access Design Guideline,

.3 the following City design standards,

- .1 clear locking and occupancy signage
- .2 toilet Seats with an integrated handle that allows the user to easily raise and lower the ring.
- .3 no perimeter doors or hidden areas
- .4 multiple points of entry/exit or visual connection
- .5 Where Projects have inclusive universal washrooms only (no gender segregated washroom option), provide one fully enclosed universal toilet room near the entrance of the inclusive universal washroom. This offers those not yet comfortable with inclusive spaces an option prior to entering the entire washroom area.
- .6 In assembly occupancies where a sudden surge of occupants is anticipated (theatres, stadiums, arenas, concert venues etc.) the Project may elect to have a 'uritorium' to

assist with throughput. The uritorium (room with urinals) may be located within the gender inclusive washroom but must be clearly signed with fixture type.

.7 Site specific considerations shall be addressed in the design to the full extent feasible. Challenges and solutions could include;

.1 Noise Transmission

- ambient background noise for audible privacy
- full height intermediate walls
- material selections

.2 Odour Control

- auto door closers
- mechanical extraction for each stall
- materials and surfaces

.3 Security

- help call button to activate audible and visual signals immediately outside the toilet stall/universal washroom, and where possible allow for door to be automatically released.
- stall usage time monitoring (operational impact)
- In washrooms with over 10 toilet fixtures/long corridors, consider centrally locating sinks for more natural surveillance of toilet stalls.
- surveillance of common areas
- motion sensor lighting
- robust fixtures and coatings
- If full height doors, a small shielded peephole, or one way mirror in stall doors to provide stall occupants the ability to view the common area before leaving a stall.
- a 50-100mm gap at the bottom of all washroom stalls. This provides visual surveillance and allows emergency services to locate persons in medical distress, and patrons ability to see immediately outside the door - prior to opening. Research has been done that supports this rationale, indicating those who have been affected by gender violence actually prefer a gap for auditory and visual alert. This may require a Code alternative solution.

.4 Comfort

- an accessible urinal with grab bars option within at least one stall, this helps people with low mobility
- step stools at sinks for children, or those of low stature
- inclusion of diverse spaces (breastfeeding, medical needs, grooming)
- Inclusion of a rest area/gathering space directly outside of the washroom area to

encourage more natural surveillance and prevent a feeling of isolation

- addition of biophilia for mental well being

## 4.11. Furniture, Fixtures, and Equipment (FF&E)

### 4.11.1. Signage

4.11.1.1. All Projects require the design of regulatory signage; washroom, room names, door numbers, maintenance door tags, exterior address, fire exiting, no smoking, parking, and barrier free signs. Consultant drawings and specifications for this signage must be included in the Construction Documents for implementation

#### .1 Bylaw Signage

.1 No Smoking Signs: City standard signage must be posted within 10 feet (3 meters) of public entrances.

#### .2 Electric Vehicle Charging:

.1 Post mounted signage with the words *“Except for Electric Vehicle While Charging”* with the international Symbol for No Parking shall be installed.

.2 DoorTags: approx. 25mm x 75mm black acrylic plate with routed numbers (white) or lamacoid, to be located on all interior swing door frames (upper right-hand corner public side). Refer to [Door Naming Convention Standards](#).

.3 Door numbers: Refer to [Door Naming Convention Standards](#).

#### .4 Exterior Signage:

.1 Design exterior illuminated signage to meet the recommended guidelines of the International Dark-Sky Association (IDA), to minimize glare, reduce light trespass, and avoid light pollution of the night sky.

.2 Provide dustproof, waterproof, and light proof seams and joints for illuminated sign boxes.

.3 Provide sufficient bleed space for sign faces within the framing.

.4 Provide UV-resistant signage to limit colour deterioration.

.5 Determine the locations of signs with due consideration to vehicular and pedestrian sight lines.

#### .5 Parking Signage:

.1 Signage shall be located such that it will not be impacted by a vehicle bumper in relation to the wheel stop.

.2 Refer to C.5 'Parking Signs' [City of Edmonton Access Design Guideline](#) for City Accessible signage and pavement marking requirements.

**.6 LEED**

.1 Plaques: Coordination of the location and installation of LEED-provided interior and exterior certification plaques.

.2 LEED Green Building Education: The Consultant will be responsible for developing LEED Green Building Education materials, and shall use the approved City Green Building Signage template. Alternate language may be considered however should be simple, engaging, easy to understand and accurate. All materials shall be approved by the City LEED rep via, [CoEleedrep@edmonton.ca](mailto:CoEleedrep@edmonton.ca) prior to implementation.

.7 Wayfinding/ Maps: Exterior directional wayfinding signs must be LED backlit such that they are viewable in all lighting conditions, placed so that queuing does not negatively impact pedestrian flow; easily accessed by persons; and they are easily accessible for regular replacement.

**.8 Other:**

.1 Colour alone should not be used to convey information due to colorblindness, instead use both colour and symbols.

.9 Other Available Signage guidelines (where two signage standards are in conflict the most recent shall apply):

.1 [Inclusive Universal Washrooms](#) and Change rooms

.2 City of Edmonton LEED Green Building Education Signage Standard, 2023

.3 Bylaw Signage:

.1 City of Edmonton Bylaw 14614 – No Smoking Signage

.4 Design Guidelines, Edmonton Recreation Facility Signage, 2023

.5 [City of Edmonton Access Design Guideline](#) (see section A.6 and K.8)

.6 Business Area-Specific Signage Guides:

.1 City of Edmonton Recreation Facility Branding colours, 2021

.2 Bike Route Wayfinding Guide, 2021

.3 LRT Signage - Light Rail Transit Graphic Standards Manual, MARCH 11, 2020

.4 City of Edmonton Pedestrian Wayfinding Standard, September 2016

.5 Edmonton River Valley Parks Signage and Wayfinding Guidelines, March 2021

.6 City of Edmonton Pedway Signing & Graphics Manual, 2015

.7 City of Edmonton Waste Bin Signage Decals

.8 City of Edmonton Project Identification Sign - Division 01 (included in Construction Contract)

.9 Building Edmonton Sign - City Project Manager IIS Communications Advisor to coordinate print production and the installation at Construction Site

#### 4.11.2. Furniture

4.11.2.1. The City holds agreements with furniture and demountable wall vendors which may be used within the Project, contact the City Project Manager for information.

#### 4.11.3. Custodial Fixtures

4.11.3.1. The City of Edmonton holds custodial contracts for the supply of consumable products and their related dispensers, contact City Project Manager for facility-specific information

4.11.3.2. Indoor Waste and Collection Bins:

.1 Refer to [Waste](#)

### 4.12. Building Acoustics

#### 4.12.1. References

4.12.1.1. Meet or exceed the guidelines and standards of the following, as applicable:

- .1 ASHRAE: 2015 ASHRAE handbook - HVAC applications, Chapter 49: Sound and Vibration Control.
- .2 CISC: Handbook of Steel Construction – Appendix G, Guide for Floor Vibrations.

#### 4.12.2. Acoustically Critical Spaces

4.12.2.1. Consult with the City for clarification of any;

- .1 Rooms where speech privacy, sound isolations, background noise, or reverberation control is critical. In most cases, more than one of these acoustic conditions will need to be considered for interview and therapy rooms, teleconference rooms, courtrooms, auditoria, and lecture halls.
- .2 Unusual situations where adjacent occupancies may not be acoustically compatible and special construction is required.
- .3 Large open-plan office projects. There are numerous acoustical requirements associated with this type of space layout.

#### 4.12.3. Acoustic Considerations: Architectural

4.12.3.1. General



- .1 Acoustically critical spaces shall not be next to high noise areas (i.e. conference rooms adjacent to mechanical rooms). Consider both the horizontal and vertical layouts.

4.12.3.2. Floor Construction

- .1 Provide a floating floor when rooms with low noise criteria (i.e. auditoria and studios) are located directly below such mechanical areas with high levels of noise.
- .2 Design for impact sound isolation where areas of high impact (i.e. corridors, fitness centres and fitness studios, indoor play, and child-minding areas) are located above or directly adjacent to occupied rooms with less activity.

4.12.3.3. Acoustic Criteria

- .1 Design to meet the following acoustic criteria. Acoustic testing and verification may be completed by the City upon construction completion, coordinate requirements with project manager:

Space Description	ASTC Rating (min)	Recommended Range for Background Noise, dB(A)	Reverberation Time, seconds
Moderate Privacy Requirements - General Office Space	40		
Private Offices	45	40-45	
Confidential Privacy Requirements Executive Offices - Large Conference Rooms, Training Rooms, Disciplinary Rooms, Interview Rooms	50	35-40	.5
Classrooms up to 300m <sup>3</sup>	50	35-40	.6
Acoustically Critical Spaces - Studios, Auditoria, Lecture Halls	50+ (varies)		
Gymnasiums		40-45	<2
Library		40-45	.7
Resting areas (separating from common hallways)	40		
Walls, partitions and floor/ceiling assemblies separating sleeping units from each other	55		

- .2 Partitions with STC 45 rating should generally be full height or incorporate a gypsum board plenum barrier.
- .3 Use full-height wall construction or drywall ceilings in rooms that require STC 50 or greater.
- .4 Provide continuous, airtight seals at building component junctions such as:
  - .1 Partition to perimeter heater cabinet
  - .2 behind the heating cabinet at all window mullion locations.

- .3 Partition to suspended ceiling,
- .4 Partition to window mullion at exterior walls.
- .5 piping, duct, and conduit that penetrate partitions and floors.
- .6 roof penetrations
- .5 Provide a solid airtight barrier behind perimeter heater cabinets to prevent sound transfer at common partitions.
- .6 Do not use operable partitions between areas that require a high degree of speech privacy.
- .7 Where operable partitions are deemed necessary for general noise isolation, specify a partition that has a minimum STC 50 rating. Detail such partitions according to ASTM E557, Standard Recommended Practice for Architectural Application and Installation of Operable Partitions.
- .8 Use massive wall construction (i.e. concrete block, poured concrete, multi-layer drywall) to separate occupied spaces from duct shafts, rain water leaders, and mechanical rooms.

**4.12.4. Acoustic Considerations: Mechanical**

**4.12.4.1. Background Noise**

- .1 Design mechanical systems to provide background noise levels, as follows (as per ASHRAE Applications Handbook):

<b>Space Description</b>	<b>Room Criterion (RC)</b>
Radio/Recording Studio, Auditorium	20 maximum
Audio/Visual Room, Courtroom, Teleconference Room	25 maximum
Large Conference Room, Observation/Therapy Room, Classroom, Lecture Hall	25 – 30 maximum
Enclosed Office, Meeting Room	30 - 35
Open Plan Areas, Library, Cafeteria, Reception/Waiting Areas	35 - 40
Computer Room, Kitchen	45 maximum
Light Maintenance Shop	50 maximum

- .2 In most office settings, a neutral, unobtrusive background noise helps to increase speech privacy. Therefore, over-silencing is undesirable.
- .3 Consult with City of Edmonton Engineering Services on spaces that require a noise level of RC 25 or less.

**4.12.4.2. Ducts, Terminal Devices, Heat Components and Silencers**

- .1 Whenever possible, design the system layout so that any medium velocity ducts and terminal boxes are above service space such as corridors.
- .2 Exhaust fans shall be located in non Acoustically Critical spaces only. Provide an acoustically lined duct on the fan intake.
- .3 Avoid placing rooftop equipment over noise-sensitive areas.

- .4 Design main air distribution systems to minimize the use of acoustic duct lining, whenever possible.
- .5 Select acoustic silencers with the lowest static pressure loss, when a selection of two or more silencers exists.
- .6 Use flexible connections between fans, plenums, and all related ductwork.
- .7 Provide smooth air flow conditions near fan units. Spiral-wound, round duct is preferred for air velocities over 9 m/s or where excessive turbulence is anticipated.
- .8 Use non-continuous perimeter heat cabinets that allow acoustic barriers to be installed behind the cabinet at all window mullion locations. Provide easy access at these locations.
- .9 Select terminal boxes on the basis of both in duct and radiated noise level. Manufacturer's VAV box noise data often assume the equipment is located above a mineral fibre ceiling and that there is the use of acoustically-lined duct. Ensure that the design includes the effect of these elements.
- .10 Select diffusers/air outlets so that the combined noise from all diffusers in a room meets the design criterion. Noise from a single diffuser will typically need to be specified 6 – 10 dB lower than RC(N) goal when several diffusers are in the same room.
- .11 Locate the balancing damper at least 2 m away from the diffuser.
- .12 Provide at least 600 mm of straight duct prior to the diffuser inlet.
- .13 Use Z shape return air transfer ducts (sound traps) for offices where privacy is identified as a concern.

#### 4.12.4.3. Plumbing Noise

- .1 Use a resilient sleeve around supply pipes with oversize clamps fastened to the structure, in areas where water flow noise may be a disturbance. Sleeves comprised of 254 mm (12") thick closed-cell elastomeric pipe insulation or proprietary resilient pipe fasteners are acceptable. Do not use hard plastic sleeves.
- .2 Ensure that pipes penetrating through drywall partitions are not rigidly connected. Provide a sleeve at the wall opening, leaving air space around the pipe, and seal with resilient caulking.
- .3 Where double plumbing walls are used (i.e. washrooms); attach supply piping only to the fixture side of the wall structure.
- .4 Consider the use of pressure reducing valves (PRVs) in the system to minimize plumbing noise for noise sensitive areas. Size PRVs to limit the pressure at fixtures to 375 kPa.
- .5 Install water hammer arrestor adjacent to any quick-acting solenoid valves.

#### 4.12.4.4. Vibration Isolation

- .1 Use the current ASHRAE Applications Handbook, as a guide for selecting vibration isolation of mechanical equipment.
- .2 Provide vibration isolators for all vibrating pipes and ducts in mechanical chases and walls common to noise sensitive areas.

- .3 Use flexible connectors on pumps that require vibration isolation from piping. Twin sphere neoprene rubber flex connectors are preferred.
- .4 For rooftop equipment, vibration problems can usually be avoided if the static deflection of each spring isolator is at least 15 times the structural deflection of the roof due to the equipment loading. Typically, this requires springs with a static deflection of 50 – 100 mm.

**4.12.4.5. Community Noise**

- .1 Silence or strategically locate outdoor mechanical equipment, interior generator rooms, and intake/exhaust openings to meet local municipal noise by-law requirements.

**4.12.5. Acoustic Considerations: Electrical**

**4.12.5.1. Transformers**

- .1 Avoid locating transformers within ceiling spaces above noise sensitive spaces.
- .2 Provide vibration isolators for transformers near occupied spaces. Use the following table as a guide for selecting vibration isolators.

Size (kVA)	Near Non Critical Areas		Near Critical Areas	
	Isolator Type	Static Deflection	Isolator Type	Static Deflection
<b>Under 50</b>	Neoprene pad	3 mm	Neoprene isolator	10 mm
<b>50 – 250</b>	Neoprene isolator	10 mm	Spring isolator or hanger	19 mm
<b>Over 250</b>	Spring isolator or hanger	19 mm	Spring isolator or hanger	25 mm

- .3 Provide flexible conduit to make the final connection to the transformer.

**4.13. Doors and Hardware**

**4.13.1. Coordination with Security**

- 4.13.1.1. Coordinate door hardware with security equipment
- 4.13.1.2. Refer to [Appendix C “Security and Card Access System Design Guidelines”](#).

**4.13.2. Lockset and Keying Standards**

- 4.13.2.1. When specifying the locksets and keying, ensure the manufacturer and model number is listed.
- 4.13.2.2. All City departments have a lockset & keying standard that must be adhered to. These standards differ between departments within the City.
- 4.13.2.3. Request the lock standard from the Project Manager.
- 4.13.2.4. Include a requirement for Contractor to hand over locksets to the City for keying at an appropriate time prior to occupation.

**4.13.3. Door Installation Tolerances**

- 4.13.3.1. Between Steel Doors & Frame: 3 mm +/- 1.5 mm hinge, top, and latch side

- 4.13.3.2. Between Wood Doors & Frame: 3 mm +/- 1.5 mm hinge, top, and latch side
- 4.13.3.3. Between Aluminum Doors & Frame: 3 mm +/- 1.5 mm hinge, top, and latch side
- 4.13.3.4. Between any door and the finished floor: 13 mm – 25 mm, depending on threshold requirements, return air requirements, and acoustic concerns.

**4.13.4. Door Naming Convention Standards**

- 4.13.4.1. When developing door schedules, ensure that the door tags used are a maximum of 7 digits. (The floor plans are used to label doors, and the City's current Access control and intrusion detection 'CCURE' is restricted to 7 digits.)
- 4.13.4.2. Coordinate the doors numbering at the same time as adding room numbers, with the input from the Cities Facility Inventory Management Team, email "[fim@edmonton.ca](mailto:fim@edmonton.ca)". This allows a cohesive wayfinding system to be implemented, where the room and door numbers align.

**4.13.5. Door Hardware**

Door hardware shall be specified as per the table below.

<b>HEAVY DUTY CLOSER</b>	LCN 4000 series	Sargent 351 series	Norton 7500 series
<b>MED DUTY CLOSER</b>	LCN 1000 series	Sargent 1331 Series	Corbin Russwin DC8000 series
<b>TRACK ARM DOOR CLOSER</b>	LCN T-series (track)	Sargent 422 Series	Corbin Russwin DC5000 Series
<b>CENTRE HUNG DOOR CLOSER</b>	RIXSON 345	IVES	Norton series
<b>CONCEALED DOOR CLOSER</b>	LCN 2030/3130/5030 series	Sargent 268 Series	Norton series
<b>DOOR CHECK</b>	GLYNN JOHNSON 400 series	Sargent 590/690/1540/1530	Hagar 6000/7000
<b>HINGES</b>	IVES 3/5KN CB/BB	McKinney 3/5KN CB/BB	Stanley 3/5KN CB/BB
<b>ELECTRIFIED HINGE</b>	approval required. Refer to <a href="#">Electric Door Strikes</a> .		
<b>KNOBSET</b>	Schlage D Series (*SFIC)	Sargent 8 Line Series (*SFIC)	Best 83K (*SFIC)
<b>LEVERSET</b>	Schlage ND Series (*SFIC)	Sargent 10 Line Series (*SFIC)	Best 93K (*SFIC)
<b>ELECTRIFIED LEVERSET</b>	approval required. Refer to <a href="#">Electric Door Strikes</a> .		
<b>MORTISE</b>	Schlage L-Series	Sargent	Corbin Russwin

<b>ELECTRIFIED MORTISE</b>	approval required. Refer to <a href="#">Electric Door Strikes</a> .		
<b>ELECTRIC STRIKE</b> * Refer to Appendix C	VON DUPRIN	RCI/EFF	HES
<b>CODE ENTRY</b>	Kaba E-PLEX/Powerplex 2000	Unican 1000/L1000 w/Key O/R	Schlage CO/AD
<b>PANIC</b>	Von Duprin 98/99 Series	Sargent 8000 /9000 series	ED5000
<b>FIRE EXIT</b>	Von Duprin 98-F/99-F Series	Sargent 8000-F series	ED5000 Rated
<b>FLUSH BOLTS</b>	Ives	Rockwood	Canaropa
<b>WEATHERSTRIPPING</b>	Zero International	KNC Crowder	Reese
<b>DOOR LOCK CORES</b>	BEST 7 Pin cores with the keyway to be specified by FMS.		
<b>SAUNA/STEAM ROOM</b>	Spring loaded hinges, not a hydraulic closer.		

**4.13.6. Maintenance Access Doors**

- 4.13.6.1. Horizontal or vertical access doors through gypsum wall board shall utilize light weight metal doors and include rounded safety corners, hinges (concealed or otherwise), screwdriver latch, anchor straps and must be able to open 180°.

**4.13.7. Overhead Doors**

- 4.13.7.1. Where large overhead doors are required, the design shall eliminate the hazard of a door free-fall, impact, or entrapment. If the hazard must remain for the product to operate, then an engineered solution (such as a fall arrestor) shall be included to guard against the hazard.

**4.14. Millwork**

- 4.14.1. All millwork shall be manufactured and installed in accordance with the standards incorporated in the Architectural Woodwork Standards of Canada.

**4.14.2. Extended Warranty:**

- .1 Confirm with the City Project Manager if an AWMAC Guarantee Certificate is required for the Project. If the AWMAC Guarantee Certificate is not required, provide the City with a two (2) year maintenance bond, to the full value of the architectural woodwork contract.
- .2 All projects with a requirement for an AWMAC Guarantee Certificate shall be subject to an inspection at the plant and site by an appointed inspector, approved by the local AWMAC/AWI Chapter. Such inspection costs shall be included in the bid price for the

project.

## 4.15. Coatings

### 4.15.1. Paint

- 4.15.1.1. Paint quality, colours and gloss level must be durable, maintainable and appropriate for location and lighting levels.

### 4.15.2. Graffiti and Stain Resistant Coatings

- 4.15.2.1. If the facility site is determined by the City as a high risk then graffiti and stain resistant coatings should be applied to all exposed to Public View surfaces to a minimum height of 3000 mm above finished floor, and: for surfaces having cladding, the coating must be applied to the nearest horizontal cladding joint above 3000 mm above finished floor; not be applied to glass surfaces, including curtainwalls, windows, or aluminium entrance systems; and the application of graffiti and stain resistant coatings must not alter the colour or other physical properties of the surface to which it is applied such that it creates a visually apparent line between surfaces which have been treated and those which have been left untreated. Joint/concealment management at building envelope material transitions are to be carefully considered so as to minimize potential stashing of illicit products and vandalism.
- 4.15.2.2. High Use Door Coating Basis of Design: Cloverdale Paint Renaissance - Hybrid Waterborne Alkyd Finish, Low Gloss (GL4) 03453

### 4.15.3. Structural Coatings:

- 4.15.3.1. Clean, and prepare and prime structural steel exposed to view to a minimum standard of MPI-23 or MPI-79 and SSPC SP1 solvent cleaning and SSPC SP243 Hand tool cleaning.
- 4.15.3.2. Remove any requirements for spare paint from project specifications.
- 4.15.3.3. Coordinate AESS – Architecturally Exposed Structural Steel with the architectural consultant.
- 4.15.3.4. Specifications must address the need for a finish coat on wood products. glulam members.
  - .1 Exterior Wood Structural Components: Recommended glulam finish is Sikkens Cetol 1 (first and second coat) and Sikkens Cetol 23 (third and fourth coat), or equivalent. Factory seal coat/wax restrictions imposed by manufacturer Sikkens should be noted in the project specifications.

### 4.15.4. Mechanical:

- 4.15.4.1. Mechanical room floors/walls should be sealed with a poly-amide epoxy coating on the floor and 6" up the walls to contain water in the event of an equipment failure or flooding.

### 4.15.5. Concrete Filter and Surge Tanks

- 4.15.5.1. Water tanks, including surge tanks within aquatic systems, need to be non porous, smooth, and easy to clean to eliminate biofilm. Coatings, waterproof membranes or alternate systems that prepare the surface for chemicals and easy cleaning from the interior must be provided. Basis of Design: Mat Reinforced Flake Filled Linings - Coroflake 266 MR.



#### 4.15.6. Ice Melt Pits, Sump Pits

- 4.15.6.1. Protect damaging effects of water intrusion on concrete, masonry or mortar. Waterproofing membrane as well as an integral waterproofing admixture shall be considered.

### 4.16. Mechanical

#### 4.16.1. References

- 4.16.1.1. In addition to all Applicable Laws, meet or exceed the following guidelines and standards:

- .1 Canadian Standards Association (CSA) Standards
- .2 ASHRAE Handbooks
- .3 ASHRAE Standards
- .4 SMACNA Standards
- .5 NFPA Standards
- .6 *Industrial Ventilation: A Manual of Recommended Practice*, American Conference of Governmental Industrial Hygienists

#### 4.16.1.2. Consultant Manual Volume 2 References

- .1 [Acoustic Considerations: Mechanical](#)
- .2 [Irrigations Systems](#)
- .3 [Appendix A](#) - Colour-Coding Requirements for Mechanical and Electrical Systems
- .4 Motor Control” for guidance on motors, voltages, system redundancy, and the use and application of Drives/VFDs
- .5 [Appendix G](#) - Guidelines for Gas Detection Systems
- .6 [Pool Systems and Other Water Treatment](#)
- .7 [Arena](#)
- .8 [Rainwater Leaders](#)

#### 4.16.2. General

##### 4.16.2.1. Accessibility

- .1 Refer to [Facility Maintenance](#)
- .2 Provide sufficient access space (manufacturer’s recommended service clearance is considered a minimum) for servicing, maintaining, and removal of equipment and components or portions thereof (i.e. tube bundles, filter media, large motors, dehumidifiers). Service access requirements shall be shown on drawings.
- .3 For bearings requiring lubrication on belt-driven equipment, remote grease nipples shall be included to facilitate maintenance activities without removing safety guards and barriers.
- .4 Mechanical room pumps shall be arranged such that all pumps have minimum 600 mm clear service clearance to one side of the pump. Duplex pump configurations shall be

located as a pair with 600 mm service clearance on both sides. Pumps shall not be stacked vertically.

- .5 Reduced pressure backflow preventers shall be installed less than 1500 mm above finished floor.
- .6 Heating and chilled water systems shall have chemical treatment equipment located such that service can be accomplished without reaching over piping and/or equipment. Chemical pot feeders shall be located less than 1000 mm above the finished floor. Filter housings shall be located less than 1500 mm above finished floor.
- .7 Provide minimum 300 mm clearance between underside of rooftop equipment and roof surfaces underneath.
- .8 Provide minimum 2.13 metre (7 feet) over head height clearance in mechanical rooms.
- .9 In general, except for heating and sanitary systems, mechanical systems must not be located in slab or below slab-on-grade. For any exceptions, consult with City Facility Engineering.
- .10 Provide an adequate lifting device or method to lift maintainable components over 22.7 kg (50 lbs). A minimum of 0.9 m (3ft) of clear space above manufacturer maintenance clearance for mechanical equipment (including pumps, boilers, etc.) is required to accommodate lifting devices, if a dedicated system is not provided as part of the design.

**4.16.2.2. Energy**

- .1 Refer to the Professional Service Agreement and the latest edition of “Consultant Manual Volume 1, Design Process and Guidelines” for sustainable design requirements.
- .2 Energy Efficiency Measures encouraged by the City are:
  - .1 Free cooling
  - .2 Heat recovery and reclaim
  - .3 Reduced fan and pumping flow rates when maximum flow is not required
  - .4 Reduced outside air volumes and ventilation rates during unoccupied hours
  - .5 Shutting down domestic hot water recirculation pumps during unoccupied hours
  - .6 High efficiency electric motors

**4.16.2.3. Existing Building Mechanical Systems**

- .1 For projects where an existing building is being renovated or being added to, the basis of design for the new mechanical system is to match or exceed the existing base building system in terms of occupant comfort and energy performance.
- .2 Design Consultant shall identify existing equipment to remain in place for systems being modified. Design Consultant shall coordinate with FMS to determine shutdown, maintenance and long term preservation requirements for dormant equipment for long term construction projects as appropriate.
- .3 Design Consultant shall identify existing equipment being removed or abandoned under the project and define decommissioning procedures and requirements in the project

specifications. Design Consultant shall identify if any regulatory requirements exist for equipment to be decommissioned and who will be filing the necessary documentation.

- .4 All existing piping and duct systems in a renovation project shall be balanced and flushed / cleaned along with any new portions added to the system.
  - .1 All existing piping systems not being modified by the project to be pressure tested along with any new piping.
  - .2 If a ventilation system was not modified but was operated during construction then the contractor is to, at a minimum, replace existing filters with new.
  - .3 It is recommended that pre-construction air / hydronic flows be measured and the system rebalanced accordingly post-construction.

#### 4.16.2.4. Winterization

- .1 Document all elements required for proper winterization of seasonal systems within the design and record documents. This shall include but not be limited to the following:
  - .1 Blow down points with maximum allowable purge pressure identified.
  - .2 A detailed winterization procedure.
  - .3 Demonstration of winterization procedures to City maintenance staff.

#### 4.16.2.5. Systems on Backup Power

- .1 Where a Backup Power source is installed, ensure the following equipment is connected:
  - .1 All components of any heating system within the building
  - .2 Building Automation System
  - .3 Additional freeze protection systems
  - .4 Flood protection systems, including sump pumps
  - .5 Critical systems on a case by case basis.
- .2 Additional non-critical systems may be placed on standby power.

#### 4.16.2.6. Balancing

- .1 All balancing shall be completed in accordance with NEBB and/or AABC procedural standards.
  - .1 It is recommended that a NEBB, AABC or TABB certified firm(s) complete all balancing scopes of work.
  - .2 In general, any existing systems which are being connected to by new work, should be re-balanced, flushed / cleaned, pressure-tested, & re-commissioned along with new work.

### 4.16.3. Design Criteria

- 4.16.3.1. Design conditions shall be January 1% and July 2.5% as per the Alberta Building Code.

- 4.16.3.2. A safety factor of 10% shall be applied to heating and cooling load calculations.
  - .1 Do not allow a 10% safety factor for cooling load when sizing central cooling plant equipment.
- 4.16.3.3. Setpoints:
  - .1 Heating space temperature setpoint shall be 23°C.
  - .2 Cooling space temperature setpoint shall be 22°C.
  - .3 Heating space relative humidity setpoint shall be 20% when the outdoor air temperature is lower than 0°C and 30% when the outdoor air temperature is higher than 0°C.
  - .1 Where humidity sensitive elements are used within the building structure, provide appropriate humidification systems
  - .4 Enclosed Parking Structures shall be designed with the ability to heat spaces to 18°C.
  - .5 Provide heat to interior envelope surfaces as required to prevent condensation. Provide heat to any interior surfaces that are adjacent to spaces with different temperature and relative humidity conditions to prevent condensation.
  - .6 In enclosed ceiling spaces with roof heat loss, provide radiation elements and temperature sensors to maintain minimum 18°C within ceiling space.
  - .7 Mechanical and Electrical room space temperature to be maintained between 18°C and 26°C.
  - .8 IT UPS and BESS rooms shall be maintained between 20°C and 22°C.
  - .1 Confirm final operating temperature range with the Electrical Consultant for the specific models during design.
  - .9 Provide cooling capacity to accommodate future growth. When a future electrical room growth cannot be precisely forecasted, the HVAC system should be installed with 15% to 25% spare capacity or with provisions made to add capacity.
- 4.16.3.4. Cooling and ventilation requirements for spaces housing Uninterruptible Power Supply (UPS) equipment and components, including batteries, should be coordinated with Electrical. For additional information on UPS design criteria, refer to [Life Safety, Emergency, and Security Systems](#).

#### 4.16.4. **Plumbing**

##### 4.16.4.1. **General**

- .1 Heat domestic hot water independent of the building heating system. Alternative and innovative designs or products are encouraged after thorough consideration of potential benefits and risks, value analysis and life cycle costs. Consult with City Facility Engineering for any alternative and innovative designs.
- .2 Instantaneous domestic water heaters shall only be used where the application requires it. Specify a water softener for instantaneous domestic hot water installations or provide three way isolation valve kits before and after the heater to allow for yearly de-scaling.
- .3 Domestic hot water recirculation piping shall connect as close as practical to washroom

lavatories.

- .4 PEX piping shall be considered for domestic hot water recirculation applications only.
- .5 Domestic water recirculation systems shall be designed to maintain a water velocity below 0.9 m/s.
- .6 Domestic hot water recirculation piping shall include a balancing valve to limit the flow to the value prescribed above.
- .7 Domestic hot water recirculation pumps to be installed so they are readily accessible from ground level.
- .8 Grey water systems will not be accepted.
- .9 Cleanouts shall be specified as 50 mm or larger. Clean-outs for urinals shall be located above the rim flood level.
- .10 High-Low systems are not accepted for mixing valves for shower applications.
- .11 For any facility with more than 4 shower heads, a feedforward digital mixing valve shall be specified. The valve is to be installed in a gender neutral, accessible area.
- .12 Plumbing pipe insulation jacketing shall be PVC.
- .13 Submersible sump pumps shall be equipped with chain, rails, or removal methods to facilitate maintenance activities. Submersed impellers with motor outside the sump are preferred.
- .14 No under sink water filtration devices are to be installed.

**4.16.4.2. Plumbing in Electrical Rooms**

- .1 Floor Drains
  - .1 Provide a floor drain with a backflow valve in any below grade Electrical or IT rooms.
  - .2 Avoid floor drains where possible for at grade or above grade electrical rooms
- .2 Pipe General
  - .1 Plumbing pipe shall be avoided in electrical rooms as much as possible.
  - .2 If pipe in the electrical room (all types including NAR, IT, UPS, BESS, etc) is unavoidable consult with City Facility Engineering for consideration of containment options and leak detection.
  - .3 Drip trays shall be piped outside the electrical room in a manner that can't back flow

**4.16.4.3. Plumbing Fixtures**

- .1 Flush valves shall be exposed, automatic infrared sensor type.
- .2 Preference is for flush valves and faucets to be self-powering.
- .3 Waterless urinals will not be accepted.
- .4 The City has preferred plumbing fixtures. Specification of these models is encouraged.
- .1 Lavatory

- .1 Faucet – Self generating turbine-powered, battery operated, 0.5 GPM (1.9LPM) automatic infrared sensor activated faucet with 10 second flow.
  - a. Toto model T28S51
- .2 Faucet (Manual)- At times the City will request to have manual lever faucets. In order to meet Code, an automatic shutoff may be required,
  - a. Delta 22C101 Single Handle Commercial Lavatory Faucet
- .3 Basin – Self rimming vanity basin with faucet ledge.
  - a. American Standard Cadet 9494
  - b. Franke V1821
- .4 Basin - Wheelchair accessible
  - a. American Standard 9141
- .2 Flush Valve Type Water Closet
  - .1 Flush Valve – Self generating turbine-powered, battery operated, automatic, infrared sensor activated, piston operated, 1.28 GPF, flush valve.
    - a. Toto model TET1LA32#CP
  - .2 Bowl – Wall mounted elongated front bowl suitable for 1.28 GPF.
    - a. Toto CT708U
    - b. American Standard AFWall 3351
- .3 Tank Type Water Closet
  - .1 Tank and Bowl – Floor mount, non-pressure assisted, 1.28 GPF.
    - a. Toto Eco Drake CST743E
    - b. American Standard Cadet Pro 215DA
- .4 Toilet Seat
  - .1 Shall be open front type with no lid.
    - a. Bemis Commercial Sta-Tite 955CT
    - b. Universal washrooms shall have an integrated handle which allows the user to easily raise and lower the ring.
    - c. Preference for universal toilets is to have a back rest and elongated flush valve.
- .5 Urinal
  - .1 Flush Valve – Self Generating, automatic, infrared sensor activated, piston operated, 0.5 GPF flush valve. Urinals shall have a minimum drain size of 75 mm nominal diameter.
    - a. Toto model TEU1LA12#CP
  - .2 Basin – Wall mounted, 0.5GPF.

- a. Toto model UT447E
- b. American Standard Washbrook 6590-001
- .6 Recreation or Fitness Facility Showers
  - .1 Shower Limiter Valve – Symmons Showeroff 4-428
  - .2 Shower Head – 2.0 GPM Delta RP38357
- .7 Floor Drains
  - .1 Epoxy coated cast iron floor drain
    - a. Watts Drainage FD-200
- .8 Mop Sink
  - .1 Molded stone mop service basin
    - a. Fiat MSB 2424
  - .1 Stainless steel is acceptable in certain situations

#### 4.16.5. Hydronic Systems

- 4.16.5.1. Where suitable, wet-rotor type inline pumps are preferred. Preferred manufacturers of these pumps include Grundfos and Wilo.
- 4.16.5.2. Preference should be given to the two-pipe reverse return system for hydronic systems. Direct return systems may be used if the design safeguards against flow imbalance to terminal units.
- 4.16.5.3. Pumps shall only be installed at floor level.
- 4.16.5.4. Pipe insulation:
  - .1 Pipe insulation jacketing is preferred to be canvas within mechanical rooms when not exposed to moisture and PVC otherwise.
  - .2 Pipe insulation jacketing shall be PVC for piping conveying fluids with a temperature of less than 10°C.
  - .3 All exterior piping insulation to be clad with metal jacketing.
- 4.16.5.5. Provide isolation valves on supply and return mains, risers, and major branches.
- 4.16.5.6. Provide isolation valves for terminal units at the supply and return connections. Circuit balancing valves must be provided at each terminal unit. Pressure independent control valves are encouraged to ensure proper balancing and increase energy performance.
- 4.16.5.7. Preferred Hydronic system treatment chemicals include:
  - .1 Dispersants, phosphonates, corrosion inhibitors, and alkaline controller products.
  - .1 Preferred product is 'Aquaguard 100' or approved equivalent.
- 4.16.5.8. Piping shall not be supported by floor supports unless specifically noted as required by equipment manufacturer installation instructions. Pipe supports from the floor are to be a



channel strut support system (Unistrut or approved equal) with a pipe clamp. Threaded rod with a half riser clamp as a floor pipe support is not acceptable.

4.16.5.9. Mechanical grooved couplings shall be permitted on hydronic heating and cooling systems; but only in mechanical rooms. Mechanical grooved couplings are not to be installed in concealed locations such as shafts, above ceilings, etc.

.1 In addition for mechanical grooved couplings to be allowed:

.1 The grooved supplier must furnish a **manufacturer** warranty for the entire grooved system. This warranty is to be for a minimum of 25 years and will be for full labour and materials related to any leaks or failures in the system. The warranty will not just be for the product itself but for any ancillary building elements damaged by the product failure.

.2 The grooved supplier to provide inspection services to ensure that every grooved coupling is installed as per the manufacturer's specifications.

.3 The grooved supplier to provide training for the installing contractor at the startup on any project where these couplings are to be used. Grooved supplier to also provide ongoing support throughout the project.

4.16.5.10. Lug style isolation valves are preferred, wafer style isolation valves will not be accepted.

.1 Valves sized DN150 (6NPS) and larger shall be equipment with gear operators.

4.16.5.11. For variable primary pumping systems for heating or cooling a flow meter is to be provided for each chiller and/or boiler to confirm adequate flow.

4.16.5.12. **Hydronic Pipe in Electrical Rooms**

.1 **General**

.1 **Hydronic pipe shall be avoided as much as possible.**

.2 **If pipe in the electrical room (all types including NAR, IT, UPS, BESS, etc) is unavoidable consult with City Facility Engineering for consideration of containment options and leak detection.**

.3 **Drip trays shall be piped outside the electrical room in a manner that can't back flow**

#### 4.16.6. **Heating**

4.16.6.1. A primary objective of the heating systems design is to ensure that the operating and maintenance of the system are as simple as possible.

4.16.6.2. In large mechanical rooms containing natural gas burning equipment, provide ventilation, heating, and or cooling to control the room temperature within the temperature ratings of equipment (i.e. electrical panels) and to maintain the space setpoints.

4.16.6.3. For buildings with high exhaust/ventilation requirements such as parking and repair garages, specify that combustion air is ducted directly to the unit from outside for all gas fired equipment where possible.

- 4.16.6.4. Hydronic Systems are the preferred heating systems for City buildings.
- 4.16.6.5. Electric resistance heating systems will only be allowed in very specific cases where it is extremely cost prohibitive to use a higher efficiency heating system.
- 4.16.6.6. Size heating elements for:
  - .1 exterior wall envelope heat loss;
  - .2 infiltration, ventilation, and
  - .3 where applicable:
    - .1 slab heat loss,
    - .2 roof heat loss, and
    - .3 reheat of minimum supply air quantity.
    - .4 thermal mass of equipment entering the building.
  - .4 Provide a minimum of 2 boilers, each sized at 60% of total heating design capacity. For systems with three boilers or more, utilize n + 1 redundancy. Noted redundancy shall apply to all main sources of heating, whether boilers or alternative equipment is utilized.
- 4.16.6.7. Hydronic heating systems that include condensing boilers shall be designed to optimize return water temperatures.
  - .1 Possible optimization options include, but are not limited to:
    - .1 lowering the supply water temperature,
    - .2 sizing heating elements for large temperature drops, or
    - .3 providing a cascading system.
- 4.16.6.8. Variable water flow rates through the boilers will only be accepted for boilers specifically designed for variable flow. Consultants to confirm with City Facility Engineering prior to specifying a variable flow rate boiler and primary system.
- 4.16.6.9. On primary-secondary pumping systems, provide a minimum of two secondary circulation pumps, each sized for duty/standby operation at 100% of maximum design capacity.
- 4.16.6.10. On variable-primary pumping systems, provide a minimum of two pumps, each sized for duty/standby operation at 100% of maximum capacity.
- 4.16.6.11. Provide a temperature controlled piping loop for air handling system coils, separate from the loop supplying radiation, radiant panels, and terminal reheat coils.
- 4.16.6.12. Provide 50% glycol solution for heating coils in air handling units which may be subject to freezing. Specify pre-mixed inhibited propylene glycol only.

- 4.16.6.13. Include specification for chemical injection system for boiler treatment and maintenance. Preferred system would include injection points, diaphragm metering pumps, and totes/tanks for chemicals as required to ensure the performance and reliability of boilers.
- 4.16.6.14. Secondary containment is required for glycol fill tanks within mechanical rooms.
- 4.16.6.15. Any boreholes or areas part of a ground source heat loop shall be located outside of the building footprint.
- 4.16.6.16. Heat domestic hot water with heaters or boilers independent of the building heating system.
- 4.16.6.17. Where solar hot water is incorporated in the hydronic heating system, the system shall include 100% redundant pumps supplying flow to the solar collectors. An alarm is to be issued to the **building automation system (BAS)** upon failure of either pump.
- 4.16.6.18. Instead of in-slab snow melt detection systems, the preference is for roof mounted sensors to detect snowfall, similar to ASE DS-224C rain / snow sensor.

#### 4.16.7. **Cooling**

##### 4.16.7.1. **General**

- .1 Chilled water cooling is preferred for systems over 100 kW of refrigeration.
- .2 Provide a minimum of 15% glycol concentration in chilled water circuits. Specify pre-mixed inhibited propylene glycol only.
  - .1 Allow appropriate capacity correction when sizing the chiller.
  - .2 Provide 50% glycol solution where the system may be subject to freezing.
  - .3 Provide chillers that allow the supply water temperature to be reset electronically.
  - .4 Air cooled chillers shall be equipped with a low ambient temperature kit to allow for cooling to be provided at an outdoor air temperature of -18°C or lower.
  - .5 Do not provide mechanical refrigeration to mechanical equipment rooms.
  - .6 Once through cooling systems are prohibited.
  - .7 Cooling tower level sensing to incorporate mechanical ball floats where possible.

##### 4.16.7.2. **Multiple Chiller Cooling Plants**

- .1 Provide two chillers as a minimum with multiple and/or variable flow pumping on the chilled and condenser water circuits for:
  - .1 central cooling plants that serve more than one building;
  - .2 buildings that require a chiller larger than 1750 kW output, and
  - .3 buildings that serve a special function as determined by the City..
- .2 Size chillers by taking into account the magnitude and duration of lighter loads relative to the peak cooling demand to ensure optimum chiller operation.
- .3 Ensure that there are bypass valves on either side of the chiller primary pumps so that

either primary pump can be used with either chiller.

#### 4.16.7.3. Reciprocating Chillers

- .1 Provide multiple compressors for chillers over 34 kW output.
- .2 Provide at least two stages of capacity for compressors over 25 kW output and at least three stages of capacity for compressors over 125 kW output. Chillers with three stages of capacity control or less shall have an additional hot gas bypass stage.

#### 4.16.7.4. Winter Cooling

- .1 Where the mechanical system is to provide cooling in the winter then a dry cooler or closed circuit cooling tower shall be used to reject the heat. Specify equipment to be able to run without water when the outside air temperature is below 2°C.

### 4.16.8. Air Handling Systems

#### 4.16.8.1. Central

- .1 Design air systems, except 100% outside air make-up type and residential furnaces, with an economizer cycle and a return fan.
- .2 Provide air plenums with hinged, sealed access doors and lighting for inspection of each chamber.
- .3 Use factory manufactured, pre-engineered air blenders, with proven performance.
- .4 Preferred location for all air handling units is indoors within designated mechanical rooms.
- .5 Air handling units installed outside must be complete with a factory built chase to house piping connections, valves, and allow for filter changes and access to the unit.
- .6 All exterior equipment with exposed fin must come with hail guards.
- .7 For applications where humid return air is anticipated, a heating coil shall be provided to temper outside air prior to entering the mixing section of the air handling unit.
- .8 Wetted media type evaporative cooling and humidification shall not be used. Kettle style humidifiers are preferred.
- .9 Specify a water softener for all steam humidification installations. If the steam humidifier is located inside the air handling unit a drain must be provided near the humidifier.
- .10 When multiple air systems are used, duct return air to each air handling system separately. Do not use common return air plenums.
- .11 Do not use mechanical rooms as return air plenums.
- .12 Preference is to have airflow monitoring on all custom and semi custom air handling units.

#### 4.16.8.2. Zoning

- .1 Provide separate zones for corner spaces if cooling requirements are significantly different from adjacent zones.
- .2 Match heating and cooling zones.

#### 4.16.8.3. Distribution

- .1 Take into account variable air volumes and tenant requirements so that proper air circulation is achieved under all conditions.
- .2 For unique ceilings, confirm air flow patterns with special studies, or by testing a mock-up.
- .3 Design ductwork to minimize static pressure losses.
- .4 In addition to providing balancing dampers for each diffuser / grille, provide balancing dampers at all branch ducts on low and medium pressure supply, return, and exhaust air distribution ductwork.

**4.16.8.4. Variable Air Volume (VAV)**

- .1 Use variable frequency drives or alternate, discrete motor on/off control method with adequate granularity, on fan motors to vary supply and return air volumes.
- .2 Design all zones with VAV boxes that close to a minimum position to ensure ASHRAE 62 minimum ventilation.

**4.16.8.5. Rooftop Units**

- .1 Provide a minimum of two-stages for heating sections. Modulating gas valves with larger turn downs are encouraged.
- .2 Provide units with economizer functionality.

**4.16.8.6. Heat Recovery**

- .1 Size heating sections in air handling units to allow the unit to meet supply air temperature setpoint if the heat recovery fails.
  - .1 Equipment schedules shall include performance of heating sections (eg. flow rate or burner output) at design conditions under both normal operation and under heat recovery failure.
  - .2 Calculate and provide optimal setpoints for all energy recovery system controls.
  - .3 The following considerations shall be made when selecting a heat recovery unit:
    - .1 Fin spacing
    - .2 Humidity
    - .3 Temperature
  - .4 Any manufacturer with less than 10 years of experience with the proposed technology shall be reviewed with City Facility Engineering.

**4.16.8.7. Electrical Room HVAC**

- .1 Locate hydronic units outside of electrical rooms
- .2 NAR / IT rooms
  - .1 Preference is to have a dedicated HVAC system
  - .3 Generator room, BESS rooms, UPS rooms, and service entrances equipped with emergency distribution equipment:

- .1 These rooms shall have a dedicated HVAC system.
- .2 Where redundant systems are installed, the ventilation and cooling system shall have the same redundancy level and shall be supplied from the site's emergency / backup generator system if any is present.
- .3 Discuss with City Facility Engineering whether the HVAC system is required to be on emergency power.

4.16.8.8. **Gas Detection Zones**

- .1 Refer to Appendix G for requirements for ventilation in gas detection zones.

4.16.8.9. **Smudging Spaces**

- .1 All spaces to be used for smudging shall be equipped with a dedicated exhaust system.
- .2 Return air from the space is not acceptable during the smudging ceremony.
- .3 Coordinate with electrical for any fire/smoke alarm requirements within the space.
- .4 Controls are to be a local manually activated push button to engage ventilation for a set time period. Time period to be adjustable and initial set point shall be coordinated with the project team during design.

4.16.8.10. **Filtration**

- .1 The minimum filtration levels shall be as follows:
  - .1 Dedicated outdoor air - MERV 8
  - .2 Recirculated air systems - MERV 13
- .3 Heat recovery units shall be specified with filtration separate from the heat recovery medium such that filter replacement can be completed without removing the heat recovery medium.
- .4 Fan-coil, remote heat pump, and similar equipment installations shall be located above corridors or other normally unoccupied areas, or, where not practical, shall have return air ducting installed such that filters are accessible by facility maintenance without disturbing facility staff.
- .5 Fan-coil, remote heat pump, and similar equipment installations located within raised floor assemblies shall have return air ducted from a wall mounted return air grill complete with a filter.

4.16.9. **Variable Frequency Drives**

4.16.9.1. **General:**

- .1 VFD's, while effective for many control and energy saving system designs, should only be used if there is a positive payback and control effect not otherwise achievable by moderately sized, across the line motors.
- .2 VFDs shall not be used as a substitute for other type of soft starter solution
- .3 Pump mounted VFDs are not acceptable.

4.16.9.2. **Location:**

- .1 Individual equipment and skid packages:

- .1 Drives shall be located in dedicated stand alone enclosures installed as close as practically achievable to motor loads.
- .2 For skid packages, VFD enclosure shall form an integral part of the skid.
- .2 VFD banks:
  - .1 VFD shall be located within Motor Control Centers when practical.
  - .2 Each VFD shall be fully complete with its own rectifier and DC link..
- .3 Ensure the VFD has the appropriately rated enclosure for its environment and avoid harsh environments where possible (see “Enclosures” below).
- .4 Consider maintenance implications in terms of accessibility and replacement items such as filters.

4.16.9.3. Bypasses, Branch Circuit Wire Size & Over Current Protection (OCP):

- .1 Bypasses shall be avoided where feasible:
- .1 Bypasses are generally not supported or advisable as many variable speed applications cannot be run safely or effectively without speed control and/or soft starting function due to excessive torque or voltage related issues:
- .2 High availability, when required, is best achieved by fully redundant n+1 drive trains including VFDs, motors, & rotating equipment (pump, fan, etc.) to best address all failure modes.

4.16.9.4. Harmonics Mitigation Techniques:

- .1 When using solid state variable frequency drives, designers shall specify the following harmonic mitigating features:
  - .1 VFD AC input:
    - .1 5% input (line side) reactors are required for all applications .
    - .2 Reactors to form an integral part of the VFD enclosure, be it a stand alone enclosure or a MCC compartment.
  - .2 VFD DC link:
- .3 all drives should be specified with swinging DC-link chokes.VFD AC outputs:
  - .1 All drives shall be provided complete with dv/dt output filters. Filters to form an integral part of the VFD enclosure, be it a stand alone enclosure or a MCC compartment.

4.16.9.5. Enclosures:

- .1 VFDs shall have adequate local LCD/LED control panel and display for configuration and control. The panel shall be visible and fully accessible while the VFD enclosure is closed and energized. The door shall include a troubleshooting connection port allowing operators to program and/or troubleshoot the VFD with close and energized enclosures.
- .2 VFDs shall have hard wired connections for status and control signals. VFD full BACnet MSTP connectivity is required for monitoring only.



.3 VFD components should be specified with integral fusing and disconnects.

4.16.9.6. Motor Protection & Wiring:

- .1 When motors and VFDs are procured separately please consult with City Facility Engineering
- .2 All motors shall be inverter grade and explicitly rated as meeting the NEMA MG1 Part 31 standard with respect to insulation withstand of 3.1 times or greater of the rated voltage with rise time of 0.1 microseconds.
- .3 Output to motors larger than 10 HP shall be via a dV/dT filter similar to MTE DVAGA or TCI V1K series.
- .4 Motors over 20HP should be specified with an Aegis or similar shaft grounding bushing if they are not otherwise shaft grounded by equipment connection or conductive fluid coupling.
- .5 Where VFD's are mounted remotely, provide local safety disconnect at motor. Local safety disconnect must be labeled in visible location with "Safety Lockout ONLY. Shutdown and disconnect VFD before switching."

4.16.9.7. Preferred Manufacturers:

- .1 Drives
  - .1 Schneider/Altivar,
  - .2 EATON,
  - .3 ABB,
  - .4 Emerson,
  - .5 Danfoss,
  - .6 TECO-Westinghouse,
  - .7 Siemens
  - .8 Toshiba
  - .9 Mitsubishi
- .10 Note: Pre approval of these manufacturers does not allow consultant, contractor, supplier and manufacturer to deviate from the above listed performance specifications. The drive supplied from these manufacturers shall be selected to meet all requirements as listed herein.

4.16.9.8. Filters/Reactors

- .1 MTE
- .2 TCI
- .3 Note:
  - .1 Reactors supplied as part of the product offering of the above listed manufacturers are also acceptable if manufactured by the VFD manufacturer.

.2 Third party reactors must be per above approved list.

#### 4.16.10. Roof Drainage Systems

- 4.16.10.1. Provide a minimum of two roof drains per contained near-flat roof area, except a single drain, may be provided for near-flat roof areas not greater than 6 sq. m, i.e. entrance canopies, elevator penthouses.
- 4.16.10.2. Use internal drainage systems routed through conditioned building spaces with open flow drains and minimum 100 mm diameter pipes.
- 4.16.10.3. Direct flow that is discharged at grade so that it does not flow onto pedestrian or vehicle traffic areas, where it could freeze and become a safety hazard, or onto areas where it could cause erosion damage.
- 4.16.10.4. Terminate roof drain exterior discharge outlet with an elbow at least 1.0 m above grade. Provide a thermostatically controlled immersion heater from the discharge back into the building to prevent freeze-up during the winter. Open style downspouts will also be considered but must be discussed with Facility Engineering prior to implementation
- 4.16.10.5. Rainwater is not to be used in any systems unless discussed with City of Edmonton Engineering Services.

Overflow devices:

Use scuppers only as overflow devices. Do not use scuppers to replace roof drains size of overflow scuppers as required to prevent overloading the building structure.

Secondary (emergency) roof drains are permitted as overflow devices where practical.  
 Secondary drains must be located higher up the roof slope or have an overflow feature.

- 4.16.10.6. Exterior rainwater leaders are not to be PVC or plastic.
- 4.16.10.7. New construction rainwater leaders shall not re-enter the building envelope.
- 4.16.10.8. Refer to Roofs "[Rainwater Leader](#)" for technical requirements of rainwater leaders.

#### 4.16.11. Radon Mitigation

4.16.11.1. References:

- .1 To find a C-NRPP registered mitigation or measurement professional, go to <https://c-nrpp.ca/find-a-professional/>
- .2 Design reference; Alberta Infrastructure : 31 21 13 - Radon Mitigation Rough-In System <https://www.alberta.ca/assets/documents/tr/tr-31-21-13b.doc>

- 4.16.11.2. All building designs shall have a Radon Mitigation Plan incorporated into the design.
- 4.16.11.3. The Radon mitigation measures listed in "EPA Radon Prevention in the Design and Construction of Schools and Other Large Buildings" include:

- .1 Soil depressurization,
  - .1 Building pressurization, and
  - .2 Sealing radon entry routes

#### 4.16.11.4. New Construction

- .1 The design team and the radon mitigation professional shall design a radon rough in mitigations system to facilitate a building with Active Soil Depressurization(ASD) system capability. Mechanical considerations for rough-in system include, but not limited to:
  - .1 Rough-in riser vent pipes with clear labelling.
  - .2 Future tie-in venting configurations. Radon venting discharges shall be located away from any building air intake and public spaces.
  - .3 Future exhaust fan locations and coordination for electrical requirements.
  - .4 Preference is to run radon piping to the exterior and be capped and labelled for future use.
  - .5 Defined radon zoning and indication of size and ventable area.
  - .6 Provide radon quantification testing as described below.

#### 4.16.11.5. Existing Buildings:

1. Project team to inquire about radon monitoring from the City - if no monitoring results are available, the Consultant team shall assist the City in sourcing an indoor air quality test to verify radon levels. Once verified, if level exceeds recommended limits, project scope shall accommodate an active extraction system, and/or other approved method for radon mitigation.
2. If any envelope or ventilation upgrades are in scope, include radon quantification testing as described below.

#### 4.16.11.6. Quality Assurance of Radon Systems:

- .1 Consultant shall conduct field reviews to monitor the installation of the design elements, as well as reviewing the barrier and sealant quality for the proposed building.
- .2 The construction contract shall include radon mitigation testing within specification to confirm that the liner is functioning properly, that the overall system is capable of maintaining a vacuum seal and can evacuate sub-slab vapours is required to be performed prior to pouring the concrete slab. Include the depressurization test results in a comprehensive testing and inspection final report.

#### 4.16.11.7. Radon Quantification Testing

- .1 Consultant to call for radon quantification testing within the specification. This testing would occur post construction, within 10 months after building substantial completion, and between November to February. This testing is to ensure radon levels are within acceptable limits. The specification should call for the test results to be included in a comprehensive testing and inspection final report for City review.

## 4.16.12. Controls

### 4.16.12.1. General

- .1 All buildings are to be designed and installed with a Distributed Digital Control (DDC) Building Automation System (BAS).
- .2 Any renovations to a building where equipment is replaced or added, that equipment is to utilize DDC controllers. Any new DDC controllers will either connect to the existing building automation system or will be specified such that they can be added to a DDC system in the future.
- .3 Only a single BAS manufacturer is allowed in any one building.
  - .1 If there are multiple buildings directly connected to each other, even if they have different site IDs, there shall only be a single BAS manufacturer for those buildings.
  - .2 If a building is being renovated and new DDC systems are being added they must be of the same manufacturer as what is in the building already or the entire system must be removed and replaced to ensure there is only a single BAS manufacturer in the building.
- .4 The City of Edmonton has standardized control systems. The supply and installation shall be limited to the following (all controls components in the building - thermostats, controllers, etc. to be from one of these three manufacturers):
  - .1 Delta Controls, installed by Ainsworth.
  - .2 Johnson Controls Metasys, installed by Johnson Controls.
  - .3 Reliable Controls, installed by Serv-All Mechanical.
- .5 Communication between pieces of equipment and the BAS is to be done through hard point control utilizing terminal strips on the pieces of equipment. This includes, but is not limited to, boilers, chillers, large central station air handling units, rooftop units, heat pumps, ductless split air conditioners, etc. Connections done virtually through a BACnet interface are not allowed except for some auxiliary point monitoring for equipment like variable frequency drives and some auxiliary inputs off of electrical meters.
- .6 In general proprietary, stand-alone control systems for pieces of equipment will not be accepted. The base building BAS should be accomplishing the control functions for all equipment. The exceptions are boiler sequencing controllers and chiller plant controllers where we allow the manufacturer's equipment controller to control those pieces of equipment. The boiler and chiller control systems, including multi stage systems, must be provided with an enable and setpoint control supplied by the base building BAS system utilizing hard points as referenced above.
- .7 Air handling unit components including fans, dampers, heating, and cooling systems for large central station air handling units shall be controlled directly by the base building BAS. There shall not be a separate integrated controller on the air handling unit unless that controller is manufactured by one of the three standardized control suppliers listed above. All control points for the components listed above are to be writable through the base building control system.

- .8 Ductless split/heat pump units to be specified so that the cooling enable and heating enable are controlled directly from the base building BAS. An adapter card may be required for this. Example: Mitsubishi Mr. Slim units can be controlled in this fashion by use of a thermostat interface card (part number: PAC-US444CN-1).
- .9 All gas and water meters connect to the BAS via a pulse output from the meter.
- .10 Coordinate with the electrical engineer and Facility Engineering Services to connect electrical meters to the BAS.
- .11 If a BACnet connection is required to a piece of equipment please consult with Facility Engineering Services. Equipment using BACnet connections to be BACnet listed and certified and to be able to utilize native MS/TP protocol.
- .12 All BAS site name, point name, panel name, and graphics filename labeling shall follow the City Facility ID naming convention.
  - .1 Building ID Ex: MEA104 - Meadows Community Recreation Centre
  - .2 Point Name Ex. (Meadows Domestic Hot Water Recirculation Pump Status): MEA104\_DHWR\_P3-1S
- .13 All sites shall be connected to the City Energy Analytics Platform (Coppertree) as part of the contract.
  - .1 All license fees, installation labor costs, and all other associated burdens shall be included in the contract price provided by the installer.
  - .2 Approved installer for Analytics Platform Connection is Ainsworth.
  - .3 For new construction projects or renovations where we are adding in 1000 or more points that project is to include a copper cube to allow for point storage.

**4.16.12.2. Control Documents**

- .1 Provide a complete schedule of physical control points. For each point provide a short description, the point type, its mnemonic (system name) as well as any alarm limits and fail safe position.
- .2 Provide a detailed control sequence for each mechanical system and any global optimization strategies. Include set points, interlocks, and alarms.
- .3 Laminated, permanently installed I/O lists shall be secured to all BAS panels.

**4.16.12.3. Hardware**

- .1 Each control system to be designed in such a way to facilitate a single connection from that control system to the City network.
- .2 Specify that the system configuration allow for 10% spare physical point input/output capacity at each RCU.
- .3 An additional eight (8) outputs shall be specified to be allocated at the panel closest to the C-Cure security system panel for future alarm use. Specify that the contractor shall run conduit and wiring from the BAS panel to the security panel to accommodate future alarms.

- .4 The firmware on the BAS panels must be compatible with the existing building automation network infrastructure. In instances where backwards compatibility to the City server becomes an issue, the Contractor will include the cost to supply and install a City approved, upgraded software on the City's server.
- .5 All panels, systems, controllers, equipment etc. must be completely accessible by the City including the ability to make graphical changes and access to programming. Proprietary or control systems with restricted access will not be permitted. Any specialty software needed to make changes to the system or equipment must be provided to the City at no additional cost.
- .6 Operator work station
  - .1 An operator work station is not a requirement nor desired for network connected sites.
  - .2 Discuss any non-network connected project with the City for operator work station requirements. In cases where furniture is required it will be supplied by the City.
- .2 Terminal Control Units (TCUs)
  - .1 Specify standalone microprocessor based controllers that will continue to control if communication with the sub-network fails.
  - .2 Use TCUs to control terminal heating/cooling devices only.
- .3 Actuators
  - .1 Specify electrically powered actuators to drive all valves, dampers, and other control devices. The sole exception is large three way valves where an electric actuator cannot be sourced.
  - .2 All damper, valve, etc. actuators to be accessible.
- .4 Control Valves
  - .1 Select control valves with flow characteristics to match the application. Do not oversize valves.
  - .2 Specify the flow coefficient (Cv) for all control valves.
- .5 Sensors
  - .1 Specify electronic room thermostats that allow access to TCU set points and configuration information, by either:
    - a. a communication port for the PCs, or
    - b. a display window and program keys incorporated into the room sensor. Program keys and display window only required for areas where user input is desired.
- .6 Control Wiring
  - .1 All controls wiring to be in EMT or rigid metal conduit.
  - .2 BAS communication wiring shall be communication rated, low capacity, and shielded.
  - .3 BAS communication wiring to be independent of power wiring and heat trace cabling.

#### .7 Current Transducers / Switches

- .1 Current switches shall not be used. Where status is required, a current transducer outputting an analog signal shall be used.

#### .8 Variable Frequency Drives (VFD):

- .1 VFD speed command shall be via 4-20mA or 0-10v signal.
- .2 VFDs shall have hard wired connections for status and control signals.
- .3 Preferred points for VFD control through BAS include:
  - a. Command - Start /Stop
  - b. Speed Reference
  - c. Speed Feedback
  - d. VFD Alarm Point
  - e. Amperage Draw

#### 4.16.12.4. Software

- .1 Colour graphics user interface and application software will reside on the Cit controls servers. Contractor to supply original graphics files to City.
- .2 Specify dynamic colour graphic screens as follows:
  - .1 For any building where graphics are being modified or added as part of a renovation, the existing building graphics are to be modified to match the style of the new graphics.
  - .2 a main screen showing the basic floor plan of the facility indicating locations of mechanical rooms and major pieces of mechanical equipment;
  - .3 a screen for each mechanical system (ahus, vav boxes, rtus, fan coils, etc.);
  - .4 a screen for each floor or zone to show space temperatures;
- .3 All BAS sites will include single point trend data, available in BACnet protocol, for each hard point and event in the entire database. These trends will be polling trends, recording at 15 minute intervals and the BAS panel(s) shall have sufficient memory to store all of these trends for a duration of 72 hours. The trends will be rolling trends.
  - .1 Change of Value (COV) trends will be preferred and used instead of a polling trend when fewer samples will generate a longer trend history. I.e.: A room temperature will be set up as a COV, single point trend with 1 degree granularity when the room temperature is expected to vary little.

#### 4.16.13. Fire Suppression Systems

##### 4.16.13.1. General

- .1 The preference is to not have a sprinkler system in any electrical room, electrical closet, energy storage room, or IT room. Coordinate with Architectural Consultant to determine the room's construction and related fire resistance rating to accommodate this.



**4.16.13.2. Electrical service entrance rooms:**

- .1 If a fire suppression system is required it shall be a dry pipe preaction system.

**4.16.13.3. Electrical rooms other than service entrance:**

- .1 If a fire suppression system is required the preference is for a dry pipe preaction system.

**4.16.13.4. NAR and IT rooms:**

- .1 Consideration shall be given for a clean release gaseous fire suppression system.
- .2 If a backup suppression system is required consideration shall be given for a dry pipe preaction system.

**4.16.13.5. Battery Energy Storage System (BESS) rooms and UPS rooms:**

- .1 Rooms shall be equipped with a clean release gaseous fire suppression system unless said suppression system is incompatible with the energy storage equipment
- .2 If a backup suppression system is required it shall be a dry pipe preaction system unless said system is incompatible with the energy storage equipment installed in said room.
- .1 The use of a typical wet pipe sprinkler system is not permitted.

**4.17. Electrical**

**4.17.1. References & Client Specific Requirements**

**4.17.1.1. Meet or exceed the following guidelines and standards:**

- .1 National Research Council Canada (NRC) Codes:
  - .1 Alberta Building Code (ABC)
  - .2 Alberta Fire Code (AFC)
- .2 Canadian Standards Association (CSA) Standards:
  - .1 CSA C22.1 Canadian Electrical Code - Part 1
  - .2 CSA-B72-M87 Installation Code for Lightning Protection Systems
  - .3 CSA C282 Emergency Electrical Power Supply for Buildings
- .3 Illuminating Engineering Society of North America
- .4 Institute of Electrical and Electronics Engineers
  - .1 IEEE 142
  - .2 IEEE 1100
  - .3 IEEE 519
- .5 Insulated Cable Engineers Association
- .6 EPCOR Customer Connection Guide
- .7 Testing: NETA standards & City of Edmonton Commissioning Manual

**4.17.1.2. Client Specific Requirements:**

- .1 Notable Clients with Distinctive Requirements
- .1 Fire Rescue Services (FRS)
  - .1 SAS dispatch system.
- .2 Edmonton Police Service (EPS)
  - .1 Security
  - .2 CCTV
  - .3 IT
  - .4 Radio & DAS.
- .3 Libraries
  - .1 Security
  - .2 CCTV
  - .3 IT
  - .4 Fire Alarm Dialers
- .4 LRT
  - .1 LRT Guideline
- .5 Waste
  - .1 Security
  - .2 IT

**4.17.2. Existing Building Electrical Systems**

- 4.17.2.1. For projects where an existing building is being renovated or being added to; the Basis of Design for the new electrical system is to match or exceed the existing base building system.
- 4.17.2.2. Design Consultant shall identify existing equipment to remain in place for systems being modified. Design Consultant shall coordinate with FMS to determine shutdown, maintenance, and long term preservation requirements for dormant equipment for long term construction projects as appropriate.
- 4.17.2.3. Design Consultant shall identify existing equipment being removed or abandoned under the project and define decommissioning procedures and requirements in the project specifications. Design Consultant shall identify if any regulatory requirements exist for equipment to be decommissioned and who will be filing the necessary documentation.
- 4.17.2.4. The City recognises that existing facilities may present conditions incompatible with the implementation of all requirements set forth in the present document. When pre-existing physical limitations are present, the consultant shall contact the city representatives to discuss alternate approaches as required. Alternate approaches shall be devised to be as close as possible to the performance as specified in the present document. In such cases, the city reserves the right to comment on the proposed alternate approach and suggest adjustments.

**4.17.2.5. Power Considerations:**

**.1 Power & Energy demand:**

- .1 The facility can accommodate the power and energy demand of the new system.
- .2 The facility or the local utility network can accommodate the output of the proposed equipment (e.g.: elevator with regenerative braking, distributed generator, Vehicle To Grid “V2G” car chargers, etc...)

**.2 Fault levels:**

- .1 The new system can withstand the maximum fault levels forecasted for the site.
- .2 The site can tolerate an increase of fault levels if the new equipment can contribute to electrical faults.

**.3 Coordination and Arc Flash Energy:**

- .1 The coordination of the protective scheme will not be compromised by the addition of the new system(s).
- .2 Arc Flash Incident Energy Levels (AF-IEL) will not significantly change following the addition of the new system(s).

**.4 Power Quality:**

- .1 The system will not introduce issues incompatible with other systems already in operation within the facility.
- .2 The system will not be negatively impacted by the operation of the facility’s existing systems.
- .3 This includes, but is not limited to confirming if power factor, harmonic distortion, voltage drop/sag/swell/flickers, current inrush, resonance can be a concern.

**.5 Site’s operations during construction:**

- .1 The site’s operations can be interrupted to accommodate the installation of the new system, or
- .2 The site’s operations will not be negatively impacted by the installation of the new system.

**4.17.2.6. If it is determined that the installation of the new equipment will not meet the conditions as stipulated above, the consultant shall propose a series of changes and/or adjustments to accommodate the equipment installation, including but not limited to:**

- .1 Alteration of the existing space / systems.
- .2 Addition of protective equipment (e.g.: harmonic filters, cooling systems, etc...)

**4.17.2.7. Phased construction and demolition supported with sufficient phasing drawings.**

**4.17.3. Service and Power Distribution**

**4.17.3.1. Power System Studies:**

- .1 The city considers the listed studies in the following sections as an integral part of the activities supporting the design of a new site or a refurbished site project, or an expansion

project.

- .2 Power system studies shall be used to confirm the attributes, characteristics and specification of the required electrical equipment scheduled for installation at the city's facilities. These studies include, but are not limited to:
  - .1 Short Circuit, Coordination and Arc Flash Optimisation
  - .2 Power & Energy Demand
  - .3 Load Flow
    - .1 Voltage Drops
    - .2 Load Shedding Scheme & Service Entrance Power Delivery Capacity
    - .3 Peak Shaving Scheme & Service Entrance Power Delivery Capacity
  - .4 Power Quality
- .3 Electrical designers shall carry out the following power system studies each time they are preparing an engineering package intended to modify an existing site, or build a new site
- .4 The studies shall cover 100% of the facility's electrical systems (new and existing). If a study was already prepared for the site, the consultant shall revalidate said study to ensure proper accuracy.

#### 4.17.3.2. Utility Service

- .1 Coordinate new and modified services with EPCOR. Refer to the latest EPCOR connection guide.

#### 4.17.3.3. Sizing

- .1 As an aid to determining the electrical service size for a facility, the information provided below can be used as a guide to establish minimum requirements which are to be reflected in the Design Development Report.
  - .1 For multi-building sites, or sites with service voltages over 750V, consult with Facility Engineering Services..
  - .2 Single building services with service voltage under 750V shall be sized as follows:
    - .1 Size main services and service transformers according to connected load with the appropriate load factor applied. Disclose service sizing criteria in design documentation.
    - .2 Calculate connected load using load factors as dictated by the type of load, plus an allowance for future load growth. Discuss future load allowances with the City.
  - .3 Calculate estimated loads based on basic power loads, plus additional loads anticipated for heavy power usage areas.
  - .4 For initial design basic power load due to lighting, general power, convenience loads, and basic mechanical equipment, calculated as follows:
    - .1 Buildings Over 1,000 m<sup>2</sup> With Air Conditioning: 60 VA/m<sup>2</sup> x total building area.

- .2 Buildings Under 1,000 m<sup>2</sup> with Air Conditioning: 70 VA/ m<sup>2</sup> x total building area.
- .3 Buildings Without Air Conditioning: 40 VA/ m<sup>2</sup> x total building area.
- .5 Heavy power usage areas include kitchens, workshops, laboratories, and areas with large numbers of electrical equipment connections or receptacles. For these areas, calculate additional loads as follows:
  - .1 Each Heavy Usage Area (base initial): 100 VA/ m<sup>2</sup>, or,
  - .2 Connected load at 100% demand, plus
  - .3 Other loads such as snow melting, block heater outlets, welders, and electric heating. Calculate additional connected load at 100% demand with a seasonal and work flow diversity factor applied.
- .6 Addition to existing service/feeder: Provide calculation as per CEC Section 8.
  - .1 Preliminary sizing to adhere to W/m<sup>2</sup> listed in item 1 above for modified area. City to provide maximum demand load for most recent 12-month period where available.
- .7 Final Load Calculation(s) to be included in drawing set.

#### 4.17.3.4. Single Line Drawing

- .1 Provide electrical single line diagram(s) as part of the Contract Documents, indicating the following:
  - .1 Configuration, type, voltage, and amperage ratings of switchgear, transformers, panelboards, and motor control centres (MCCs).
  - .2 Type, size, and amperage ratings of services and feeders.
  - .3 Type, frame size, and trip rating of overcurrent protective devices.
  - .4 kAIC rating of switchgear, panelboards, transformer secondaries, and overcurrent devices.
  - .5 Anticipated demand load at switchgear, panelboards, and MCCs.
  - .6 Arc flash incident energy levels at all equipment on line and load side of all transformers including load side of Utility transformer. Refer to "[Appendix E: Arc Flash Guideline](#)" for additional information.
  - .7 Provide separate Single Line Diagram for service and distribution grounding/bonding.
  - .8 Existing Building: Provide complete facility wide single line diagram; partial single line diagrams will not be accepted. City to provide existing master single line diagrams where available.
- .2 Provide copies of single line diagrams from Record Drawings, recording actual construction, to:
  - .1 Incorporate into Operating and Maintenance Manuals.
  - .2 Display in frame with clear plexiglass and hang in each major electrical equipment room, with equipment in the respective room highlighted. This requirement is to be included in the electrical construction specifications.

#### 4.17.3.5. Protection and Control

- .1 Perform arc flash, short circuit, and coordination study to inform and validate requirements below. Refer to "[Appendix E: Arc Flash Guideline](#)" for additional information.
- .1 Where applicable, the consultant shall append the site's single line diagram to record all "as-found" conditions if said conditions differ from those presented in the available record documentation.
- .2 For sites where high incident energy levels are anticipated, designer to investigate the use of specialty arc flash protective features as follows:
  - .1 Trip units or relays offering options to program at least two setting families, with one setting group being used during normal operation, and one setting group being used during maintenance operation (i.e.: Arc Flash Maintenance Switch). Such a system shall be designed to ensure a clear warning system (e.g.: pilot lights) is present to inform operators about the maintenance switch status.
  - .2 Arc detection relays relying on a combination of optical sensors, pressure sensors and current transformers. Detection schemes relying solely on optical sensors are NOT acceptable.
- .2 Ensure priority tripping and coordination of overcurrent and ground fault devices. Provide final consolidated trip curves for additions, services sized 600 A and over, and multi-building sites.
- .3 Ensure adequate fault interrupt ratings of all switchgear, panels, MCCs, and overcurrent devices. Provide calculation results when requested by the City of Edmonton.
- .4 Use fully-rated overcurrent protective devices throughout the distribution system. Series-rated combinations may only be used with permission by the City of Edmonton.
- .5 Where ground fault protection is provided on services and feeders, ensure protection is also provided for downstream feeders and loads that are susceptible to nuisance ground faults. Ensure ground fault equipment is coordinated to prevent upstream devices tripping before downstream devices.
- .6 Evaluate the feasibility of peak demand control through the use of load shedding or emergency generation equipment. Review all options with the City of Edmonton.
- .7 Do not provide under voltage protection on main breakers. Provide single phase motor protection using differential overloads or phase loss.

#### 4.17.3.6. Harmonics

- .1 Applicable Standards and guidelines:
  - .1 EPCOR Customer Connection Guide
  - .2 EPCOR Distributed Generation connection guide
- .2 Design Philosophy:
  - .1 IEEE 519 requirements at the PCC are deemed as minimum requirements and the Harmonic Control and Mitigation design approach is to be discussed with the Facility Engineering Service at the onset of the project. For existing sites, the impact of the

proposed additions shall be accompanied by a complementary mitigative measure.

.1 New sites or sites scheduled for a complete refurbishment:

- a. For sites with a large proportion of non linear loads (VFD, LED, DC rectifiers such as battery chargers, EV chargers, energy storage systems), compare the proportion of linear VS nonlinear current.
- b. Comparison shall be based on known mode of operations, switching scenarios, and utility contribution to determine if a form of harmonic correction strategy is required.

.2 Existing sites scheduled for a minor or partial upgrade or equipment addition:

- a. Consultant to prepare a site harmonic assessment study for facilities with known harmonic's issues.

.3 Performance Validation

.1 Existing Sites: Where feasible test THD and TDD levels before construction initiation and after construction completion to ensure harmonic mitigation choices were appropriate. Feasibility of this scope to be consulted with Facility Engineering Services.

.2 New Sites: Test THD and TDD levels after construction completion to ensure harmonic mitigation choices were appropriate.

.3 For all sites:

- .1 Compliance with the IEEE 519 recommended distortion limits shall be determined as part of a full load test and/or monitoring of ITHD & VTHD throughout the first year of operation.
- .2 For sites with seasonal and daily or weekly power demand variation, tests shall be performed for all applicable scenarios to identify the worst case existing and residual THD and TDD levels.

4.17.3.7. Service Spaces

.1 General:

.1 Service spaces are defined as Electrical, Generator, NAR, and UPS rooms.

.2 All service spaces to be sized to accommodate for planned future equipment. Room size, working clearance and doorway sizing to accommodate the removal and replacement of the largest piece of equipment.

.3 No electrical room shall be located within a Zone 0,1, or 2 environment.

.4 Electrical rooms near or adjacent to a classified area shall consider positive pressure makeup air and exclude door/openings providing a direct access to the classified area.

.5 Fire Detection and Suppression

- .1 Fire detection and suppression systems shall be coordinated with all other disciplines including but not limited to architectural, structural and mechanical designers. Refer to section 4.17.13 for Fire Suppression System.



- .6 Fire Alarm Requirements:
  - .1 Where the rate of heat rise is a concern due to the equipment's mode of operation, and where permitted by code, install smoke detectors only (rooms and closets)
  - .2 Room housing equipment supporting Mission Critical Systems such as UPS rooms shall be equipped with a Very Early Smoke Detection System (VESDA or equivalent).
- .7 Cooling
  - .1 Where a room contains heat generating equipment, adequate cooling and/or ventilation shall be provided by mechanical.
- .8 Leak Detection & Prevention systems (Existing facilities)
  - .1 For UPS, NAR, and Emergency Generator rooms shall be equipped with leak detection systems where presence of water resulting from condensation (i.e.: near cooling units), or due to accidental ingress (i.e.: near conduit/cable wall/floor/ceiling penetrations) may be a concern.
  - .2 Drip trays, connected to building drainage systems to be utilized to protect equipment
- .9 Ceiling and Roof Penetrations not permitted
- .10 Provide raceway system between all Electrical Rooms, Closets, and Network Access Rooms (refer to IT Guideline for additional information)
- .2 Service Entrance Room
  - .1 For services over 200A: Main Electrical Service Room to be a dedicated space, located on the ground floor, exclusively for electrical services, without any communication equipment, mechanical devices, gas, or water systems present.
  - .2 Coordinate new and modified services with EPCOR. Refer to the latest edition of EPCOR's connection guide at the time of the project initiation and apply all conditions as stipulated by EPCOR.
  - .3 Coordinate new and modified services with EPCOR including but not limited to the routing of the incoming utility feeders and all related requirements for segregation and maximum length.
  - .4 Main Electrical Service room to be sizing to also consider the selected equipment size and required clearances listed below:
    - .1 Service Entrance equipment to have 1500mm clearance.
- .3 Electrical room
  - .1 Locate in core areas of the facility and stack vertically where possible.
  - .2 Locate at grade or above if in flood zone when room contains critical pieces of electrical equipment.
  - .3 Electrical rooms must not contain communication equipment, mechanical equipment, ducts, pipes, shafts, or water mains unless they are specifically serving the room.

- .4 Provide a minimum of one electrical room sized 1800 mm by 3000 mm (6' by 10') for every 930 sq. m (10,000 sq. ft.) of floor area served or portion thereof.
- .5 Floor drain to be provided.
- .4 Electrical Closet
- .1 Not permitted to contain transformers, motors, or other heat generating equipment.
- .2 Locate in core areas of the facility and stack vertically where possible.

#### 4.17.3.8. Grounding & Bonding

##### .1 Applicable Codes & Standards

###### .1 CSA CEC C22.1

###### .2 IEEE Std. 142 (Green Book) & IEEE Std 1100 (Emerald Book)

###### .3 For medium voltage service entrances:

###### .1 IEEE 837 Standard for Qualifying Permanent Connections Used in Substation Grounding

###### .2 IEEE 80 Guide for Safety in AC Substation Grounding.

##### .2 General

###### .1 Ensure the access to grounding connections are OHS compliant.

###### .2 Ensure that all connections to be labelled with their destination.

###### .3 Ensure that connections are made to a copper ground bar mounted on insulated standoffs.

###### .4 City basis of design for underground or concrete embedded connections are to be exothermically welded and/or by using a compression system that meets IEEE 837-2014 standard.

###### .5 Ground grid installations to incorporate ground rod test wells.

##### .3 Testing

###### .1 Ground Electrode Testing

###### .1 The performance of a ground electrode shall be validated using the fall of potential method.

###### .2 The test result complete with curve and interpretation of the plateau reading

###### .3 Minimum testing requirements:

###### a. The reading variation shall be typically provided for a range of 50% to 80% of the ground electrode to test electrode distance

###### b. The reading range shall be adjusted as required to produce a meaningful typical curve and "plateau reading" variation based on site specific conditions, testing equipment rod lengths, the ground electrode topology, and known underground structures which may impact the test's accuracy.

.2 Bonding Testing (measuring resistance to ground):

.1 When the conditions for a ground electrode testing are not practical, or when it is required to test a specific equipment bonding link (measuring the resistance to ground), the use of a clamp-on style ground tester is acceptable.

.2 The tester shall be used with a calibrated “test card” to validate the clamp readings

4.17.3.9. Switchgear, Panelboards, and MCCs

.1 General

.1 Tin plated copper bussing.

.2 Ensure bussing extends to all spaces for future growth.

.1 Vertical bus shall be sized based on section’s maximum power demand +25% for future breaker additions if any spare space is available for future expansion.

.3 Enclosure is NEMA 1A

.4 Metal Clad

.5 Floor Mounted

.6 Hinged, door-in-door construction.

.7 Lockable.

.8 Located in a Dedicated Room. MCCs can be located in the mechanical room.

.9 Where Arc Flash ratings are a concern, consider Arc Reduction Strategies and Arc Resistant designs, consult with Facility Engineering Services.

.2 Switching and Overcurrent Devices

.1 Use bolt on molded case circuit breakers with thermal, magnetic trip for all circuit protective devices except as follows:

.1 For services over 750V, provide relaying using relay accuracy class CTs with test block and solid state relays with trip indication for each function. Provide a DC battery source for control and tripping.

.2 Use industrial duty, draw out type air circuit breakers for all services and feeders 800 Amps and over.

.3 Use circuit breakers with maintainable contacts, complete with electronic trip units and trip indication for all main service or feeders for all services over 400 Amps and under 800 Amps.

.4 Use metal enclosed switchgear with air vacuum circuit breakers for all high voltage equipment.

.5 Obtain the approval of the City of Edmonton for the use of fused equipment. Consideration will only be given where fault duties of equipment require a limitation of the available fault current.

.2 All breakers supplied from service entrance, emergency power sources, distributed generators and all branch circuits feeding life safety or mission critical equipment shall be

100% rated.

- .3 All protective devices installed in distribution centers to be equal or greater than the rated withstand capacity.
- .4 All protective devices shall have provisions for lockout tagout provisions
- .3 Panelboards
  - .1 Copper bussing.
  - .2 Bolt on style breakers.
  - .3 Maximum number of breaker positions in a single tub to be 42. Double wide is acceptable. Provide minimum 225A bussing for panelboards with 42 or more positions.
  - .4 Do not use feed through.
  - .5 Provide panel schedules indicating breaker size and wattage of all connected loads. Panels to be a maximum of 75% filled at the completion of Construction.
  - .6 Hinged, door-in-door construction.
  - .7 Lockable.
  - .8 Distribution panelboards to be located in dedicated rooms and closets. Provide additional space on wall for at least one (1) future panel.
  - .9 Single pole breakers with handle ties are not permitted in place of multi pole breakers.
  - .10 Provide minimum of two (2) spare 27 mm conduits c/w pullcord to ceiling space for all recessed panelboards.
  - .11 Combination (single cabinet) transformer and panel board are not acceptable.
  - .12 Wire splices required for panel replacements are to be completed with terminal blocks, housed in a separate enclosure.
- .4 Spare Capacity
  - .1 Switchgear: Provide at least one spare section with 4 breaker spaces and one 1200A frame spare breaker.
  - .2 Distribution Panels: 25% spare capacity capable of accommodating at least 4 x 3P400A breaker and provide one (1) 3P400A breaker.
  - .3 Panelboards: Provide 25% spare capacity in breaker spaces filled. Provide breaker assortment to have at least one spare breaker for each size (in number of pole and Amps rating) required on site.
  - .4 Provide additional space on wall for at least one (1) future panel of same size.
  - .5 MCCs: Provide at least one full section with spare for installing two bucket starters sized per largest required starter on site, and two buckets capable of accommodating a 3P400A moulded case breaker frame.
- .5 P & C components (All distribution centers, when present):
  - .1 PLC and HMI shall be installed in a stand alone enclosure

- .2 Power quality meters shall also be installed in a stand alone enclosure. See Energy Metering and Power Quality Monitoring section.
- .3 Enclosures can be type floor standing or wall mounted and must be NEMA 1A minimum. It shall be located outside of the arc flash boundary limit. Where practical, shared enclosures can be used to house protective relays, PLC, HMI, and power quality meters.
- .6 Accessories
  - .1 Provide lifting equipment for all industrial type air circuit breakers, high voltage switches and stacked high voltage starters.
- .7 Working Clearances
  - .1 Provide all switchgear and MCCs with minimum 1.5 m front clearance, in addition to space required for drawout equipment in full disconnect position, and all free standing switchgear with minimum 1.0 m back and side clearance.
- .8 Housekeeping Pads
  - .1 Provide all floor mounted equipment with a 100 mm (4") tall housekeeping pad except for roll-out style switchgear. Pad to extend 150 mm on average around the equipment enclosure perimeter
  - .2 Roll out SWGR to have an extended pad complete with ramps allowing the removal of roll out equipment and repositioning of said equipment outside of the gear's front clearance zone.
- .9 Outdoor Enclosures:
  - .1 Provide precast concrete base and local heat to provide minimum temper heating to 5°C to facilitate proper operation of equipment and prevent condensation.
  - .2 Enclosure to be minimum NEMA 4X.
  - .3 Ventilation to be provided for enclosures housing heat generating equipment (e.g. transformers).
  - .4 Additional protective features shall be considered (e.g. vandalism, vehicle strikes, etc...)

4.17.3.10. Hazardous Classifications Studies & Related Design Activities

- .1 Refer to [Appendix M - Hazardous Classification Study](#)

4.17.3.11. Energy Metering & Power Quality Monitoring:

- .1 General
  - .1 Dedicated stand alone meters shall be installed as follows:
    - .1 At a facility service entrance in wall mounted enclosures or installed on distribution centers instrumentation and control doors. Meter to have panel mounted, or adjacent, display capable of displaying above listed values for at least the service connection.
    - .2 At any breaker connecting a distributed generator or energy storage system to the service entrance (e.g.: CHP, PV solar, BESS, etc...). Refer to Solar Design

guidelines for Solar monitoring requirements.

- .3 As required / directed by the mechanical discipline for the purpose of monitoring the energy efficiency of mechanical systems
- .2 Note regarding breaker with advanced built- in trip units offering power quality meters functions:
  - .1 It is acceptable to use a circuit breaker’s trip unit to cover the functions as listed herein
  - .2 This substitution is only allowed if said built-in metering system matches or exceeds the characteristics listed in the following subsections.
- .3 When present at a service entrance, enclosure housing PLC, protective relays and other control systems (P & C enclosure) shall also be used to house the power quality meters.
- .2 Type:
  - .1 Provide multichannel meter(s) channels to monitor true RMS values for phase voltage (line to line and line to neutral), phase currents, kVA, kVAR, kW, PF, Hz, MWhr, kWd, kVAd, ITHD, and VTHD.
  - .2 Meter to be field programmable via front keypad and communications port or wireless equivalent.
  - .3 Size incoming service current transformers such that the initial design full load is approximately 60% of rating.
  - .4 Consult Facility Engineering Services for currently recommended models. On larger, more complex distributions consider sub-metering on secondary CDPs & Panels. Consult with Engineering Services for exact project requirements.
- .3 Data export & logging capabilities:
  - .1 Logging:
    - .1 The metering system shall provide function to log and store the measured data over a long period of time.
    - .2 At least 10 years worth of data shall be available at any given time.
  - .2 Data Export:
    - .1 For system inclusive of a TCP/IP monitoring and control wiring providing access to both breaker’s built in metering system and breakers controls, blocking diodes shall be installed to interface the TCP/IP ethernet control and monitoring loop wiring to the world wide web/ Blocking diodes shall be configured to provide a uni directional read only data export for the metering features as described above.
    - .2 TCP/IP ethernet based control features shall not be accessible outside of the facility’s ethernet system.
- .4 Communication Requirements:
  - .1 Data required via BAS / BACnet Connectivity:
    - .1 Meter must be either BACnet listed or compatible with a BACnet gateway module

and natively utilize BACnet MS/TP protocol to integrate kVA, kVAR, kW, and kWh, to the Building Automation system for monitoring.

- .2 Coordinate with Mechanical Discipline to ensure controls points list captures all metering points.
- .3 These parameters shall be sent to City Energy Analytics Platform (Coppertree) for logging. No gateway devices to convert to the meter output are allowed.
- .4 Wiring: Provide 22 AWG twisted pairs in braided or aluminum foil shield
- .2 Data required via TCP-IP Ethernet Connectivity:
  - .1 Meter must be either compatible with a ethernet communication protocol type TCP/IP, either natively or via a gateway module to provide access to kVA, kVAR, kW, and kWh, I-THD & V-THD,
  - .2 Wiring: Cat 5e minimum.
- .5 Metering Transformer Wiring
  - .1 PT CT ration sizing to be written and compatible with typical industry testing equipment.
  - .2 All current transformers (CTs) and potential transformers (PTs) to be wired to end devices (protection relay and/or metering devices) via test blocks:
  - .3 Test blocks to be equipped with transparent covers providing a full unobstructed view on the various contacts and switches. Test block to be specified complete with test plugs.
  - .4 Test block to be installed on P & C compartment door or meter stand alone enclosures. Test plug to be installed within enclosures on holders. Enclosure doors to be equipped with labeling indicating rated size of PTs and CTs as applicable. Labeling to provide types of CTs and PTs including accuracy.
  - .6 The above described test block requirement shall NOT apply to the utility revenue metering installed by the local utility provided. For details on applicable installation features, refer to EPCOR's Customer Guidelines.

**4.17.3.12. Transformers**

- .1 Location
  - .1 All Transformers shall be installed such that replacement is possible without unforeseen building modifications nor surface or structural damage. Provisions may include double doors, expanded hallways, reinforced and or widened routes to loading docks and grade, removable wall panels, top access pits, etc.
  - .2 Main Building Transformers: locate standard 600V or 208V outside with pads and rails as per EPCOR guide. Provide screens where required by project. Location to be serviceable as required by EPCOR standards and as close as possible to building service entrance to reduce capital and operating costs (line losses). All primary, MV services to be in fully isolated, interior vault segregated from 600V or lower distribution.
  - .3 All Indoor Transformers over 45 kVA: allow for removal by wheel mounted equipment.
  - .4 Indoor transformers are to be preferentially floor mounted on housekeeping pads. Suspended installation only permitted for transformers within service rooms where there



is lift accessibility. Transformers 45 kVA and less may be cantilevered/wall mounted where access is not impeded by other equipment. Coordinate transformer heat removal with Mechanical.

## .2 Type

.1 Use minimum K-4 rated for distribution transformers.

.2 Use minimum K13 rated or Harmonic Mitigating Transformer with Zig-Zag windings for large non-linear loads such as solar PV, EV charging stations and large lighting installations. Where needed (e.g. large facilities) split loads between at least two phase shifted (e.g. 0 and 30 degree phase shift) transformers.

.1 Ensure transformer neutral capacity is sized to selected k-rating (e.g. 200% neutral capacity for K13 transformers)

.3 Autotransformers only permitted for dedicated equipment step-up/down applications.

.4 Copper windings only.

.5 Combination (single cabinet) transformer & panel board are not acceptable.

## .3 Secondary Voltage (isolation/distribution)

.1 347/600 V, three phase, four wire, solidly grounded wye.

.2 120/208 V, three phase, four wire, solidly grounded wye.

.3 120/240 V, single phase, three wire, solidly grounded, center tap.

.4 Obtain approval from the City of Edmonton for other voltages, connections, or any impedance grounding schemes.

## .4 Acoustical Considerations

.1 Ensure adequate acoustic ratings, treatment location and mounting of transformers. Refer to Section "[Acoustic Considerations: Electrical](#)".

### 4.17.3.13. Feeders

.1 Use copper conductors.

.2 Provide a full capacity neutral and a bonding conductor with all feeders.

.3 Other than main service feeder cables and/or raceway, feeders are not permitted to be located in slab or below slab-on-grade.

### 4.17.3.14. Power Factor Correction

.4 Correct power factor to at least 95% where normal loading yields a power factor of less than 90%.

.5 Locate PFC close to the motor or group of motors, preferably downstream of starters.

.6 Review use of automatic correction equipment with the City of Edmonton.

### 4.17.3.15. Arc Flash and Shock Hazard Labelling

.7 Refer to [Appendix E – “Arc Flash Design Guideline”](#)

#### 4.17.4. Motor Protection and Control

##### 4.17.4.1. References:

- .1 IEEE 1100 Recommended Practice For Powering And Grounding Electronic Equipment. (IEEE Emerald Book).
- .2 IEEE 995 – Recommended practice for efficiency determination of AC drives.

##### 4.17.4.2. General

- .1 Where possible, provide motors ½ hp (0.37kW) and larger as three phase units.
- .2 Where possible, provide motors larger than 1 hp (0.75kW) as three phase 600V units.
- .3 Provide motors smaller than ½ hp (0.37kW) as single phase, 120V units. Usually with integrated thermal overload.

##### 4.17.4.3. Motor Protection and Control

- .1 Do not use fuses for individual motor overcurrent protection.
- .2 Provide single phase protection for all three phase motors either by motor protection relaying (multifunction relays) or by the use of solid state differential overloads relays. BAS shutdown can also be used if it can be demonstrated that the implementation of this solution is cheaper than the use of a solid state overload relay.
- .3 Provide space on backpan for BAS current sensors.
- .4 Consider harmonic contribution when designing Variable Frequency Drives and provide filtering as required. See Variable Frequency Drive section for further details.

##### 4.17.4.4. Control Wiring

- .1 Coordinate control requirements with mechanical designers. Indicate control branch circuits on electrical drawings and panel schedules.
- .2 Low voltage control wiring to be run in conduit or otherwise mechanically protected.
- .3 For Motor Control Centers (MCC), control wiring to each bucket is not acceptable. MCC to include a marshalling panel located in a dedicated low voltage instrumentation and control section to wire all external control to said MCC.

##### 4.17.4.5. Full Voltage Starters

- .1 Full voltage starters shall be the default application for any motors.
- .2 Reversible or non reversible attributes shall be confirmed with the mechanical discipline.

##### 4.17.4.6. Reduced Voltage Starters

- .1 The use of this type of starter shall be justified based on a load flow and motor starting study demonstrating that an across the line application results in unacceptable voltage drop on site.
- .2 Where required, the use of delta/wye starters can be specified for large motors.
- .3 Soft starters are not desirable but can be specified if it is demonstrated that the use of a

delta wye starter is not practical due to specific load requirements, starting time, etc...

#### 4.17.4.7. Solid State Starters: Variable Frequency Drives

- .1 Power Quality: Filters:
  - .1 The MCC or stand alone enclosures shall be sized to offer sufficient space to install any required input and/or output filters or transformers (see “Harmonics Mitigation Techniques” below).
- .2 Bypasses, Branch Circuit Wire Size & Over Current Protection (OCP):
  - .1 When bypasses are not specified, VFD branch OCP and conductors must match and be sized as per manufacturer's recommendations or otherwise 125-175% of drive rated FLA.
- .3 Branch Circuit Distribution:
  - .1 Distribution feeds for stand alone drives should not be sourced from an MCC. In a mechanical room scenario, with many drives, there should be a CDP to aggregate feeds.
  - .2 Supply an SPD/TVSS device at any CDP distribution and/or individually at VFDs larger than 50HP.
- .4 Harmonics Mitigation Techniques:
  - .1 When using solid state variable frequency drives, designers shall specify the following harmonic mitigating features
    - .1 VFD AC outputs
      - a. Triplex cable (e.g. TECK-90 XLPE), cable to be rated for VFD application and complete with additional shieldings preventing EMF interferences with adjacent systems.
      - b. VFD output cables shall not be made using single conductor cables installed in conduits. Spacing with other circuits shall be of a minimum of a full cable diameter (based on the largest cables) to account for additional heating created by harmonic currents and to avoid cable derating.
    - .2 For further harmonic mitigation in a large installation, or on a large drive, a full active harmonic filter will be required on the input of the drive or at the MCC or distribution panel supplying said drive and a group of drives.
- .5 Enclosures:
  - .1 Drives and above input & output filter elements and bypasses may be neatly mounted separately or located in an integrator enclosure. All such integrator enclosures must be heat run tested at full load for 24h and not exceed manufacturer's published environmental limit for any interior components (i.e. drive, filters, etc.). All enclosures shall have active, redundant fan ventilation with over-temperature and fan failure alarms. Only filter inlet ports. When an integrator supplies an enclosure with multiple components they have full design, startup, testing and warranty responsibility for the entire package.
  - .2 Input voltage rating +/- 10% or better of nominal. IE. 208/240V class shall be rated up to 264V and 600V class shall be rated up to 660V or better. In heavy duty or large motor applications 690V Class drives rated up to 759V are preferred.

.6 Motor Protection & Wiring:

- .1 Output from drive/filter to all motors (or to motor starter, overload & disconnect distribution and on to motors) shall be correctly wired with drive/VFD "Teck" style cable similar to Beldan Symmetrical YC4936x series or Nexans DriveRX.

**4.17.5. Surge Protective Devices**

- 4.17.5.1. Provide surge protective device (SPD) on Utility incoming mains.
- 4.17.5.2. For areas containing a large group of electrically sensitive load, provide surge protection on panelboards serving the area.
- 4.17.5.3. Coordinate surge suppression devices within the same power distribution system.

**4.17.6. Branch Wiring**

4.17.6.1. Conductors

- .1 Use copper conductors minimum #12 AWG conductor size.
- .2 Conductors and cable splices are not permitted beyond #12 AWG.
- .3 Minimum insulation rating for 347/600V cables to be 1000V.
- .4 Minimum insulation rating for 120/208/240V cables to be 600V
- .5 Obtain approval of the City of Edmonton for the use of non-metallic sheathed cables. Consideration will only be given for buildings of combustible construction.
- .6 Use AC-90 cable only in short lengths, less than 3 m, for final connections to luminaires and similar equipment or vibration isolation.
- .7 Ensure to meet current CEC requirements of 5% voltage drop between source to destination for all equipment.
- .8 Ensure conductors and cables are rated for their application and environments per current CEC requirements.

4.17.6.2. Raceway

- .1 Minimum raceway size to be 21 mm.
- .2 Raceways are to be exposed surface mounted pipe and wire for all connections for long term maintenance and reliability.
- .3 Provide a separate bonding conductor in all branch circuit raceways. Conduit shall not serve as bond.
- .4 Branch circuit cable and/or raceway are not permitted to be located in slab or below slab-on-grade.
- .5 For high humidity applications, ensure surface raceways are galvanized and painted (coordinate with Architectural).
- .6 Ensure proper inter-discipline coordination for the use of expansion joints, couplings,

fittings where deemed appropriate.

#### 4.17.6.3. Receptacles & Wiring Devices

- .1 All receptacles to be specification grade with screw terminals.
- .2 Provide separate circuits for coffee makers, refrigerators, and microwave ovens. Consider 20A 5-20R T-slot type general purpose receptacles in kitchen/coffee counter areas.
- .3 Housekeeping receptacles in corridors to be located 15 m on center and 7.5 m from corridor ends.
- .4 All branch circuits to be labeled with panel name & circuit designation.
  - .1 For circuits less than or equal to 20A and 240 volt, panel name and circuit designation to be indicated with a wrap-around style label on the faceplate and permanent marker inside the box.
  - .2 Otherwise, all higher voltage and ampacity circuits have lamacoid style labels with panel name, circuit, and voltage/phase.
  - .3 Ensure dedicated circuit requirements for specific equipment are provided (e.g. Gas Detection, IT Requirements, CCURE, etc.)

#### 4.17.6.4. Provisions for Computer and A/V Based Equipment

- .1 A/V requirements to be coordinated with Open City & Technology (OCT) Network Analyst when a network connection is required.
- .2 Identify electronic equipment and systems likely to be affected by electrical service disturbances including voltage sags, surges, short and long term transients and outages. For this equipment, determine the extent of protection necessary for normal operation.
- .3 Protection and Power Conditioning.
  - .1 Isolation Transformers: electrostatically shielded transformers for equipment affected by transients and noise.
  - .2 Regulated Power Supplies: for equipment and systems affected by transients, noise, voltage sags, and surges.
  - .3 Electronic Filters: for equipment affected by power line noise.
  - .4 Uninterruptible Power Supplies: for equipment requiring continuity of service.
- .4 Computer Circuits
  - .1 Supply only electronic equipment with these circuits. Do not use these circuits to supply convenience receptacles or mechanical equipment.
  - .2 Generally supply only two computer workstations per circuit.
  - .3 Provide a separate, dedicated bond and neutral back to panel for each circuit.
  - .4 In situations where multiple circuits will supply potentially interconnected equipment in an area, ensure the circuits feed from a common panel.

#### 4.17.6.5. Block Heater Outlets

- .1 Design to shut off all power to outlets when outside temperature is above  $-10^{\circ}\text{C}$ .
- .2 Provide a timer to cycle energized outlets on and off at a maximum 30 minute period. If there are more than 30 parking stalls, split the load into two groups and alternately cycle load.
- .3 Assuming supply sized to supply all outlets simultaneously, inhibit cycling below  $-30^{\circ}\text{C}$ .
- .4 Where possible, consider integrating block heater control with building's BAS system. Coordinate with the Mechanical Section.
- .5 Provide override switch (ie. H-O-A) for parking lot controller testing/maintenance.
- .6 Provide hard or walkable surface from vehicle stall to block heater outlet.
- .7 Position Block Heater Outlets on a durable surface, and sufficient distance to prevent impact from vehicles.
- .8 Provide exterior rated use in place cover/box on all receptacles

#### 4.17.6.6. Electric Vehicle Supply Equipment

- .1 Refer to [Appendix I - Electric Vehicle Charging](#)

#### 4.17.6.7. Provisions for Custodial Equipment

- .1 Storage/Janitorial rooms to have adequate (number and current capacity/type) receptacles for any equipment. Ensure mechanical is aware of any exhaust requirements due to battery charging.
- .2 Ensure adequate (number and current capacity/type) receptacles throughout the facility for equipment such as floor polishers, etc.

#### 4.17.6.8. Provisions for Mechanical Systems

- .1 Indicate location and circuiting of all mechanical control panels on drawings.
- .2 Coordinate electrical equipment required for mechanical equipment with the mechanical designer. Items may include UPS for head end of BAS systems, power filters, regulators, electrically powered valves and dampers, lighting in air handling units, heat tracing of piping or equipment, etc.
- .3 Rooftop receptacles to be on dedicated branch circuit and installed in enclosure with weatherproof clear plastic covers
- .4 Local disconnects to be provided for humidifier units.

### 4.17.7. Life Safety, Emergency, and Security Systems

#### 4.17.7.1. General

- .1 Provide emergency power for all life safety, security, and required mechanical systems referred to in Section 4.16.2.5. Pay particular attention to fire rating of emergency lighting feeds or feeds to smoke evacuation fans, elevators, fire pumps, or similar emergency life safety classed equipment.
- .2 Provide battery backup for all systems with volatile electronic memory including but not

limited to IT equipment, telecommunication systems, and any other system designated as designated mission critical systems.

- .3 Refer to 'Security and Card Access System Design Guideline', 'Video Surveillance System Design Guideline' and "Fire Alarm Communication Design Guideline" in Appendices for further information.

#### 4.17.7.2. Fire Detection Systems

- .1 Design and install system to latest CAN/ULC-S524 Standard, Installation of Fire Alarm System and Verify system to latest CAN/ULC-S537 Standard, Verification of Fire Alarm System.
- .2 Provide a fire alarm as a stand alone system, independent of building control or security system.
- .3 Select system vendors with local support. Do not use proprietary equipment.
- .4 Show fire alarm devices on plan drawing(s). Include a fire alarm system riser diagram in contract documents.
- .5 In case of retrofit, clearly identify all existing equipment and indicate if they will be demolished, relocated, or remain. Protect existing items designated to remain and items designated for salvage.
- .6 Use horn/speaker-strobe combination devices for audio-visual signals unless site conditions dictate otherwise.
  - .1 Audibility shall be code minimums. Do not exceed 90 dB SPL in non-service spaces.
  - .2 When using speaker for alerting, design for lower SPL and higher density of speakers to maintain intelligibility.
- .7 Coordinate duct detectors with mechanical to ensure air velocities are compatible with detectors.
- .8 Coordinate sprinkler flow alarms and valve tamper locations with mechanical and indicate on fire alarm plan.
- .9 Coordinate kitchen hood fire suppression connection with the fire alarm system.
- .10 Indicate all auxiliary connections to the fire alarm panel, including elevators, emergency dialers, fire door hold-open devices, fan shut-down relays, cistern tank levels, photovoltaic interlock as required.
- .11 Provisions shall be made to allow for the by-pass of some equipment for the purpose of periodic fire alarm testing with the press of a button. A password code may be required to enable this function. More specifically:
  - .1 Button for the by-pass of all audible & visual devices.
  - .2 Button for the by-pass of all auxiliary functions such as elevator recall, ventilation system shutdown, hold-open devices, etc.
  - .3 Button for the by-pass of all sprinkler systems and standpipe flow-switches.
- .12 Note that any and all consultant expenses for fire alarm verification are considered



included in design and construction management fees.

- .13 "Computer Software" shall be available within the distributor to allow for verification of programming modifications to the fire alarm system. The city maintenance department has the right to obtain this software with no additional fee or required subscription cost incurred to the city.
- .14 All fire alarm wiring to be red FAS cable or fiber in conduit. BX/AC90 only acceptable for movement or vibration isolation, final device stub, or in a retrofit situation where running conduit not practical. Length to be 3 m or less without explicit *City* approval and product must be factory supplied as red armored FAS.
- .15 Basis of Design to be Simplex, Notifier and Mircom.
- .16 Fire Alarm Communications (dialer) to be provided for all ULC and non-ULC compliant installations as per '[Fire Alarm Communication Design Guideline](#)' in [Appendix F](#). For facilities that require a non-ULC Dialer, please engage AHJ and Facility Engineering Service for proposed installation.

#### 4.17.7.3. Generators

- .1 Locate generator and associated electrical equipment at grade of above if in area subject to flooding.
- .2 Provide sufficient clearances for maintenance and repair personnel to access all sides of the generator.
- .3 Provide provisions for removal/replacement of generator at end of life that does not require substantial building modifications.
- .4 Programming software used to program the generator is to be non-proprietary and provided to the City.
- .5 All cables or equipment required for monitoring to be provided to the *City*.
- .6 Transfer switches are to be capable of remote monitoring of generator status and state.
- .7 When fire pump transfer switch is on generator power and pump is running, generator battle short mode shall be engaged.
- .8 Provide vibration isolators for field installation.
- .9 Paralleled generator configurations shall only be considered for extremely high availability applications and/or large loads. They shall be of integrated, PLC controlled switchgear style and fully configured to operate and load shed feeder breakers under failed generator and overload conditions. BAS only load shed not acceptable.
- .10 Service and parts shall be available within 24 hours
- .11 Manufacturer shall provide a certified summary of prototype-unit test report
- .12 Manufacturer shall be experienced in installation and operation of generator set of comparable size.
- .13 Manufacturer shall guarantee availability of parts for a minimum of 25 years.
- .14 Generator shall include at a minimum:

- .1 Remote annunciator panel
- .2 External Battery Charger.
- .3 Braided fuel lines c/w union connections for fuel inspections (carburetor to tank)
- .15 Final Site Design Load Calculation(s) to be included in drawing set.
- .16 Site Design load to be posted on each transfer switch with red lamacoid (white writing).  
 Minimum size 50 mm x 100 mm.
- .17 Enclosure
  - .1 Install the generator in a dedicated generator room with an exterior wall, or, alternatively, in an exterior walk-in enclosure with a designated access pathway.
  - .2 Where not feasible and with City approval, a sound attenuated enclosure and Winter Package may be acceptable. Refer to section Generator Power Supply for Life Safety Loads for additional requirements for Life Safety loads.
- .18 Exhaust
  - .1 Exhaust shall discharge vertically for maximum dispersion modeling. Rain cap shall fully open without impeding the vertical discharge while the generator is operating.
  - .2 Position the exhaust point above roof level and away from air intakes.
- .19 Ventilation
  - .1 Outside air and recirculating motorized dampers to be provided.
  - .2 Ensure generator room layout allows for optimal generator cooling, intake and outake louvres to be configured as per manufacturer recommendations.
- .20 Fuel Fill Port and Control Panel
  - .1 Fill level indicator panel adjacent to exterior fuel fill port. Panel to contain six (6) indicator lights and lockable cover with clear plexiglass window:
    - .1 "Fuel Leak" (Red) (Local Audible Alarm at fill panel)
    - .2 "25%" (Yellow)
    - .3 "50%" (Green)
    - .4 "75%" (Green)
    - .5 "Tank Full - STOP FILL" (Red) (90%)
    - .6 "Overfill Alarm" (Red) (Local Audible Alarm at fill panel)
  - .2 One (1) button:
    - .1 "Indicator Test" (momentarily activates all Indicator Lights (1 thru 6 and Local Audible Alarms)
  - .3 Fill levels to be manufacturer set to allow for full -40C tank expanding to +40C. Automatic overfill prevention device to be used to comply with code.
  - .4 "Fuel Leak" indicators (where applicable) to be tied to high level sensor within curbed

generator room (or generator containment perimeter).

- .5 Fuel Port to have lockable cover.
- .6 Plan for fueling accessibility and spill control during fueling.
- .7 CSA 282 compliant as required.
- .8 CSA Certification or approved equal.
- .21 Annunciator
  - .1 Panel to be located at Service Desk or Operator's station or as directed by City.
  - .2 Panel to contain four (4) indicator lights:
    - .1 "Generator Run" (Green) (Audible Alarm)
    - .2 "Generator Trouble" (Red) (Audible Alarm)
    - .3 "Generator Fail" (Red) (Audible Alarm)
    - .4 "Low Fuel" (Red) (Audible Alarm)
  - .3 Two (2) buttons:
    - .1 "Silence Horn" (acknowledges and silences any alarm)
    - .2 "Indicator Test" (momentary button activating all indicators and audible alarms)
  - .4 CSA 282 compliant as required.
  - .5 CSA Certification or approved equal.
- .22 Sub-base fuel tank
  - .1 Provide curb
  - .2 Built-in fuel gauge on sub-base tank
  - .3 Two fill ports sufficient to facilitate fuel conditioning
  - .4 Exterior generator installation to have NEMA 4 spill containment device fitted to the inlet of the storage tank. Spill containment device to be at least five (5) gallons and must be lockable.
- .23 Stand-alone fuel tank
  - .1 Provide integral secondary containment with leak detector tied to indicators and alarms
  - .2 Fuel tank shall rest on supports or piling made of concrete, masonry, or steel. Tank supports shall be installed on firm foundations designed to minimize uneven settling of the tank and to minimize corrosion of the part of the tank resting on the foundation.
  - .3 Provide levelometer
  - .4 Barriers shall be used to protect exterior fuel tanks from mechanical damage by vehicle or other sources
- .24 Load bank
  - .1 Cam-lok connectors for load bank test to be E1016 Series, 400A (minimum), female and

to be mounted in load bank quick connect (c/w non-conductive mounting plate) located inside generator room where clear path to outside is available. Otherwise to be located adjacent Fuel Port and Control Panel (exterior).

- .2 LSI local breaker (generator) w/ shunt trip and aux. contacts for load bank connection
- .3 Minimum load on generator to be 40% (or as dictated by monthly testing for installations to CSA C282). A permanent load bank is to be installed unless it can be shown that the site demand will not drop below the minimum load requirement.

.25 Portable Generator Connection

- .1 Cam-lok connectors for a portable generator to be E1016 Series, male and to be mounted in quick connect (c/w non-conductive mounting plate) located in close proximity to the Load bank connection.
- .2 Manual transfer switches are only permitted for installation to accommodate portable generator.
- .3 Combination Manual Transfer switch - portable generator cabinets are preferred.

.26 Acoustics

- .1 Refer to the section [Acoustic Considerations: Electrical](#)

.27 Overfill/Leak Protection/Diesel Piping Leak

- .1 Overfill and leak protection is required on all installations as stated in 3.18
- .2 Double wall tubing is required where fuel fill tank are stored indoors and fuel fill port is located outside
- .3 In room spill control to be considered for elevated generator rooms or as directed by the City. Ensure room is capable of containing the capacity of the largest tank in the room.

- .28 Refer to [Appendix K - Distributed Generator \(DG\)](#) for additional generator considerations

**4.17.7.4. Generator Power Supply for Standby Loads**

- .1 Refer to Section [Standby / Backup Power \(Non Life & Safety Loads\)](#):
- .2 Provide a minimum of one receptacle in electrical and mechanical rooms connected to emergency power where a generator is installed.
- .3 Power to electrically actuated washroom fixtures shall be on standby power circuits if available.

**4.17.7.5. Generator Power Supply for Life Safety Loads**

- .1 CSA 282 shall be met for all generator installations powering Life Safety (L/S) systems as per code.
- .1 All police, fire, and ambulance facilities shall have C282 compliant generator installations even if not required by code for Life Safety (L/S) system service.
- .2 Generator to be installed within the facility. Where not feasible and with City approval, a climate controlled, sound attenuated, walk-in enclosure equipped with motorized louvres may be acceptable.

- .3 Where systems are required by code to run past 30 minutes, concrete encasement of conductors/conduit may be permitted in place of MI cable. Consult Facility Engineering services for discussions of alternative approach.

#### 4.17.7.6. Uninterruptible Power Supply

- .1 Refer to [Appendix K - Uninterruptible Power Supply \(UPS\)](#).

#### 4.17.7.7. Egress/Emergency Lighting

- .1 Design emergency lighting in such a way as to ensure local emergency lighting is activated when normal lighting in the area it serves is disrupted at the branch circuit level, not just when main building power or major feeders are disrupted.
- .2 All battery powered emergency lighting unit equipment shall have auto-self test with audible battery failure alarm.
- .3 In all electrical and generator rooms provide battery powered emergency lighting unit equipment with a minimum 2 hour capacity or greater as required by any codes.
- .4 Access hatches required to troubleshoot equipment and areas/rooms equipped with transfer switches, emergency generators, UPS and related distribution panels shall be equipped with LED and dedicated battery packs specified for 8 hour runtime.
- .5 Integral batteries within standard area lighting fixtures not permitted without explicit approval from City Engineering Services.

#### 4.17.7.8. Exit Signs

- .1 Exit signs to use permanently illuminated, backlit or edge lit LEDs that illuminate the entire face (or stencil cutout when using deprecated red 'EXIT' signs).
- .2 Any particular renovation/addition must be judged on its unique merit in terms of the implementation of new standard 'Green Running Man' signage vs. older 'Red Exit' signage. The factors will include, but not necessarily be limited to:
  - .1 Percentage size of new area (however \*no\* absolute number such as 51%)
  - .2 Impact on egress routes and need for clear wayfinding to building exits, i.e. Only one (1) signage style permitted on any egress route.
  - .3 Acceptable solutions may include:
    - .1 Usage of older "Red Exit" signage in new areas to preserve the integrity of egress route wayfinding "system" and prevent confusion when exiting (particularly in lower area percentage renovations/additions).
    - .2 Mixed use of older "Red Exit" and new "Green Running Man" signage (i.e. situation where there is basically no crossing of exit routes and little to no connection between old and new areas; or situation where there would only be one change of signage on the way out, such as a full floor renovation or additional building wing).
    - .3 Retrofit of entire building to new standard "Green Running Man" signage for a consistent egress route wayfinding "system" (preferred solution when renovation and addition would be a substantial percentage, 50%+ of resultant new space, and said retrofit of old area would not result in undue cost ).

- .4 Any project that is remotely questionable should be submitted to the Sustainable Development Building Inspection office for AHJ review at the conceptual stage to avoid unnecessary costs due to design changes or construction change orders.

#### 4.17.8. Lighting

##### 4.17.8.1. General

- .1 Design to maximize the energy efficiency of lighting systems.
- .2 Only use the task-ambient approach where work surface and task orientations are predetermined and as agreed to by the City of Edmonton.
- .3 It is not necessary to design for worst case work surface and task orientations in general office space.
- .4 Design to minimize direct and reflected glare and maximize contrast.
- .5 Lighting fixtures, dimmers, sensors, controllers, & disconnect/switches, must be CSA approved or equivalent.
- .6 Ensure specified lighting fixtures to be readily available in the local market or has an approved market distributor in the province of Alberta.

##### 4.17.8.2. Recommended Lighting Levels

- .1 Design lighting levels to IES recommended lighting levels for horizontal and vertical illuminance. Refer to the latest edition of the IESNA Lighting Handbook.
- .2 Consider the following criteria when deciding the appropriate average maintained light levels within a space. Criteria may be determined upon consultation with the City of Edmonton.
  - .1 Visual Tasks performed: High, medium or low contrast, large or small size
  - .2 Occupant Age
  - .3 Task Duration: Short or Prolonged periods
  - .4 Workplane height
- .3 Consult with the Architect and consider the room finishes (colour and reflectance) when performing light calculations.
- .4 Maintained Values: Use the following criteria for calculation of maintained values.
  - .1 Luminaire Dirt Depreciation: 0.90 (Typical office environment). This value may be adjusted based on project specific criteria such as dirtiness of the environment.
  - .2 Lamp Lumen Depreciation: LLD factor is different for each lamp type. Utilize mean lumen output ratings from lamp manufacturer when calculating light levels in a space.

##### 4.17.8.3. Uniformity

- .1 All areas in a space need not be to minimum average maintained values if functions permit. Lighting levels may be non-uniform. For example, circulation areas in an office may be of a lower level than recommended for the work surface.

#### 4.17.8.4. Exterior Lighting

- .1 This section applies to sites within the City of Edmonton that have metered exterior lighting (ie. Facility site lighting, Park lighting) that are maintained by the City. Unmetered installations (ie. Roadways) are to be designed to 'Road and Walkway Lighting Construction and Materials Standards', latest edition, available through the City Transportation Department.
- .2 All projects to adhere to the City of Edmonton 'Light Efficient Community Policy', latest edition.
- .3 Use LED for parking, roadway, area lighting, and building exterior. Acceptable voltages are 120V, 208V, 240V. 347V not permitted for new installations. In retrofit situations where only 347V is available and no conversion feasible, true integrated 347V drivers preferred (no external autotransformers) and confirm acceptability with City Engineering Services prior to specification.
- .4 Approved luminaire head manufacturers include "Philips Lumec", "Cooper/Eaton", or "Acuity Brands". Preferentially recognized families already approved by Transportation for roadway or MUT or those otherwise previously used by the City. Acceptable examples include "Philips Lumec" 'Roadstar', 'Roadview', 'Streetview', 'Metroscape', 'Urbanscape' & 'Ancestra'; "Cooper/Eaton" 'Ridgeview'. Explicitly confirm exceptions with City Engineering Services prior to specification.
- .5 Use cast in place or precast concrete piles with internal ducts and embedded bolts/rods. 280 mm (11") BCD nominal standard. Top of pile shall be 150 mm above finished grade in soft landscaped areas, 150 mm if in sidewalk or other hard surfaced areas. Additionally, for parking lots and roadway areas where there is likely a risk of vehicular impact, top of pile shall be 1000 mm above finished grade.
- .6 Pole design & size to be coordinated with the structural consultant taking into account soil & grade conditions and final pole/head requirements. Acceptable examples for precast piles include Armtec '8-0082', '8-0083-6', & extended (3000 mm) '8-0079' depending on application. Cast in place to be fully detailed.
- .7 Poles to be square or octagonal, galvanized steel, and painted with 2 coats of enamel on primer or polyester powder coated. Handholes with security bolts to be used to deter theft of cables, ensure tools to operate security bolts are stored in the metering cabinet. Approved manufacturers include Novapole & West Coast Engineering. Any aluminum and/or custom poles to be explicitly approved by City Engineering Services. Pole supplier to confirm design suitability for luminaire head EPA and associated installation location parameters.
- .8 If cameras are specified to be pole mounted then please ensure that poles are equipment with segregated raceways for mixed voltages with manufacturer approved camera mounts. Custom poles to be explicitly approved by City Engineering Services.
- .9 Luminaires including emitter diode package & driver shall be explicitly rated to operate from -40°C to 40°C.
- .10 Exterior luminaires to have minimum colour rendering index (CRI) of 60 and correlated colour temperature (CCT) of 3000 (± 200) K with a  $D_{UV}$  of -0.006 to 0.006. Optionally a



CCT of 4000 ( $\pm$  200) K with a  $D_{UV}$  of 0.005 to 0.007 will only be accepted with explicit approval from City Engineering Services.

- .11 A single head's emitter diode package/board should not exceed 12000 lumens for general purpose horizontal illumination. Consult with the City of Edmonton for project-specific details that may fall outside this limit.
- .12 Use UV resistant diffusers/lenses for exterior luminaires and consider vandal resistance.
- .13 Use full cutoff luminaires for all parking, roadway, and area lighting. House side shielding to be specified on property perimeter luminaires unless there is otherwise lit road, or other adjacent city property, that could benefit from spill light. Wall mounted luminaires to be positioned or shielded to eliminate glare and light trespass to adjacent, non-city, properties.
- .14 Where multiple different architectural exterior luminaires are used (i.e. pole mount, bollard, building mount), select luminaires to complement each other, possibly from the same manufacturer "family".
- .15 Bench and in ground lighting by explicit approval only, please contact City Engineer Services prior to specification.
- .16 Bollard lighting by explicit exception approval only and used for decorative, architectural purposes only, not general area lighting. Follow above pile guidelines. Breakaway base design required except when not indicated due to security requirements.
- .17 Custom products highly discouraged and not permitted without explicit approval from City Engineering Services. Eg. Architectural marquee luminaires, bollards, rail and rope light installations, etc.

#### 4.17.8.5. Interior Lighting

- .1 Lighting Supply voltage to be preferentially 120V but not to exceed 240V. 347V not permitted.
- .2 Purpose designed LED luminaires from major manufacturers preferred; must meet IES LM-79 and IES LM-80. For some architectural purposes E26/GU10 fixtures with LED lamps may be acceptable.
- .3 Minimize the number of unique lamp types used. Specialty lamps beyond E26, E39, GU5.3, GU10, G5 & G13 by exception only.
- .4 For Lighting Power Density targets, please refer to NEC latest edition.
- .5 Use of non-LED, generally incandescent, sources not permitted without explicit approval from City Engineering Services. Propose only where minimal burning hours are expected and/or significant architectural considerations are presented.
- .6 LED sources to have minimum colour rendering index (CRI) of 80 and have colour temperature of 3500K, or as determined in consultation with the City of Edmonton depending on building use. Colour temperature should be consistent throughout building except intentional architectural purposes.
- .7 Cove lighting not permitted without explicit approval from City Engineering Services due to stringent reliability and service requirements. Recessed lighting may be acceptable

provided fixtures are easily accessible for maintenance (ie. not over toilets which make ladders unusable).

- .8 The use of LED tube style lamps for fluorescent luminaire replacement or retrofit is not supported.
- .9 High efficiency, low brightness diffusers are preferred in areas containing computer display workstations.
- .10 Consider direct/indirect combination lighting in office areas and where glare is to be minimized, but only if adequate ceiling height exists.

**4.17.8.6. Drivers and Ballasts**

- .1 Use energy efficient electronic, solid state designs with built in inrush and surge suppression.
- .2 Total Harmonic Distortion of less than 12% and Power factor greater than 0.95.
- .3 Where dimming is required must be capable of 0-10V.

**4.17.8.7. Control**

- .1 Lighting control systems (LCS), if implemented, shall be a Low Voltage Relay System and provide manual, automatic, or programmable lighting control. The application of this control and the controlled zones will depend on a number of factors including frequency of use, available daylighting, normal or extended work hours, and operational/security requirements. All of these factors must be considered when establishing zones, zone controls, and the overall lighting control narrative/strategy.
- .2 Do not use breaker switching.
- .3 Nightlights, if switched, are to be controlled from a keyed switch located in a secure location.
- .4 Provide time clock or programmed switching for large general use areas.
- .5 Provide an automated dimming system in office areas or other sensitive areas to prevent initial overlighting of the space and ensure adequate light levels throughout the life of the light source.
- .6 Daylight harvesting to be provided with photocell control wherever feasible and provide control narrative for facility integration.
- .7 Provide single photocell, manual electromechanical time clock, or security device control or a combination thereof for exterior luminaires. Consider facility usage and security when determining the exterior lighting control scheme.
- .8 Wireless controls not permitted in new construction; renovations by explicit approval from the City. Wireless devices for programming purposes are permitted.
- .9 Provide motion sensor control where economics are favourable. Areas to consider include washrooms, lunch/break rooms, copy rooms, individual offices, low-use corridors, and nightlights. Motion sensors in offices are to be manual on, automatic off. Use dual technology (PIR & microphonic) sensors in areas where line of sight cannot be assured, such as washrooms. Depending on technology (LED vs fluorescent) and situation, ensure

adequate time outs to avoid frequent or nuisance cycling.

- .1 Do not use motion sensor control in mechanical/electrical rooms, elevator rooms, or service areas.
- .2 Do not use motion sensor control in rooms/areas that require roof and/or roof access
- .3 Ultrasonic sensors are not permitted.
- .10 Ensure that equipment is UL 924 (Emergency Lighting Equipment) and UL 2043 (Heat and Smoke Release for Air-Handling Spaces) listed as required.
- .11 Provide at minimum 25% spare capacity in lighting control panels.

#### 4.17.8.8. **Low Voltage Relay System**

- .1 Must be capable of integrating with the building management system (BMS) and communicate over BACnet/IP with BBMD capability.
- .2 Must be fully integrated into the City centrally monitored BMS network before turnover.
- .3 Must provide the ability to use standard BMS structure to command objects: zone controls and schedule objects.
- .4 Must provide the ability to use standard BMS structure to view objects: power/energy meters, individual lighting stem alarms or failures, motion/occupancy sensors, light output levels(intensity), and indoor ambient light levels(intensity).
- .5 Programmable relays, field devices, DACs, or similar not to be located in walls or ceiling spaces, to be logically marshaled in a common panel.
- .6 Any specialized equipment or programming required for commissioning, troubleshooting, or general maintenance to be provided at turnover.
- .7 Provide switching for conference rooms, board rooms, groups of common offices, large areas of single use, and offices.
- .8 Low voltage lighting panels to be located adjacent to lighting distribution panelboards/placed to minimize circuit lengths to a maximum circuit distance of 300 m. Panels are not to be shared between floors.
- .9 Each lighting control relay shall be capable of controlling incandescent, fluorescent, electronic ballast, and H.I.D. lighting loads and have an inrush capability of 3000 amperes. Relays shall be complete with a minimum 5 year manufacturer's warranty.
- .10 Lighting control relays shall include captive screw terminals for both the line voltage and the low voltage connections. Switching the relay shall be accomplished with one (1) signal wire and a common return. The signal wire shall be able to signal on and off and shall carry status current that indicates if the relay is on or off.
- .11 Relays are to be individually replaceable.
- .12 Relay must be provided with a manual override.
- .13 Capable of mixed load voltages as well as mixed sources (i.e. normal and emergency power).
- .14 Ensure that relays are provided with a single 0-10V dimming output (IEC 60929 Annex E)

capable of sinking 30mA (corresponding to 30 typical ballasts/LED drivers).

.15 Ensure that under loss of utility power, relay contact returns to the normally closed position and bypasses control to the emergency/egress lighting.

.16 All control wiring to run from device to headend, daisy-chaining of devices not permitted.

## .2 Digital Addressable System

.1 Digital Addressable System is not permitted.

.2 Power over Ethernet (PoE) lighting systems are not permitted.

### 4.17.8.9. Installation

.1 Support recessed luminaires independently of T-Bar.

.2 Only use luminaire manufacturers approved for the installation method specified. Failure to do so may result in mechanical failure or heating causing reduced lifetime and/or fire hazard.

.3 Indicate on drawings the method of support for luminaires. Provide details if required.

.4 When fixture installation requires securing the unit with screws, dimensional lumber substrate is to be used as screw stripping and tear out in gauge metal or plywood substrate poses a risk to occupants. Where use of dimensional lumber is not feasible, toggle anchors must be specified.

### 4.17.8.10. Maintenance

.1 Commonly replaced components used in specified lighting products, such as LED arrays/lamps and ballasts/drivers, are to be available locally from wholesale supplies and/or distributors. Ensure the manufacturer specified guarantees the compatible replacement parts for a minimum of 10 years.

.2 All LED arrays, lamps, lens, ballasts, drivers, etc shall be readily accessible for service and replacement without any requirement for architectural remediation (i.e. carpentry, drywall, painting). All luminaire replacement elements such as lenses, drivers, lamps, panels, hatches, grills, etc. shall be 2.5 m or less in length and of a reasonable cross-section and weight.

.3 Luminaires located in high areas (above 3 m) are to be positioned to allow for maintenance and replacement of parts with standard City of Edmonton maintenance equipment.

.4 LCS to have local technical support & maintenance with factory trained technicians and service and parts available within 24 hours.

## 4.17.9. Communication Equipment

### 4.17.9.1. Structured Wiring

.1 Coordinate structured wiring requirements with the City of Edmonton.

.2 Structured wiring designed to comply with [Appendix B - IT Infrastructure Design Guidelines](#).

- .3 Structured wiring design to follow latest edition of TIA/EIA-568 – Commercial Building Telecommunication Standard.

#### 4.17.10. **Audio Visual Systems (A/V)**

##### 4.17.10.1. **General**

- .1 Coordinate A/V requirements with the City of Edmonton.
- .2 Structured wiring cables (CAT6 or Fibre) to be supplied, installed and tested by Division 27 cabling contractor as per the [Appendix B - IT Infrastructure Design Guidelines](#)
- .3 Please provide Network bandwidth calculations prior to tender.
- .4 Please provide POE Power budget calculations prior to tender.
- .5 Please provide Serial # & MAC Address for each item in tabulated form
- .6 Page zones are to be made available to all users in smaller zones:
  - .1 Emerg All Zones (entire building)
  - .2 Rec All Zones (all zones in rec section)
  - .3 Rec Common (all common public areas in rec)
  - .4 Pool All Zones (pool deck & pool change rooms)
  - .5 Fitness Common (all fitness zones)
  - .6 MPR All (all multipurpose rooms)
  - .7 Arena Common (all common public areas in arena)
  - .8 All individual rooms should still be able to split out to separate zones in the future in the event of the room changing function
  - .9 Library Zone should be isolated to be operated from the Library desk only.
- .7 Be sure to specify a wall mountable weatherproof CB style microphone to the pool deck for emergency pool page only.
- .8 All rack mount UPS shall have data ports connected back to the City network for remote monitoring.
- .9 Basis of design is the 70V speaker line.
- .10 Basis of Design for Arena - Wireless microphone to be a dual channel wireless receiver with both audio outputs routed to the corresponding arenas.
  - .1 Only one handheld microphone will be required at time of install. Second wireless channel is for future events or if future wireless expansion is needed.
  - .2 Wireless system to have remote antennas mounted in each corresponding arena, antenna cable to be factory built cable and any RF inline amplifiers to be installed according to factory spec's to have proper RF gain structure.
  - .3 Handmade cables will not be accepted.
- .11 Network switching manufacturer to be fully defined.

- .1 POE Power budget to be coordinated with **City** prior to tender.

**4.17.10.2. Assistive Listening Device Systems (ALD)**

- .1 Generally to code for assembly occupancies.
- .2 Contact City for specialty implementations in Libraries.
- .3 Make allowances in millwork, floor, or ceiling for the Induction loop at public service desk locations.
- .4 Refer to the [City of Edmonton Access Design Guide](#) for preferred systems and locations.

**4.17.10.3. Distributed Antenna Systems (DAS)**

- .1 In large facilities investigate and allow for DAS systems (Bi-directional Amplifiers (BDAs), etc) to allow for both emergency responder and public cell data frequencies.
- .2 For EPS facilities, contact the Project Manager for a list of specific requirements.

**4.17.11. Miscellaneous**

**4.17.11.1. Maintenance & Sustainable Design of Electrical Equipment & Infrastructure**

- .1 Common replacement components used in electrical equipment, such as lamps, ballasts, fuses, and breakers, must be available through local distributors.
- .2 Where possible, specify electrical equipment and systems that have local service and support with 8 hr response time.
- .3 Allowances shall be made for access to electrical elements and raceway infrastructure shall be provisioned to interconnect devices, major distribution nodes, etc. Examples include spare conduit across inaccessible spaces (high ceiling, drywalled ceilings, etc.), adequate access hatches, raceway system between electrical & Datacom (NAR) rooms.
- .4 Any large electrical equipment such as UPS or Transformers must be located such that a future service replacement is possible. This includes a planned path with adequate structural rating and clearances around corners and through doors. Consider required dollies and/or potential rigging.
- .5 Any electrical elements such as luminaires that require a lift to service must have a clearly planned and reserved serviced corridor to bring in a lift. This includes double doors, ramps, turning radii, etc. Maximum height for lift service 9 m. Maximum height for ladder service 4 m.
- .6 Any electrical elements in the vicinity of stairs, atria greater than 9 m, etc. shall be evaluated for serviceability so as not to require scaffolding, bosun's chair harnessing, specialty lifts, or other extraordinary means.

**4.17.11.2. Electrical Service Rooms (ESR), Network Access Rooms (NAR), & Other Security or DataCom Equipment Locations**

- .1 To be sized as per Service Spaces in the [Service and Power Distribution](#) section, building & electrical code(s), EPCOR, and other City guidelines to ensure serviceability and future expansion.



- .2 Collocated with mechanical or similar equipment by exception only.
- .3 Environmental conditions to be maintained to suit equipment requirements and maintained under power loss conditions if equipment will continue to function.

#### 4.17.11.3. **Software**

- .1 Software used to program, monitor, or control specified electrical equipment is to be supplied to the City. Do not specify equipment that uses proprietary software that is not made available by the vendor to the end user. This may apply to equipment such as generators, distribution equipment (MCCs), lighting control systems, fire alarm panels, etc.
- .2 Specify training on all software provided.

#### 4.17.11.4. **Lightning Protection:**

- .1 Provide lightning arrestors on all services connected to overhead lines or elements/systems otherwise deemed to be exposed plant (i.e. Roof mount antennas) in compliance with CSA B72.
- .2 As a guideline, provide lightning protection for structures that are taller than adjacent structures within a 500 m radius.
- .3 Lightning protection requirements depend on a multitude of building design, construction, & location factors. On all projects, the design professional of record shall positively confirm the requirement or exclusion of lightning protection.

#### 4.17.11.5. **Penetrations and Firestopping:**

- .1 Ensure adequate treatment for all envelope penetrations such as generator exhaust piping, lightning down conductors, and points and service masts. Refer to [Building Envelope](#) for specific requirements.
- .2 Coordinate firestopping requirements with Architect. Ensure firestopping responsibility is clearly indicated in contract documentation. Any disturbance of existing firestopping to be repaired to current standards. Any previously deficient firestopping to be remediated to current standards.
- .3 For penetrations of Datacom cabling and/or trays that are subject to repeated, frequent, operational alterations specify a reusable system.
- .4 Perform non-destructive, investigative survey with radar, x-ray, sonar, or other appropriate means prior to any and all penetrating operations on floor slab, wall, structural member, or similar building element that may contain reinforcement or building systems susceptible to damage. This includes, but is not limited to, coring, cutting, boring, depth fastening, etc.

#### 4.17.11.6. **Colour Coding Requirements:**

- .1 Refer to [Appendix A – Colour Coding Requirements](#) for Mechanical and Electrical Systems for identification symbols and colours for electrical conduit and equipment.

## 4.18. **Energy Modelling Guidelines**

### 4.18.1. **Acceptable Energy Modeling Software**

- 4.18.1.1. The simulation program shall meet the requirements of ASHRAE 140 and ASHRAE 183.



#### 4.18.2. Energy Model Requirements / Objectives

- 4.18.2.1. The energy model will follow the requirements of the current version of the National Energy Code for Buildings for weather files, unmet hours, schedules, internal loads, DHW loads, elevators, process loads, ventilation rates, infiltration, envelope heat loss, opaque assemblies, fenestration, and doors.

### 4.19. Pool Systems and Other Water Treatment

#### 4.19.1. General

- 4.19.1.1. In addition to meeting all applicable laws, pool systems shall be designed to the requirements of the following standards:
- .1 Alberta Building Code, especially Part 7 and Part 2
  - .2 Alberta Health - Pool Standards - 2014
  - .3 Alberta Regulation 204/2014 - Public Health Act - Public Swimming Pools Regulation
  - .4 ASHRAE guidelines for pools—outdoor airflow and air distribution designs.
- 4.19.1.2. Building Automation system to trend all pool water systems and include historical data collection. Refer to [Controls](#) in the mechanical section
- 4.19.1.3. If inline salt-sourced chlorine generators are used:
- .1 A floor drain shall be provided next to each bank of salt-source chlorine generators (salt cells).
  - .2 Only single salt-source chlorine generators shall be specified.
- 4.19.1.4. Only regenerative media filters or high-rate sand filters shall be specified. Horizontal sand filters will not be accepted.
- 4.19.1.5. Drywall and suspended ceilings in natatoriums are discouraged. Ceilings must allow for investigation and repairs within the ceiling space without significant damage, deconstruction or disruptions to normal operations.
- 4.19.1.6. All hangers and pipe/electrical/architectural supports in natatoriums to be corrosion resistant in aquatic environments. Consider galvanized or nickel based alloy.
- 4.19.1.7. Flow meters are to be electronic type with the ability to be monitored from the building automation system. In addition, a non-electronic flow gauge shall be installed as a secondary flow measurement device. Flow meters to have isolation valves installed before and after the meter.
- 4.19.1.8. One flow meter and turbidity meter shall be installed on the main inlet and outlet lines of the circulation system.
- 4.19.1.9. Flow meters shall be installed on the supply line to slipstream devices such as heat exchangers

and in-line chlorine generators.

- 4.19.1.10. One spare strainer basket is required for each set of strainers. A wash area is required, complete with three sides to prevent overspray, outlet for power washer, hose bib, and drain.
- 4.19.1.11. All pool pumps shall:
  - .1 Be specified and installed with adequate access space for strainer maintenance and cleaning.
  - .2 Be powder coated on all wetted components and surfaces with fusion bonded epoxy coating 134, or equivalent food-grade coating. Thickness and surface preparation requirements shall be included within the specification. In lieu of coating the impeller, a high nickel "Marlow" impeller may be specified.
  - .3 Ensure shaft and frame bonding provisions are provided. Coordinate with Electrical Consultant.
  - .4 All pool pumps to be base mounted on a housekeeping pad complete with vibration isolation.
- 4.19.1.12. Pool basins are to be capable of being drained by gravity.
- 4.19.1.13. If pool deck drains are installed stalled within 1.5m of the pool basin they must be plastic.
- 4.19.1.14. Pools designed for the purpose of use by small children shall be a separate pool with separate filtration, circulation, and chemical treatment systems.
- 4.19.1.15. Wave pools shall be designed to prevent waves from pushing bathers into obstructions.
- 4.19.1.16. Pool tanks to have a continuous service and pipe space around each tank. The service space shall be full height and at least 2 m wide with ventilation, lighting, drainage, and convenience power outlets.
- 4.19.1.17. Locate all elbows and tees in the service space.
- 4.19.1.18. Sand and other similar permanent filter media systems shall have a turbidity meter installed on the backwash effluent pipe.
- 4.19.1.19. Each backwash effluent pipe shall have a 600 mm linear section of transparent pipe for the purpose of confirming when backwash is complete.
- 4.19.1.20. Surge tanks should be easily accessible from the mechanical rooms and conform to confined space regulations. Access to surge tanks shall not be directly from the deck. Access ports into surge tanks shall have a minimum inside clear diameter of 900 mm.
- 4.19.1.21. Surge tanks to be exhausted with a dedicated exhaust fan and venting to allow for removal of chloramines.
- 4.19.1.22. Dedicated control systems for oxidation reduction potential, pH, and other chemical treatment shall be controlled by external devices and where required, BAS may be used to monitor these

systems.

- 4.19.1.23. Pool systems controlled and monitored by the BAS shall have independent graphics from the building HVAC systems.
- 4.19.1.24. Pool circulation systems shall be controlled and monitored by BAS.
- 4.19.1.25. Pool circulation systems shall be sized such that under loaded filter conditions, the minimum turnovers times are still maintained.
- 4.19.1.26. Gutters and Surge:
  - .1 Deck-level gutters to be designed to hold 100% of the instantaneous maximum surge.
  - .2 Gutter grates to be oriented parallel with the pool basin walls.
  - .3 Pool edge of the gutter shall use coved tile to form a lip with hand grip tile spaced throughout the perimeter of the basin.
  - .4 Pool filtration circulation surface collection shall be achieved by perimeter overflow. Where a perimeter overflow system is not practicable, skimmers will be acceptable, subject to review by Facility Engineering.
  - .5 Circulation shall be designed such that 100% of the circulated water returning to the filtration equipment, based on the design flow rate, can be accomplished by surface perimeter overflow.
- 4.19.1.27. Acoustics design shall be done by an acoustics engineer for all natatoriums.
- 4.19.1.28. Pool circulation shall employ bottom inlets, not side inlets. If side inlets are proposed instead of bottom inlets, this matter is to be discussed with Facility Engineering.
- 4.19.1.29. Natatorium Lighting:
  - .1 Lighting in areas specified in A.B.C 7.2.3.20 to be designed to a minimum of 300lx
  - .2 Stainless steel hangers are not permitted in natatorium
  - .3 Lighting fixtures are not permitted over the pool basin.
  - .4 Underwater lighting is not permitted without explicit approval.
- 4.19.1.30. Equipotential Bonding:
  - .1 Equipotential bonding for All type of facilities:
    - .1 The below grade component of the water spray deck, and natatorium equipment is to include two (2) redundant manufacturer provided bonding lugs.
    - .2 The above grade component of the water spray deck equipment is to include provisions for proper bonding: Bond must be electrically continuous, as defined by CEC, between the above grade and below grade components.
    - .3 All exposed metallic features, structural steel, pool equipment, in slab/wall rebar, piping to be connected to a dedicated grounding and bonding loop installed around each basin, pool, fountain, water collection depression. Bonding and grounding loop to be made with

at least a 4/0 cable

- .2 Conditions specific to salt water pools/facilities.
  - .1 Ground all metals within the pool and pool circulation system (e.g. cup anchors grab rails, water features, drains, grates, wave chamber partitions, pumps, heating system components, etc.). Pump casing, shaft, and impeller shall be grounded.
  - .2 Cathodic Protection on bonding/grounding of all pool components, including heat exchangers, susceptible to corrosion shall be considered during design.
- .3 Special considerations for motor shaft bonding (all facilities):
  - .1 All motor shafts shall be grounded using slip rings (With a circumferential conductive microfiber shaft grounding ring) and appropriate manufacturer recommended bonding hardware. The grounding shall be devised to prevent bearing damages, especially for Variable Frequency Drive Application. In such applications, the bonding system shall be specified to address VFD induced voltage bearing discharge and related damage by “frosting” and “fluting” effects ..
  - .2 The requirements shall apply to all motors used for the facility HVAC and water treatment / pumping. For additional details, refer to the motor and VFD sub-sections of the present electrical section.
  - .3 There shall be no exceptions
- .4 Special considerations for galvanic corrosion / cathodic protection (all facilities):
  - .1 Project scope shall evaluate if the use of sacrificial anode, special coating, and galvanic corrosion prevention measures are required for the site. This is especially important for pool using on demand chlorination unit using electrolysis and salt, and for salt water facilities
  - .2 Electrical discipline to coordinate with architectural, structural, and mechanical discipline to identify the material used on site and to determine is there are risk of metal incompatibility which would result in galvanic corrosion
- .5 System Performance Testing:
  - .1 **For rehabilitations, renovations and/or addition of on deck pool equipment within 1.5 m of the pool edge:** Equipotential bonding testing to occur before implementation of any changes. In case of identification of unacceptable results, the scope of the proposed additions/changes/rehabilitations shall include the design and implementation of mitigation solutions as required to ensure proper bonding and grounding of both existing and new features.
  - .2 **All projects:** Equipotential bonding testing to occur before and after basin concrete pour for all permanent metallic structures with 1.5m of the pool and whirlpools are bonded per CEC section 68.
  - .3 **Bonding Study, Notes:**
    - .1 List in specification that contractor is to:
      - a. Perform visual inspection of existing bonding system, torque (and mark) all

accessible hardware and inspect anchorage for tight connection

- b. Perform both Tests as required and as defined in the above and “Ground Electrode Testing” subsection on all metal parts of the pool and of other non-electrical equipment located within 1.5 meters of the pool edge. Pool edge definition to follow applicable code. Bonding study is to be completed before and after concrete pour. Equipment to be tested shall include (but not be limited to):
  - Piping;
  - Pool Reinforcing Steel (including rebar or other steel structure exposed during work);
  - Grates (including non-metallic grates);
  - Fences;
  - Lighting;
  - Speakers;
  - Conduits;
  - Junction Boxes;
  - Control Cabinets;
  - Electrical Cabinets.
- c. Perform bonding study using methods appropriate to site conditions and to the approval of the Engineer of Record, City of Edmonton and local authority having jurisdiction. Forward copy to City Representatives. Test back to the main ground connection point at the incoming electrical service. Coordinate main electrical service shutdown with the City of Edmonton and all associated parties.
  - Ensure test point locations are <20m apart.
  - Disconnect and test main ground to establish base point including test lead values.
  - Connect main ground and test each point bonding point.
  - Perform self-check prior to testing each point
- d. Where metallic equipment is covered with a coating (i.e. paint), expose base metal as required to perform test, using non-destructive methods. Patch and repair any removed coating to the satisfaction of the City of Edmonton.
- e. Submit tabular results to the Engineer of Record for review.
- f. Disconnect main power to any motors or electrical equipment (switches, outlets) prior to testing.
- g. Disconnect or bypass ground fault indicator during tests.

4.19.1.31. Pool membrane should be run over the pool edge, under the perimeter drain, and onto a portion of the deck.

4.19.1.32. Pool Mechanical Rooms:

- .1 The Consultant shall complete a Hazardous Assessment Report on pool mechanical rooms and acid rooms. This report shall provide the basis for rating electrical equipment within these spaces.

- .2 Pool mechanical rooms to be properly ventilated.
- .3 Agitation of the pool effluent within mechanical rooms should be minimized.
- .4 Acid used for pH control for pools and acid delivery systems shall be stored in a dedicated 'acid room' which shall be properly vented and designed for this purpose.

4.19.1.33. Chlorine Rooms:

- .1 The Consultant shall complete a Hazardous Assessment Report for chlorine rooms. This report shall provide the basis for rating electrical equipment within these spaces.
- .2 The following codes and guidelines shall be followed and applied in the design of gaseous chlorine rooms. All the requirements and suggestions contained therein shall be applied to all chlorine room designs.
  - .1 Alberta Building Code Part 7
  - .2 Alberta Fire Code
  - .3 Alberta Occupational Health and Safety Act, Regulation, and Code
  - .4 WorkSafe BC - Chlorine Safe Work Practices
  - .5 Workers Compensation Board (WCB) Alberta
  - .6 Building Code Interpretation 06-BCI-003 (September 2007)
- .3 In addition to the codes and guidelines referenced above, the following shall apply to chlorine rooms:
  - .1 The manual switch for the chlorine room exhaust fan and the chlorine room light shall each be labelled clearly.
  - .2 The manual switch for the chlorine room exhaust fan shall be a basic manual dial timer switch, with a time range of 4 hours.
  - .3 Supply air discharges (indoors) shall be located to provide cross-ventilation using outdoor air.
  - .4 Exhaust air discharges (outdoors) shall not be positioned where they can discharge into areas where chlorine gas may cause damage or injury, such as schools, playgrounds, worksites, private homes, or shopping centres; or where they can be captured by the air intake system of the same or another building.
  - .5 Provide signage below chlorine room viewing window that indicates location of all chlorine vents or exhaust fan outlets which may discharge chlorine out of the building.

4.19.1.34. Ozone Generators:

- .1 Follow all provisions in WorkSafeBC's Ozone Safe Work Practices document.

4.19.2. **Salt Sourced Chlorine Pools**

- 4.19.2.1. Ground all metals within the pool and pool circulation system (e.g. cup anchors grab rails, water features, drains, grates, wave chamber partitions, pumps, heating system components, etc.). Pump casing, shaft, and impeller shall be grounded.

- 4.19.2.2. All metal components in the natatorium that are exposed to air should be protected against corrosion (e.g. properly coated or selected as 316 stainless steel).
- 4.19.2.3. Sacrificial anodes for heat exchangers containing pool salt water and other components susceptible to corrosion due to salt concentrations shall be considered during design. Material selection for heat exchangers in salt pool applications shall consider the use of titanium or stainless steel components in preference to copper or cupro-nickel material complete with cathodic protection on these components.
- 4.19.2.4. For existing heat exchangers to remain for pools being converted to salt-cell chlorination it is preferred to replace existing copper and cupro-nickel components within the exchanger with stainless steel or titanium components and provide cathodic protection on these components.
- 4.19.2.5. Cathodic Protection on bonding/grounding of all pool components, including heat exchangers, susceptible to corrosion shall be considered during design.
- 4.19.2.6. Consider humidity control (eg. using outdoor air) to prevent corrosion of components in natatoriums.
- 4.19.2.7. Prevent condensation on cold surfaces (eg. chilled water, domestic cold water) with insulation.
- 4.19.2.8. Ensure neutral to slightly negative relative air pressure in natatoriums to prevent moist air exfiltration through exterior walls.
- 4.19.2.9. Ensure rooms containing salt cells do not exceed 26 °C indoor air temperature and manufacturer's recommended ambient temperature.
- 4.19.2.10. Ductwork within the natatorium should be protected against corrosion.
- 4.19.2.11. Air handling units handling with mixed return air and outdoor air shall have outdoor air preheating to prevent condensation of return air humidity.

## 4.20. Arenas

### 4.20.1. General

- 4.20.1.1. The requirements contained within this section are to apply to any ice plant design completed directly by the consultant or any delegated design completed by the contractor. If there is to be a delegated design the requirements below shall be contained within the performance spec for the ice plant contractor. In addition the shop drawings for any delegated design are to be provided to the City for review and approval prior to construction.
- 4.20.1.2. During upgrades or replacements, ensure that the current program requirements of the facility will be met.
- 4.20.1.3. Replacing units one-for-one is not acceptable if the facility has extended the seasonal duration that ice is in place (i.e. earlier in the fall, later in the spring, or has ice year-round.)
- 4.20.1.4. A Class T mechanical room is required to house a refrigeration plant and must be designed accordingly.



- 4.20.1.5. All equipment must be accessible for maintenance and ensure the manufacturer's service clearances are maintained.
  - 4.20.1.6. Specify a water softener for all ice plant installations.
  - 4.20.1.7. The City preference is to locate the brine header in a header trench.
  - 4.20.1.8. Ice plant rooms shall have a minimum of two exit doors for egress.
  - 4.20.1.9. Ventilation in Class T Machinery Rooms:
    - .1 Exhaust for ice plant rooms shall be provided by two separate exhaust (2) fans and meet CSA B52 requirements. Single fans with VFD will not be accepted.
    - .2 Class T machinery rooms require two levels of ventilation: low flow and high flow.
    - .3 Low flow shall be achieved by a make-up air unit and exhaust fan pair (interlocked), both sized exclusively for the required low flow.
    - .4 High flow shall be achieved by a separate exhaust fan and exterior wall outdoor air intake opening, both sized exclusively for the required high flow.
    - .5 The low and high flow ventilation systems shall operate independently. The high flow system shall not require the low flow system to operate in order to satisfy the high flow requirement. The low and high flow exhaust fans may use the same ductwork or part of the same ductwork.
    - .6 Please refer to gas detection guidelines for additional information on ventilation system design.
  - 4.20.1.10. Specify an eyewash station and floor drain in the vestibule outside Class T machinery rooms.
- 4.20.2. **Refrigeration System**
- 4.20.2.1. The ice plant and the HVAC building cooling must be independent systems.
  - 4.20.2.2. The City prefers anhydrous ammonia as the refrigerant with low charge capacity and calcium chloride or environmentally friendly propylene glycol as the secondary coolant. Ethylene glycol is not to be used.
  - 4.20.2.3. The City preference is for Armstrong pumps to be utilized in brine circulation to ensure compatibility with the City standby pump.
  - 4.20.2.4. Include VFD control on secondary coolant loop pumps.
  - 4.20.2.5. Transformers and VFDs are not to be skid mounted. Provide proper clearance for maintenance.
  - 4.20.2.6. Clamps on arena brine system headers shall be stainless steel with brass nuts.
  - 4.20.2.7. Ensure that a filter is included in the brine system.
  - 4.20.2.8. Consultant to add within the specifications that brine lines shall be pressurized, approx. 103.4 kPag (15 psig) over design pressure prior to construction to identify leaks. If leaks are identified,

the Contractor shall repair as required.

- 4.20.2.9. The preferred compressor is the Mycom 'M' Series reciprocating compressor.
- 4.20.2.10. If screw compressors are required, select with a maximum of 1800 RPM.
- 4.20.2.11. High temperature piping (including refrigerant discharge and liquid lines) shall be coated with high temperature paint.
- 4.20.2.12. Plate and frame heat exchangers are preferred over shell and tube.
- 4.20.2.13. Follow manufacturer's service clearance recommendations but allow at a minimum 1m service clearance on all sides of the compressor.
- 4.20.2.14. Specify cooling condensers/cooling towers to be able to run without water when the outside air temperature is below 2°C.
- 4.20.2.15. The City requires closed circuit cooling towers with glycol as the working fluid, rather than evaporative condensers or other rooftop components utilizing ammonia.
- 4.20.2.16. Refrigerant systems for arenas must be sized to deliver 282kW (80 Tons) minimum at standard operating conditions. Standard operating conditions should be considered 29.5°C (85°F) condensing and -12.2°C (10°F) evaporating. Sizing for 'seasonal' operation will no longer be accepted.
- 4.20.2.17. Use plate and frame heat exchanger to capture heat from the condenser loop.
- 4.20.2.18. For any equipment that requires relief provide a dual relief valve assembly.
- 4.20.2.19. On systems where refrigerant volumes are low enough (Ammonia DX plate and frame systems):
  - .1 Route the refrigerant relief valve into a dedicated deluge tank. The system must meet the requirements of CSA B52-13 section 7.3.6.1.3. Venting of refrigerant, specifically ammonia, directly to atmosphere will not be accepted.
  - .2 The sump or deluge tank must be sealed from the ice plant room and vent to atmosphere outside. The deluge vent shall be a minimum 4.6 m above the adjoining ground level or accessible roof level and not less than 7.6 m from any window, ventilation opening, or exit.
  - .3 Domestic cold water makeup system with backflow prevention shall be provided for deluge tank.
- 4.20.2.20. Manual fire-line dump valve to be installed regardless of refrigerant charge.
- 4.20.2.21. For ammonia, rupture disc assemblies (RDAs) are to be used on all pressure-relief valves to indicate which valve has discharged.
- 4.20.2.22. Ensure adequate headspace on second level of skid package.
- 4.20.2.23. Ensure adequate protection of electrical equipment from leaks on second level of skid package. (i.e. provide covers over electrical panels, provide liquid tight NEMA Class 4).
- 4.20.2.24. Working clearances on skid packages to be visually verified during a factory site tour by City

Facility Engineering/FMS prior to shipment of skid. Design consultant shall include this in the project specifications for the Contractor.

- 4.20.2.25. Provide drainage pipe to collect glycol/brine from seal leaks and take it down from the second level of the skid package.
- 4.20.2.26. All brine balance tanks to be sealed and complete with pressure and level switches.
- 4.20.2.27. Emergency shutdown switch/buttons for fire personnel installed exterior of mechanical rooms shall be installed at a minimum height of 3.1 m (10ft) above grade. Emergency shut offs shall be identified and adequately protected from accidental activation (i.e. providing a cover).
- 4.20.2.28. Traps on suction lines shall be avoided to protect compressors.

#### 4.20.3. **Dehumidification**

- 4.20.3.1. Preference for dehumidification is to use desiccant electric dehumidifiers as opposed to gas fired units.
- 4.20.3.2. The preferred suppliers of dehumidifiers are Munters, CDI, Engineered Air, or equivalent.
- 4.20.3.3. Rooftop dehumidifier may be utilized, but the preference is for units installed in the dehumidified space with a maintenance platform.

#### 4.20.4. **Controls**

- 4.20.4.1. Do not allow proprietary controls for the refrigeration system. Refer to Consultant Manual controls section for approved controls systems / contractors.
- 4.20.4.2. All ice plant graphics shall be delivered to the City including the containing folders with unrestricted access to all provided files. These files shall be delivered to City FMS via USB Drive without access restrictions. The sequence of operations for the ice plant in all weather conditions will be listed on one of the ice plant graphics.
- 4.20.4.3. All costs associated with the development and unrestricted access to provided work product shall be included in the Construction costs.
- 4.20.4.4. The City must be able to modulate all control valves via BAS (i.e. for setting brine temperature).
- 4.20.4.5. Provide remote reading capability for the operation of the plant.
- 4.20.4.6. The ice plant packaged control system is only to be integrated into the building control system if the two systems are supplied by the same manufacturer. If the two control systems are supplied by different manufacturers there must not be any interconnections of data and the two systems must be connected to the City network independently.
- 4.20.4.7. Ensure that BAS has full electromechanical backup with BAS / Off / Local setting. Include safety and operating switches for high pressure, low pressure, oil failure.
- 4.20.4.8. Ensure redundancy in brine temperature sensing including return temperature sensors, slab temperature sensors, and infrared sensors.

#### 4.20.5. **Ice Resurfacing Requirements**

- 4.20.5.1. Ice resurfacer to be fueled by compressed natural gas.
- 4.20.5.2. Ice resurfacer water supply must have the capacity to fill the resurfacer up to twice per hour (based on a twin arena).
- 4.20.5.3. Provide a water fill station with a 25mm cold water hose bibb, a 25mm tempered water hose bibb, and two (2) standard (12mm) hot water hose bibbs.
- 4.20.5.4. Provide a feedforward digital mixing valve connected to the BAS to control the temperature of water supplied to the ice resurfacer.
- 4.20.5.5. Provide a two way valve on the tempered water line connected to a timer to allow operators to set the ice resurfacer fill time.

#### 4.20.6. **Heating**

- 4.20.6.1. Heating is required for the timekeeper and spectator spaces. Player boxes do not require heating.
  - .1 In-slab or in-seat heating is the preferred method of heating in the spectator and time keeper areas. Radiant tube heaters are an acceptable alternative where in-slab or in-seat heating is not feasible. Unit heaters will not be accepted.
- 4.20.6.2. Ensure heaters face away from the ice.

### **4.21. Elevators**

- 4.21.1. Non-proprietary elevators controllers to be specified.
- 4.21.2. The City has preferred controller manufacturers. Specification of these brands is encouraged:
  - .1 Elevator Controls Corporation
  - .2 GAL Manufacturing Corp.
  - .3 Motion Control Engineering
- 4.21.3. Specify that the contractor must provide the City a complete set of any specialty tools required for elevator maintenance.
- 4.21.4. Any elevator controller passwords required for maintenance must be given to the City.
- 4.21.5. Consider urine resistant floors on all elevators with unmonitored public access.



## **APPENDIX A - COLOUR CODING REQUIREMENTS FOR MECHANICAL AND ELECTRICAL SYSTEMS**

## 1. Mechanical Equipment

### 1.1. Concealed Equipment within Ceiling Spaces

- 1.1.1. Locations for equipment that is concealed above a ceiling shall be identified by the use of a self adhesive “Data Dot”.
- 1.1.2. The “Data Dot” should be adhered to a non-removable surface that is clearly visible without the removal of obstruction and without the use of a ladder.
- 1.1.3. Example: For T-Bar Ceilings, the data dot should be adhered on the T-Bar frame adjacent to the panel to be removed to gain access to the equipment.
- 1.1.4. Colours for “Data Dots” should follow the recommendations identified in the table below:

Access Purpose	Colour
HVAC Equipment and Duct Cleaning	Yellow
HVAC Valves and Dampers	Blue
Plumbing equipment and valves	Green
Control dampers and sensors	Black
Fire, smoke and sprinkler equipment	Red

### 1.2. Piping

- 1.2.1. All pipe painting/coating and labelling (including flow direction arrows) shall be in accordance with ASME A13.1 unless otherwise specified herein.
- 1.2.2. Labels shall be applied exterior to insulation and jacketing when used.
- 1.2.3. All piping exposed to exterior weather conditions shall be coated to protect against degradation. Exposed piping shall be coated and labelled in accordance with this appendix.
- 1.2.4. All piping within ceiling spaces must be appropriately labelled as defined herein.
- 1.2.5. All exposed piping within mechanical room areas shall be painted and labeled. Paint colour shall match label background colour as defined in Table A-1.2.3 unless otherwise specified herein.
  - 1.2.5.1. Refrigerant line coating shall be ‘Safety Grey’ in colour, however labelling for ammonia shall be in accordance with International Institute of Ammonia Refrigeration (IAR) Bulletin 114.
  - 1.2.5.2. Ammonia relief vent lines shall be coated ‘Safety Red’ and labeled in accordance with IAR Bulletin 114.
- 1.2.6. All piping routed through hazardous or corrosive environments shall have appropriate surface coating to protect the piping system from degradation. Labeling and colour coding shall be similarly applied in these areas as within mechanical room areas.
- 1.2.7. Labels shall be applied on both sides of all wall and floor penetrations, adjacent to changes in pipe direction, adjacent to valves and flanges, and at minimum every 6 m (25ft) on straight runs as

appropriate.

- 1.2.8. Distance between labels for ammonia systems shall be in accordance with IIAR Bulletin 114.
- 1.2.9. Buried piping shall utilize a detectable metalized ribbon laid 150 mm (6") below ground level and above the buried pipe. Ribbon should display the same information for piping labels identified herein at intervals not exceeding 800 mm (31.5").

### 1.3. Labeling

- 1.3.1. Colour of background and lettering shall be in accordance with ASME A13.1 recommendations unless otherwise specified in Table A-1.2.3.
- 1.3.2. Labeling for ammonia systems shall be in accordance with IIAR Bulletin 114.

**Table A-1.2.2 General Label Colouring (ASME A13.1)**

Service	Label Background Colour <sup>1</sup>	Label Lettering Colour
Fire Protection, Suppression & Quenching Fluids	Safety Red	White
Toxic & Corrosive Fluids	Safety Orange	Black
Flammable & Oxidizing Fluids	Safety Yellow	Black
Combustible Fluids	Safety Brown	White
Potable, cooling, boiler feed, and other water	Safety Green	White
Compressed Air	Safety Blue	White
Strong Acids & Strong Caustics	Safety Purple	White
Refrigerants (Except Ammonia)	Safety Grey	White

- 1.3.3. Size and font of label lettering shall be in accordance with ASME A13.1 recommendations or IIAR Bulletin 114 as appropriate.
- 1.3.4. Flow direction arrows shall be incorporated within the label or on bands matching the scheme of the label on either side of the label. Flow arrow bands shall be self adhering and applied around the full circumference of the piping when used.
- 1.3.5. For canvas wrapped piping, labels shall be stencil painted directly to canvas surface as appropriate.
- 1.3.6. Approved abbreviations for fluid labels have been provided in Table A-1.2.3. Labels using other abbreviations for fluids shall only be used when approved in writing by the City Facility Maintenance Services (FMS) and Facility Engineering Services (FES) or designates.

<sup>1</sup> Colours preceded by the word "Safety" shall meet the requirements of ANSI Z535.1



## 1.4. Designation of Colours

1.4.1. Piping systems labelling shall be colour-coded as indicated in Table A-1.2.3. If substance is not listed within Table A-1.2.3, refer to Table A-1.2.2 for general labeling colours per ASME A13.1.

**Table A-1.2.3, Colour Coding Requirements for Piping Systems**

Service	Coating Colour	Label Background Colour <sup>2</sup>	Label Lettering Colour	Label Legend <sup>3</sup>	Specialty Notes
Fire Suppression - Sprinkler	Safety Red	Safety Red	White	WET SPRINKLER	
Fire Suppression - Wet Standpipe	Safety Red	Safety Red	White	WET STANDPIPE	
Fire Suppression - Dry Standpipe	Safety Red	Safety Red	White	DRY STANDPIPE	
Fire Suppression - Carbon Dioxide	Safety Red	Safety Red	White	*[ ]kPa CO2	
Fire Suppression - Foam & Clean Agent	Safety Red	Safety Red	White	FOAM	Label should be product specific as appropriate.
Oxygen		Orange	Black	*[ ]kPa O2	
Natural Gas	Safety Yellow	Safety Yellow	Black	*[ ]kPa NATURAL GAS	
Vacuum		Aluminum	Green	VAC.	
Compressed Air	Safety Blue	Safety Blue	White	*[ ]kPa COMPRESSED AIR	
Compressed Air - Instrument	Safety Blue	Safety Blue	White	*[ ]kPa LAB AIR	
Water - Demineralized		Safety Green	White	DEMIN. WATER	
Water - Softened		Safety Green	White	SOFTENED WATER	

<sup>2</sup> Colours preceded by the word “Safety” shall meet the requirements of ANSI Z535.1

<sup>3</sup> Where (\*) is noted, insert appropriate operations condition.

Water - Deionized		Safety Green	White	DEIONIZED WATER	
Water - Distilled		Safety Green	White	DISTILLED WATER	
Domestic Cold Water		Safety Green	White	DOMESTIC COLD WATER	
Domestic Hot Water		Safety Green	White	DOMESTIC HOT WATER	
Domestic Hot Water Recirculation		Safety Green	White	DOMESTIC HOT WATER RECIRC.	
Heating Hot Water Supply		Yellow	Black	*[ ]°C HOT WATER HEATING SUPPLY	
Heating Hot Water Return		Safety Green	Black	*[ ]°C HOT WATER HEATING RETURN	
Heating Glycol Supply		Yellow	Black	*[ ]°C HEATING GLYCOL SUPPLY	
Heating Glycol Return		Yellow	Black	*[ ]°C HEATING GLYCOL RETURN	
Chilled Glycol Supply		Green	White	CHILLED GLYCOL SUPPLY	
Chilled Glycol Return		Green	White	CHILLED GLYCOL RETURN	
Chilled Water Supply		Safety Green	White	CHILLER WATER SUPPLY	
Chilled Water Return		Safety Green	White	CHILLER WATER RETURN	
Condenser Water Supply		Safety Green	White	CONDENSER WATER SUPPLY	
Condenser Water Return		Safety Green	White	CONDENSER WATER RETURN	
Plug Load Cooling Water		Safety Green	White	PLUG COOLING WATER SUPPLY	
Plug Load Cooling Water Return		Safety Green	White	PLUG COOLING WATER RETURN	
Steam - Low		Yellow	Black	[100]kPa LP STEAM	

Pressure					
Steam - High Pressure		Yellow	Black	*[ ]kPa HP STEAM	
Steam Condensate		Yellow	Black	*[ ]kPa HOT STEAM CONDENSATE	
Dry Mop	-	Aluminum	Green	DRY MOP	
Refrigerant - Ammonia (R-717)	Safety Grey	Safety Orange	Black	AMMONIA	Per IIAR Bulletin 114
Vent - Ammonia (R-717)	Red	Safety Orange	Black	AMMONIA	Per IIAR Bulletin 114
Refrigerant - Carbon Dioxide	Safety Grey	Safety Grey	White	*[ ]kPa CO2	
Refrigerant - Other - Liquid	Safety Grey	See ASME A13.1	White	FREON (LIQ)	Label should be fluid specific.
Refrigerant - Other - Gas	Safety Grey	See ASME A13.1	White	FREON (VAP)	Label should be fluid specific
Fuel Oil	-	Safety Brown	White	FUEL OIL	
Lubricating Oil	-	Safety Brown	White	LUBE OIL	
Engine Exhaust	-	Aluminum	Black	ENGINE EXHAUST	
Boiler Feed Water		Yellow	Black	BOILER FEED WATER	
Strong Acid	Safety Purple	Safety Purple	White	*ACID [SYMBOL]	Use WHMIS Symbol
Nitrogen		Safety Orange	White	*[ ]kPa N2	
Brine		Green	White	BRINE	
Chemical Feed Line		Green	Black	*CHEMICAL FEED [SYMBOL]	Use WHMIS Symbol
Drains	-	Aluminum	Green	DRAIN	
Vent (Except Ammonia Vents)	-	Aluminum	Green	VENT	
Blown Down	-	Aluminum	Green	HOT BLOW DOWN	

Acetylene		Orange	Black	*[ ]kPa ACETYLENE	
Hydrogen		Safety Orange	Black	*[ ]kPa H2	
Carbon Monoxide		Safety Orange	Black	*[ ]kPa CO	
Propane		Safety Yellow	Black	*[ ]kPa PROPANE	
Methane		Safety Yellow	Black	*[ ]kPa METHANE	
Butane		Safety Yellow	Black	*[ ]kPa BUTANE	
Ethane		Safety Yellow	Black	*[ ]kPa ETHANE	
Combined Methane Argon		Orange	Black	*[ ]kPa METHANE/ARGON	
Argon (Gas)		Orange	White	*[ ]kPa ARGON	
Helium		Safety Orange	Black	*[ ]kPa HELIUM	

## 1.5. Ductwork

- 1.5.1. All ductwork shall be identified with Identification Labels complete with directional flow arrows.
- 1.5.2. Labels shall be applied exterior to insulation and jacketing when used.
- 1.5.3. All Identification Labels shall be as identified below:

Service	Background Colour	Lettering Colour	Label Legend
Supply Air	Blue	White	SUPPLY AIR
Return Air	Blue	White	RETURN AIR
Mixed Air	Blue	White	MIXED AIR
Combustion Air	Blue	White	COMBUSTION AIR
Relief Air	Blue	White	RELIEF AIR
Exhaust Air - General	Blue	White	GENERAL EXHAUST AIR
Exhaust Air - Toilet	Blue	White	TOILET EXHAUST AIR

1.5.4. Ductwork access panels shall be identified with Identification Labels conforming to the following table:

<b>Access Type</b>	<b>Background Colour</b>	<b>Lettering Colour</b>
Cleaning and Service Access	Yellow	Black
Controls (including Heater Sensor)	Black	White
Dampers - Backdraft, Balance and Control	Blue	White
Fire Damper	Red	White
Smoke Damper & Detectors	Red	White

## 2. Electrical Equipment

- 2.1. All pull boxes, junction boxes, covers, and conduit fittings shall be enamel finished in the colour indicated in Table A-2. All cover markings to be in black lettering.
- 2.2. All switchgear, distribution centers, panelboards, motor control centers, motor starter cabinets, motor control cabinets, disconnect switches, contactor cabinets, relay cabinets, transformers, termination cabinets, splitter boxes, bus duct, cable duct, etc are to be colour coded as indicated in Table A-2.

**Table A-2, Electrical Colour Coding Requirements**

System	Description	Conduit Banding/ Colour Coding	Cover Marking
Distribution	High Voltage (>750V)	Orange (RAL 2011)	
	347/600V Distribution	Sand (RAL 1001)	
	277/480V Distribution	Maroon (RAL 3011)	
	230/400V Distribution	Cream (RAL 9001)	
	120/208V Distribution	Grey (RAL 7001)	
	Emergency Power Systems	As Per Voltage + Black Striping	"EM"
	Isolated Ground Systems	As Per Voltage + Orange Striping	"IG"
	Solar PV DC Power (various Voltage)	Gold (RAL 1003)	
Fire and Emergency	Fire Alarm and Fire Phone	Red (RAL 3001)	"FA"
Security	Card Access	Yellow (RAL 1003)	"CA"
	Electrical Door Lock System	Yellow (RAL 1003)	
	Security Control Systems	Yellow (RAL 1003)	
Gas Detection	Gas Detection	Yellow (RAL 1003) + Black Striping	"GD"
Communication	Audio Visual TV Systems	Green (RAL 6032)	"AVTV"
	Computer and Data Systems	Blue (RAL 5005)	"C"
	Intercom Systems	Yellow (RAL 1003)	"I"
	Telephone System	Blue (RAL 5005)	"T"
	Television Distribution	Green (RAL 6032)	"TV"
Miscellaneous	Low Voltage Control for Lighting	Black (RAL 9004)	
	Lighting LV DC Power (<50V)	Lt Blue (RAL 5012)	



## **APPENDIX B - IT INFRASTRUCTURE DESIGN GUIDELINES**



# 1. General

## 1.1. Overview

- 1.1.1. This document is intended to guide the consultant when designing the structured wiring and associated infrastructure for a new building, building addition, or building renovation for the City of Edmonton.
- 1.1.2. These guidelines are to be used in conjunction with building program requirements to design the IT infrastructure to meet the needs of the facility.
- 1.1.3. The technical information contained in this document is to be used as a guide only. The consultant is expected to follow his or her professional judgment as well as all applicable codes and regulations. Building projects may have specific requirements that supersede material presented in this document. When a deviation from these guidelines is either required or requested by the consultant or the City, it is to be documented in writing.
- 1.1.4. Prior to the Design Development phase, a meeting with the City of Edmonton Project Manager and Open City & Technology (OCT) Design Advisor will be arranged to discuss the IT design. For projects with minimal IT requirements, email or telephone correspondence may be adequate, at the discretion of the City.

## 1.2. References

- 1.2.1. Design is to comply with the latest adopted edition of all applicable codes and standards, including the Alberta Building Code, Canadian Electrical Code, and this guideline.
- 1.2.2. ANSI/TIA/EIA-568-C.1 Commercial Building Telecommunications Cabling Standard Part 1: General Requirements
- 1.2.3. ANSI/TIA/EIA-568-C.2 Commercial Building Telecommunications Cabling Standard Part 2: Balanced Twisted-Pair Cabling Components
- 1.2.4. ANSI/TIA/EIA-568-C.3 Commercial Building Telecommunications Cabling Standard Part 3: Optical Fiber Cabling Components Standard
- 1.2.5. ANSI/TIA/EIA-569 Commercial Building Telecommunications Pathways and Spaces
- 1.2.6. ANSI/TIA/EIA-606 Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
- 1.2.7. ANSI/TIA/EIA-607 Commercial Building Grounding and Bonding Requirements for Telecommunications

## 1.3. Responsibilities of the City of Edmonton

- 1.3.1. Supply, install and configure client IT equipment, such as hubs, switches and routers in Network Access Rooms (NAR).
- 1.3.2. Commission the overall IT system. This does not include performance testing of the structured wiring and terminations.
- 1.3.3. The assigned City Project Manager will be the primary point of contact, and will facilitate communication between the Consultant and City Open City and Technology personnel, as required.

## 1.4. Responsibilities of the Design Consultant

- 1.4.1. Design the IT infrastructure and structured wiring system to ensure all program requirements are met. This includes:
  - 1.4.1.1. Identifying all locations where structured wiring is to be run, based on program and building requirements.
  - 1.4.1.2. Locating Network Access Room(s).
  - 1.4.1.3. Laying-out and coordinating equipment within Network Access Room(s), including equipment racks and backboards, ensuring adequate space for identified City-supplied equipment.
  - 1.4.1.4. Specifying required connections to other building systems. This may include mechanical/BAS systems, security equipment, etc.
- 1.4.2. Coordinate required communication services to the building. Coordinate with City of Edmonton IT Design Advisor, through the Project Manager, to ensure the building is on the City-wide IT network and also to confirm requirements. Connection requirements will vary from site to site depending on various factors such as facility capacity, function, growth and service ability.
- 1.4.3. Prepare the IT infrastructure drawings and specifications. Refer to Submission Requirements section.
- 1.4.4. Attend construction meetings, inspect installations and perform contract administration relating to the IT infrastructure.

## 1.5. Submission Requirements:

- 1.5.1. Refer to the Professional Service Agreement and the latest edition of “Consultant Manual Volume 1, Design Process and Guidelines” for a complete list of submission requirements.
- 1.5.2. The consultant is responsible for preparing all drawings and specifications necessary to convey the entire scope of the IT infrastructure to bidding contractors.
- 1.5.3. All progress review submissions are to include information on the IT infrastructure system.
- 1.5.4. Refer to Vol. 1 for submission requirements.
- 1.5.5. Subsequent submissions are to indicate the locations of all end devices, and refine the details, diagrams and plans presented in previous submissions.
- 1.5.6. Where possible, provide a separate drawing for low tension system plans and details.
- 1.5.7. If a submission is not sufficiently detailed to review, it will be returned for resubmission.
  - 1.5.7.1. Provide required specification sections for the non-City provided infrastructure associated with the structured wiring system and IT infrastructure. Specifications to address communication services, structured wiring (horizontal, backbone, etc), patch panels & racks, conduit and cable tray. Specifications are to include: Structured wiring testing requirements and procedures.

# 2. Technical

## 2.1. Utility Services

- 2.1.1. Determine what communication services are required for the building, based on program

requirements and consultations with Open City & Technology (OCT). The building may require service connections for telephone, television, City network, Supernet, emergency communications and remote monitoring of building systems such as fire alarm, security, CCTV, or BAS. Connection requirements will vary from site to site depending on various factors such as facility capacity, function, growth and service availability.

- 2.1.2. Consult with the Project Manager and OCT Network Analyst to determine the necessity of providing a fiber service to the site. The supply of a fiber service will be based on the requirements of the building user and the cost to supply and maintain the service.
  - 2.1.2.1. Consult with the City to determine if it is feasible for a City-owned fiber service to be brought to the project site. Typically, the provision of a new City-owned fiber service will be a separate project. Coordinate with that project to ensure appropriate infrastructure, such as service conduit to the site boundary, is provided.
  - 2.1.2.2. If a City-owned fiber service is not available or cost-effective to supply, determine through consultation with the utility provider if a managed fiber service is available. Coordinate with the utility provider to ensure appropriate infrastructure, such as service conduit to the utility pedestal, is provided.
  - 2.1.2.3. For sites connected to the City network or with security and/or CCTV equipment, present or future, it is the recommendation of this guideline to provide a fiber service, where economically viable.
  - 2.1.2.4. When a fiber service is not installed, consider providing an empty conduit to the property line to facilitate a future fiber service. Indicate pull-box locations on long runs, and where conduit changes direction, as required.
- 2.1.3. Many installations require a limited number of analog phone lines for emergency phones and auto-dialers (ie. Fire Alarm). Determine requirements through consultation with the Service Provider and indicate required equipment and additional backboard configuration in NAR on drawings. Refer to Consultant Manual section [Life Safety, Emergency, and Security Systems](#) for additional requirements.
- 2.1.4. All incoming service conductors are to be terminated in a rack-mounted patch panel in the main Network Access Room.
- 2.1.5. All required utility services are to be identified no later than the Design Development submission. A site plan showing the location of the utility service box(es) and the preliminary route of the underground service conductors to the main incoming service room should be included with the submission.

## 2.2. Horizontal and Backbone Cabling

- 2.2.1. For horizontal cabling, specify 4-pair Category 6 UTP (blue) for all data and voice cables between patch panels and end devices. All components to meet the technical performance requirements for Cat 6 installation. Refer to the Section for [Inspection, Testing, Commissioning and Training](#) for additional information. Cabling shall have end to end Cat 6 products and shall be of one manufacturer. Cable length (Ethernet over UTP) is not to exceed 90m including patch cables.
- 2.2.2. Horizontal cabling for CCTV Cameras described in [APPENDIX D - VIDEO SURVEILLANCE SYSTEM](#) to be specified as follows:

**2.2.2.1. Less than 90 meters:**

- Above ground: Camera runs shall have one Cat-6 cable with the following specs: Cat-6: Solid Copper, Unshielded Cable, 350 MHz Rated, FT6 as required (Yellow Jacket).
- Underground: Camera runs shall have one Cat-6 with the following specs: Cat-6 - Solid Copper, Flooded, Shielded Cable, 350 MHz Rated. Rated for wet locations

**2.2.2.2. Greater than 90 Meters. Require fiber with approved fiber modules**

**2.2.2.3. Network lines at cameras are to be terminated with approved RJ-45 modular plug (Crystal), such as Paladin PA-9655. NOTE: Platinum Tools EZ-RJ45 modular plugs are NOT approved for use.**

**2.2.2.4. Camera jacks at Network head end equipment are to be terminated using standard TIA/EIA T568A with Category 6 Yellow jacks such as the Hubbell HXJ6Y or approved equal.**

**2.2.2.5. Fiber to be terminated in Fiber Trays with LC Duplex Connectors.**

- 2.2.3. For data backbone cabling, specify multi-strand single-mode fiber optic cable, terminated in a rack mount enclosure mounting in the rack using LC connectors at each end. Determine the number of strands based on design requirements. The number of strands will determine the size of the rack mount enclosure for terminating the fibre.
- 2.2.4. Provide two (2) Cat 6 cables to each identified workstation.
- 2.2.5. Network cabling to be terminated with a standard network jack compatible with industry standard keystones for mounting such as Hubbell HXJ6. Jacks to be installed into an unloaded patch panel that accepts industry standard keystone mounted jacks such as Hubbell UDX24E.
- 2.2.6. Specify cabling suited for the environment it is being installed in. This may include areas with extreme temperatures, high humidity, excessive “noise”/RF interference, etc. Where possible, avoid extreme environments.
- 2.2.7. Cables are to be specified as ULC rated for risers or plenums where appropriate.
- 2.2.8. All cables are to be uniquely labeled at the patch panel. Cable origin needs to be indicated at the end of the cable not terminated in the patch panel. Ensure cable labeling standards are included in the specifications. A copy of the City labeling standard is included as an appendix to this document.
- 2.2.9. Consult with the OCT Network Analyst, through the Project Manager, should an alternate cable type be required or recommended for a specific application.
- 2.2.10. Under no circumstances are horizontal or backbone cable runs to be spliced between origin and destination.
- 2.2.11. All cabling communications lines, copper or fiber optic must be terminated on patch panels mounted in the rack.

**2.3. Horizontal Cabling Raceways**

- 2.3.1. Do not run horizontal cabling and backbone cabling in the same conduit.
- 2.3.2. Do not run horizontal cabling for data and voice in the same conduit as Security or CCTV.
- 2.3.3. Do not run communication and power cables in close proximity to each other. In no circumstances

are they to be run in the same conduit or non-barriered cable tray.

- 2.3.4. Structured wiring in walls is to be run in minimum 21mm conduit to ceiling.
- 2.3.5. Structured wiring may be run in conduit or cable tray (basket or ladder types acceptable) in ceiling space as appropriate. For accessible ceiling areas (T-Bar), branch distribution from tray to individual rooms may be supported by J-hook with permission from the Project Manager. In no circumstances are structured wiring cables allowed to be laid directly on a building surface such as on a T-bar ceiling.
- 2.3.6. Size conduit and cable tray on drawings to ensure maximum fill allowance is not exceeded and provide min 25% spare capacity for future growth.

## 2.4. Existing Data Cable Installation

- 2.4.1. All redundant materials to be removed from ceiling space including conduit, boxes, cables and patch cables.
- 2.4.2. Existing cables may be relocated and/or reconnected as required for renovations and expansions; however, inspection and recertification of reused data lines is required.

## 2.5. Network Access Rooms (NARs)

- 2.5.1. All horizontal cabling from end devices throughout the facility is to be run to the nearest NAR and terminated in patch panels located in free-standing racks. Backbone cabling is to be run between NARs and terminated in patch panels.
- 2.5.2. NARs are to be located throughout the facility to ensure maximum allowable run lengths of horizontal cabling are not exceeded. Where possible, locate NAR rooms near locations with a high density of IT equipment to minimize the amount of structured wiring cable run throughout the facility.
- 2.5.3. In multi-level buildings, provide a NAR on each storey, stacked where possible.
- 2.5.4. In facilities with multiple NARs, connect racks in a star topology, where each NAR is directly connected via backbone cabling to the main NAR (typically where the service conductors are terminated). Where this is impractical due to physical or cost limitations, remote NARs may be connected to the nearest NAR where backbone cables can be “jumpered” to connect to the main NAR.
- 2.5.5. Minimum size 1800 mm x 4800 mm. For EPS facilities, minimum size to be 2115 mm x 3200 mm.
- 2.5.6. Backboards and equipment required for items such as service terminations, analog telephone equipment, fire alarm panels, etc are to be located in NAR rooms.
- 2.5.7. Confirm with the Project Manager before locating Security and Video Surveillance System equipment in the NAR. Be aware that the Video Surveillance recording equipment (Head-end) must be located in a separate rack than other IT equipment. This rack must be housed in a secure cabinet refer to Video Surveillance System Guideline. Cables associated with Video Surveillance are to run in dedicated conduit to the closest IT network rack.
- 2.5.8. NAR not to contain power and distribution equipment, mechanical equipment, ducts, pipes, shafts or water mains unless the equipment is serving the room.
- 2.5.9. In buildings with electronic security, NARs are to be secured with card access control to restrict access and monitor usage. Where electronic security is not provided, discuss alternate forms of

security such as a lock or keypunch with the Project Manager.

2.5.10. Provide emergency lighting.

2.5.11. Equipment in NARs:

2.5.11.1. Racks are to be free-standing 19" type (steel) without cable management guides, equipment mounting rails fabricated, drilled and tapped for No. 10-32 screws, with provision to attach grounding and designed to accept EIA standard 483 mm (19") wide panels. The rack should be tapped on both sides. Provide minimum 915mm clearance on front, back and one side of all floor-mounted racks, remaining side requires minimum 610mm clearance. Refer to Detail.

2.5.11.2. Wall-mount racks may be approved by OCT for small installations with minimal IT requirements where there is insufficient space for a floor-mounted rack. Close coupled racks are permitted. In such instances, a horizontal basket cable tray must be installed across the top of the close coupled racks.

2.5.11.3. Fibre patch panels to be 4RU in size, for lower density installation 2RU size upon approval from OCT.

2.5.11.4. Patch panels are to be 24 or 48 port, designed for Category 6 RJ-45 jacks.

2.5.11.5. Horizontal and vertical cable management and all patch cords will be provided by the City.

2.5.11.6. Rack-mount equipment other than patch panels, such as network switches, will be provided by the City. Ensure adequate space is available in racks for City-supplied equipment.

2.5.11.7. Provide a second rack if the cabling equals or exceeds 20 RU (Rack Units) in horizontal copper data cabling.

2.5.11.8. Sites with multiple NAR: provide one NAR with an additional rack for FOC (Fiber Optic Cable) aggregation.

2.5.11.9. Provide 1.0 m working clearance in front of all backboards.

2.5.12. Indicate all grounding and bonding for equipment installed in NARs, including incoming conduit and cable tray. Cable trays to be continuously grounded. Show on elevation drawing(s) discussed in submission requirements.

2.5.13. The NAR must be adequately lit and be subject to standard interior environmental conditions. Provide HVAC services as required to ensure environment maintains optimum operating requirements for the equipment housed therein.

2.5.14. Provide a minimum of two dedicated circuit 208/240V, 30A L6-30R "Twist lock" receptacles to serve each rack, utilize UPS power where available. Provide a minimum of two dedicated circuit 120V, 20A 5-20R "T-Slot" duplex receptacles to serve each rack, utilize UPS power where available. Consult with OCT Network Analyst to ensure additional receptacles are not required. Receptacles are to be mounted on the wall directly behind the rack. Provide one dedicated circuit 120V, 20A 5-20R "T-Slot" duplex receptacle on the bottom right corner of each backboard. Refer to City of Edmonton Security Guidelines for additional requirements for security backboards. Quad receptacles are not acceptable due to clearance conflicts.

## 2.6. WiFi (Internal Wireless Access)

2.6.1. Consult with the Project Manager and OCT Network Analyst to determine the WiFi requirements.



- 2.6.2. Access Point (AP) equipment will be provided by the OCT Network Analyst. AP map will be generated by the OCT Network Analyst using Consultant provided floorplans.
- 2.6.3. Provide one (1) Cat 6 cable to each identified WAP location. Cable to run from patch panel in NAR to AP location. Provide minimum 3m of excess cable with female termination connector neatly coiled in ceiling space at AP location. Cable to be clearly labeled at rack and at AP location (i.e. AP1 etc.) along with tag on the ceiling T-bar, tile or connection box to identify the AP location.

## **2.7. Telephone and Fax Equipment**

- 2.7.1. Most new installations in the City will utilize Voice Over Internet Protocol (VOIP) technology for telephone services. Confirm with the Project Manager prior to commencing design. Consultation with OCT Network Analyst required for all VOIP systems to determine requirements.
  - 2.7.1.1. There is no requirement for backboard or rack space to mount VOIP telephone equipment, as this equipment is server based and located off-site.
- 2.7.2. In a building using VOIP technology, fax equipment does not require an independent analog phone line. The OCT department will install a fax analog to digital converter in the NAR room for each fax station identified on the drawings. This converter allows faxes to utilize the VOIP system.
- 2.7.3. All cabling to be Cat 6. Specify appropriate terminations for structured wiring identified for VOIP (data) and analog (voice) telephones.
- 2.7.4. For renovations and additions to existing buildings with analog phone systems, provide minimum Category 5e voice cabling to all identified new analog phone locations. Provide additional backboard space in NARs as necessary to accommodate voice backbone terminations and telephone equipment.

## **2.8. Emergency Phones and Auto-dialers**

- 2.8.1. Emergency phones and auto-dialers are to be identified on drawings and must be connected to a dedicated analog line. This equipment must remain operational during a power interruption and therefore cannot be serviced by the VOIP system.
- 2.8.2. Where an analog line to the facility is not available from the Service Provider, fiber may be used provided that the line is from a managed modem/switch supplied by the Service Provider, and that the system is set up to test the line every 6 hours. City Fiber does not comply and cannot be used for this purpose.

## **2.9. Inspection, Testing, Commissioning and Training**

- 2.9.1. The consultant is responsible for inspection of the IT infrastructure installation and is to issue contemplated changes or instructions to the Project Manager as required, during construction.
- 2.9.2. Ensure the specification indicates the contractor's responsibility to do performance testing of the horizontal and backbone cables and terminations to ensure they meet minimum industry-defined performance criteria and certified. Describe testing procedures and submittal requirements in the specification. Review submissions and performance tests to ensure the installed system meets all requirements.
- 2.9.3. Certification Testing of Final Installation using ANSI/TIA/EIA-568 Series compliant, UL verified Class IIe, III, or IV field certification instruments are required for testing the Category rated copper infrastructure. The installation must be tested in accordance with approved certification procedures



as detailed in ANSI/TIA/EIA-568 Series standards and the Telecommunications Distribution Methods Manual.

- 2.9.4. All fiber optic installations to be certified must be tested with optical loss test sets (power meters or field testers), capable of reporting Insertion Loss and Length, or an appropriate OTDR capable of reporting link loss measurements. These test results will be submitted with a link loss budget corresponding to the installation.
- 2.9.5. Fibre Optic Test results must include:
  - 2.9.5.1. The calculation of the loss budget at 1550nm and 1310nm
    - Maximum loss budget @1550nm = **(Length in Km X 0.3dB/Km) + (# Connectors X 0.5dB/connector) + (# of splices X 0.3dB/splice)**
    - Maximum loss budget @ 1310nm = **(Length in Km X 0.4dB/Km) + (# Connectors X 0.5dB/connector) + (# of splices X 0.3dB/splice)**
  - 2.9.5.2. The power meter test report
  - 2.9.5.3. The OTDR test results
    - The pulse length for automatic OTDR is often not adequate.
  - 2.9.5.4. The CFOT (Certified Fibre Optics Technician) Ticket of the operator for each of the submissions.
- 2.9.6. Testing to be completed on 100% of all installed copper and fiber optic Links and Channels that comprise both the horizontal and backbone portions of the structured cabling system. An exception is made for factory pre-terminated copper and fiber optic cable assemblies.
- 2.9.7. After the project has been granted substantial completion and is handed over to the City for occupancy, the City will install all City-supplied IT equipment.
- 2.9.8. The City will conduct training on the IT system, where required.

## 2.10. Warranty

- 2.10.1. Installer must supply an end to end 15 year manufacturer warranty covering all passive copper and fiber optic connectivity products including connectors, patch panels, pre-terminated cable assemblies, patch cords, equipment cords, and enclosures. Includes associated replacement parts and labour.

## 2.11. Labeling Standard

- 2.11.1. General
  - 2.11.1.1. This section details labeling standards for library, police, and all other types of City buildings.
  - 2.11.1.2. Ensure the applicable labeling standard is clearly described in the construction specifications.
  - 2.11.1.3. Cables serving VOIP telephones are data cables, not voice cables, and should be labeled accordingly.
  - 2.11.1.4. Network patch panels and wall plates to be mechanically labeled.

## 2.12. Edmonton Public Library IT Labeling Standard

- 2.12.1. The following labeling standard is to be used when working on a library building:

### **TF-RRR-P**

where: T = type (D or V)

F = floor

RRR = three digit room number

P = port letter (NOT number)

Examples: V3-101-A, D3-101-A, D3-101-B

## **2.13. Edmonton Police Service IT Labeling Standard**

- 2.13.1. This standard will be added in a future edition of this document. When writing the specifications, confirm labeling requirements with Project Manager.

## **2.14. City of Edmonton IT Labeling Standard**

- 2.14.1. For all other building types, the following labeling standard is to be used:

### **AT-PP**

where: A = NAR Room identifier. This is not required in buildings with only one NAR.

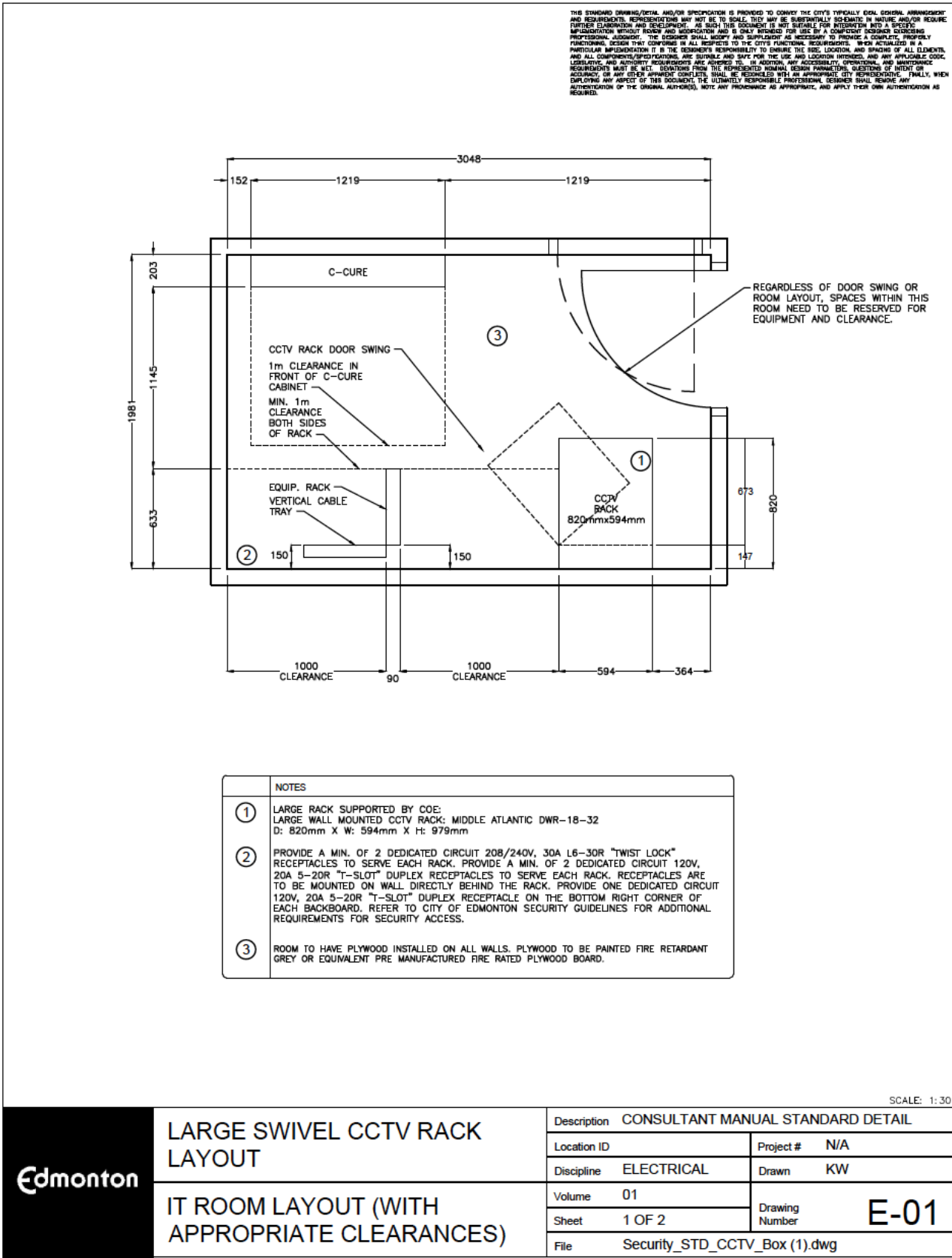
T = type. This will always be "D". No labels to be labeled "V"

PP = cable number

Examples: D-01, D-02, 2D-01



## **APPENDIX B1 - STANDARD NETWORK ACCESS ROOM LAYOUT**





## **APPENDIX C - SECURITY AND CARD ACCESS SYSTEM DESIGN GUIDELINES**

## 1. GENERAL

### 1.1. Overview

- 1.1.1. This guideline is to be used in conjunction with project program requirements to design a security system that meets the needs of the facility and is compatible with the City of Edmonton's requirements.
- 1.1.2. For the purposes of this guideline, the term 'Security System' refers to the access control and intrusion detection system, inclusive of card access and motion sensors.

### 1.2. References

- 1.2.1. "Safety Audit Guide for Crime Prevention", City of Edmonton, Jan 2000. This document can be found on the City of Edmonton website.
- 1.2.2. CSA C22.1, Canadian Electrical Code, Part 1
- 1.2.3. Software House - CCURE - iStar Edge G2- Installation and Configuration Guide, REV E0 or higher
- 1.2.4. Software House - CCURE - iStar Ultra G2- Installation and Configuration Guide, REV A0 or higher
- 1.2.5. City of Edmonton - CCURE 9000 - Element Naming Convention Rev A7 or higher
- 1.2.6. City Of Edmonton - Corporate Security Charter

### 1.3. Responsibilities of the Consultant

- 1.3.1. Incorporate the requirements described in the Functional Security Program, provided by the City, using a combination of electronic and non-electronic security measures.
- 1.3.2. Incorporate Crime Prevention through Environmental Design (CPTED) principles in design.
- 1.3.3. Consider security when determining site layout, sightlines, interior & exterior lighting, landscaping, program relationships, etc. Effective security design will seek to minimize the amount of electronic security devices needed through the use of intelligent design.
- 1.3.4. Where electronic security equipment is used:
  - 1.3.4.1. Specify and locate all detection and access control equipment such as control panels, motion sensors, glass break sensors, card readers, etc.
  - 1.3.4.2. Specify connections between security equipment and other building systems requiring audible and remote alarm annunciation. This includes ensuring an appropriate communication service is provided.
  - 1.3.4.3. Coordinate security design across disciplines, including architecture, door hardware, and electrical.
  - 1.3.4.4. Prepare the security system drawings and specifications, and perform contract administration relating to the security system.

## 1.4. Submission Requirements:

- 1.4.1. All progress review submissions are to include security information.
  - 1.4.1.1. Refer to the Professional Service Agreement and the latest edition of “Consultant Manual Volume 1, Design Process and Guidelines” for a complete list of submission requirements.
  - 1.4.1.2. If a submission is not sufficiently detailed to review, it will be returned for resubmission.
- 1.4.2. Standard security drawing details and a Security Specification Template are included in the appendices to this guideline. These documents do not account for all possible scenarios, and are provided for reference only. It is the responsibility of the Consultant to make modifications and add new details or information as necessary to accurately convey project requirements.

## 2. TECHNICAL

### 2.1. General

#### 2.1.1. Security System Selection:

- 2.1.1.1. The City of Edmonton uses two types of security systems, selected based on specific project requirements. Refer to the table below and consult with the City to determine the appropriate system for your project:

System	Card Access & Intrusion Detection (C-Cure)	Intrusion Detection (Honeywell ADEMCO)
Arming:	Pre-Programmed or Manual	Manual
Max # of intrusion devices:	See Section 2.3	128 (Typical)
Communication Service:	IP Network with City Domain	POTS
Cost:	Higher	Lower
Product:	See Section 2.3	See Section 2.2

#### 2.1.2. Field Device Input/Output Point Allocation:

- 2.1.2.1. Refer to Cable Schedule table on drawing E-08 for the number of points required on a security panel for typical field devices. This information is not dependant on the type of security system selected.

#### 2.1.3. Communication Service and Alarm Annunciation:

- 2.1.3.1. All security systems are to be remotely monitored for status and building alarms at the City’s central monitoring station.
- 2.1.3.2. Provide City Domain using IP Ethernet Networks using the following media types:



- .1 Fiber – City Owned or Leased.
- .2 Copper – Managed ADSL or POTS
- 2.1.3.3. Depending on program requirements, building alarms such as mechanical alarms and generator status may be annunciated through the security system.
- 2.1.3.4. Do not remotely annunciate fire alarms through the security system. Provide a separate fire alarm dialer, compliant with City requirements. Refer to Fire Alarm Communication Design Guidelines in [Appendix F](#) for additional information.

## **2.2. Intrusion Detection Systems (Non-Card Access)**

- 2.2.1. This section discusses intrusion detection systems where card access is not required. Refer to the next section when designing a security system requiring card access.
- 2.2.2. Intrusion detection systems are to be one of the following approved products:
  - 2.2.2.1. Honeywell Ademco Vista (model 128 BPT or higher) or approved equal.
- 2.2.3. When designing an intrusion alarm system without card-readers:
  - 2.2.3.1. Design to accommodate 25% future expansion. If more than one panel is required, use a C-Cure IStar System.
  - 2.2.3.2. Connect to communication service for remote alarm annunciation. A dedicated copper analog telephone service is required.
  - 2.2.3.3. Refer to manufacturer documentation when choosing a product and designing the system.
- 2.2.4. Intrusion detection alarm panels are to be installed in a secure location, on a plywood backboard.
- 2.2.5. Provide two(2) individual dedicated 15A/120V circuits(emergency circuits are preferred when available) to panel and to duplex receptacle (located adjacent to each intrusion detection alarm panel).
- 2.2.6. Refer to the Non-Card Access Security Specification Template, and manufacturer’s guidelines.

## **2.3. Card Access & Intrusion Detection Systems (C-Cure 9000/IStar)**

\*VERSION OF SOFTWARE HOUSE SOFTWARE (9000) TO BE CONFIRMED WITH THE CITY.

- 2.3.1. Card Access Security Systems are to be C-Cure 9000/IStar-based, and have strict design and installation requirements, described in this guideline. Refer to the previous section when designing an intrusion detection system without card access.
- 2.3.2. Contractor must be “C-Cure 9000 system installer/maintainer with IStar” certified by Software House to purchase, install and program C-Cure 9000 components. Contractor responsible for programming must already have pre-approved access to the City’s C-Cure 9000 system. City to provide a list of Contractors with access. Ensure the specification clearly identifies this requirement.
- 2.3.3. Security backboard are to be located throughout the facility to ensure maximum allowable run lengths are not exceeded.

2.3.4. In multi-level buildings, provide a Security backboard on each storey, stacked where possible.

2.3.5. Security Zoning:

2.3.5.1. Ensure that system design is consistent with Owners Project Requirements.

2.3.5.2. All devices on a single zone are to run to the same IStar panel. One (1) IStar panel may serve multiple zones (Zone Type 1 and 2 Only).

- .1 Zone Type 1 - Manual Arming/Disarming: Where intrusion devices(glass breaks, door contacts and/or motion sensors) and/or card readers are armed and/or disarmed manually with an arming reader.
- .2 Zone Type 2 - Scheduled Arming/Disarming: Where intrusion devices (glass breaks and door contacts) and/or card readers are armed and disarmed on a preprogrammed schedule, or remain armed at all times. Assign different zones to areas that are armed and disarmed on different schedules.

2.3.6. Control Panel:

2.3.6.1. There are two types of control panels approved for use in a C-Cure 9000 compatible security system installed in a City of Edmonton building, IStar Ultra G2, and IStar Edge G2. The IStar Edge may only be used upon explicit approval by City Engineering Services and PRT. Consider the following criteria when determining the type, number, and location of IStar security control panels:

- .1 The following table indicates the maximum number of field devices that one security control panel can accommodate.

	# of Readers per ACM	# of Inputs per ACM	# of Outputs per ACM
iStar Ultra G2	8	24 expandable to 128	16 expandable to 128
iStar Edge G2	2 expandable to 4	8 expandable to 64	4 expandable to 64

- .2 Provide eight (8) additional inputs in CCure panel closest to BMS panel for BMS alarms. Wire, as per Cable Schedule drawing E-08, to be provided in conduit sized as per [Appendix C2 - Security Specifications Template Card Access](#).
- .3 Design to accommodate 25% future expansion spare input/outputs and readers. Add additional CCure system equipment as required.

2.3.7. Communication between security control panels:

2.3.7.1. Structured wiring cables (CAT6 or Fibre) to be supplied, installed and tested by Division 27 cabling contractor as per the [Appendix B - IT Infrastructure Design Guidelines](#).

2.3.7.2. At each security backboard location, provide two (2) structured wiring cable (Cat 6 minimum) with certified terminations between each IStar control panel and a network patch panel or ADSL box. Panels communicate on City Network.

2.3.7.3. Additionally, provide one (1) spare structured wiring cable at each security backboard location to facilitate local programming with a laptop.

### 2.3.8. Security Room & Backboards

- 2.3.8.1. The security backboard must be adequately lit and be subject to standard interior environmental conditions.
- 2.3.8.2. At each security panel location, specify:
  - .1 A 1219 mm x 2438 mm x 19 mm plywood backboard, dedicated for security equipment. Plywood to be painted fire retardant grey or equivalent pre manufactured fire rated plywood board.
  - .2 A 1219 mm wide x 254 mm high x 203 mm deep gutter box with internal backpan, hinged down and lockable, to collect wiring to and from field devices. All conduits must enter gutter box to the rear (ie. close to backboard).
  - .3 LifeSafety E8S enclosure (or equivalent) containing the IStar Ultra GCM and ACM boards, relay boards, distribution boards, and power supplies with separate battery enclosures mounted below the E8S enclosure. Any deviations from this setup to be approved by City Engineering Services and PRT.
  - .4 Provide two(2) individual dedicated 15A/120V circuits(emergency circuits are preferred when available), one for the power supply and one for the convenience duplex receptacle).
- 2.3.8.3. Refer to the Card Access Security Specification Template, included as an appendix to this document.

## 2.4. **Wire and Conduit**

- 2.4.1. Install a separate dedicated conduit system for all security (intrusion and card access) system components, do not share with any other building systems. All security wiring is to be run in conduit.
- 2.4.2. Conduit is to be concealed where possible. Where conduit is exposed, it is to be installed on the secure side of the wall.
- 2.4.3. Conduit home-runs to the security backboard are to be minimum 21 mm. Conduit home-runs for card reader equipped doors are to be a minimum 27 mm.
- 2.4.4. Composite and “Banana” cables are not permitted, see cable schedule E-08 for full requirements.
- 2.4.5. Wires are to be adequately rated for the application (i.e. underground run, wet rated, temperature, etc.).
- 2.4.6. Provide an individual wire home-run from each field device to the security backboard. Do not splice wiring between the field device and security backboard.
- 2.4.7. All wires are to be mechanically labeled with the unique field device number at both ends.
- 2.4.8. Typical wire types and sizes are indicated in the standard details, included as an appendix to this document. Increase wire size as necessary for distant devices.

## 2.5. **Field Devices**

### 2.5.1. **General**

- 2.5.1.1. For product information and installation requirements for typical field devices, refer to the Security Specification Template, included as an appendix to this document,
- 2.5.1.2. Where possible, locate all devices where they can be easily accessed for maintenance (Maximum height of 2500 mm from finished grade).
- 2.5.1.3. All security field devices must be powered from the security control panel. Most existing installations and all new installations are 12VDC. When working on an existing building, consult with the City to determine if the building has 24VDC devices.
- 2.5.1.4. All powered door hardware components (i.e. retractable panic bars, delayed egress) must be powered from a separate power supply (by others). On secured doors & gates with electric door hardware, specify a relay, powered from the security control panel to support the typical operations outlined in detail E-04 and E-05.
- 2.5.1.5. Indicate each field device's intrusion zone adjacent to its symbol on the drawing(s). Provide an intrusion zone schedule on the drawing(s) indicating the area protected, arming method (manual, scheduled, special user access) and that zone's security panel location.

**2.5.2. Card Readers**

- 2.5.2.1. Install card readers where access is limited to authorized personnel or where the City has identified a requirement to log door use for auditing purposes in compliance with the Security Charter consider the application when specifying card reader type. One reader type may not be suitable for all locations.
  - .1 Specify readers designed to operate in the intended environment. This may include outdoors, extreme temperatures, condensation/frost, and wet, dirty or hazardous environments.
  - .2 Provide long read range readers for applications where the user may be further from the reader, such as parking garage entries. Consult with the City prior to specifying long read range readers.
  - .3 Ensure specified readers are able to physically mount where required. Specify flush mount (preferred), surface mount or mullion mount as required.
- 2.5.2.2. Refer to accessibility guidelines for recommended mounting heights for barrier-free entrances.
- 2.5.2.3. Flush mount device box where possible. For surface installations, use a weatherproof device box.
- 2.5.2.4. Specify card readers compatible with the C-Cure 9000/IStar system. Refer to the Security Specification Template, included as an appendix to this document, for further information.
- 2.5.2.5. Where possible, limit cable distance between card readers and security control panel to 125 meters. If distance exceeds 125 meters, consult City Engineering Services and PRT for approved options.

**2.5.3. Arming Readers and Keypads**

- 2.5.3.1. For facilities using a C-Cure 9000/IStar system, Software House RM2L-SE readers are required for zones that will be armed or disarmed manually.
- 2.5.3.2. For facilities using a non-card access intrusion system, a keypad is required to arm and disarm

the system and must be installed inside.

- 2.5.3.3. Locate arming readers and keypads at location(s) where staff will be arming the system or intrusion zone, preferably inside the building.

**2.5.4. Request to Exit Sensors and Door Release Buttons**

- 2.5.4.1. Install request to exit (RTE) sensors at all card-reader doors that have intrusion detection (ie. door contacts) to disable the contact while exiting from the secured side.

**2.5.5. Door and Window Contacts**

- 2.5.5.1. Install contacts in all doors entering an intrusion zone.
- 2.5.5.2. Contacts may be required in operable windows entering an intrusion zone, depending on the project requirements.
- 2.5.5.3. Where possible, conceal contact and wiring in door/window frame.
- 2.5.5.4. On double doors, contacts at each door may be wired in series and therefore only use one input point per pair at the security control panel.
- 2.5.5.5. On sliding doors, monitor the door open and break away status with a door position switch.

**2.5.6. Motion Sensors and Glass-Break Sensors**

- 2.5.6.1. Select the appropriate form of detection and sensor based on the environmental and physical limitations of the space.
  - .1 Install glass-break sensors where occupants may be present while the system is armed and in areas that are prone to nuisance alarms.
- 2.5.6.2. Locate sensors to minimize the quantity needed. If not obvious on the drawings, indicate the area to be covered to facilitate calibration by the contractor.
- 2.5.6.3. Mount sensors as per the manufacturer’s specifications. Sensors must remain accessible for maintenance.

**2.5.7. Electric Door Strikes**

- 2.5.7.1. Electric door strikes are the preferred method for electronically securing card-access doors.
- 2.5.7.2. Coordinate electric door strikes with automatic door operators to ensure attempted unauthorized operation of the automatic door does not damage the door motor.
- 2.5.7.3. Electric door strikes are to fail-secure, except where fail-safe strikes are required to satisfy building code and safety requirements.
- 2.5.7.4. Electric door strikes are to be 12VDC and powered from the relay panel at the security backboard. Do not power strikes directly from the IStar security panel ACM outputs.

**2.5.8. Magnetic Locks**

- 2.5.8.1. To be used by explicit exemption only.

**2.5.9. Sirens and Signaling Equipment**

- 2.5.9.1. Provide an audible alert to annunciate security alarms within the facility.

- 2.5.9.2. Sound level (dB) is to be designed appropriate to the application.
- 2.5.9.3. Signaling equipment is to be 12VDC and powered from the relay panel at the security backboard.

#### **2.5.10. LED Indicators**

- 2.5.10.1. Use LED indicators when it is required to have visual indication that an intrusion zone is armed.

### **2.6. Programming, Testing and Training**

#### **2.6.1. Card Access Security System (C-Cure 9000/IStar)**

- 2.6.1.1. To facilitate programming, the security drawings and/or specifications are to indicate all intrusion zones and arming methods. Zone/room naming methodology to be submitted to the City for approval prior to start of programming.
- 2.6.1.2. Installation and programming of the C-Cure 9000 system must be completed by a certified Software House contractor. Contractor must also have pre-approved access to the City's C-Cure system. City to provide a list of contractors with access.
- 2.6.1.3. System to be ULC Certified.
- 2.6.1.4. Contractor to provide the City with verification reports and as-builts.
- 2.6.1.5. Refer to the Security Specification Template, included as an appendix to this document, for typical testing and training requirements.

#### **2.6.2. Intrusion Detection Systems (No Card Access)**

- 2.6.2.1. Installation and programming of the C-Cure 9000 system must be completed by a certified Software House contractor. Contractor must also have pre-approved access to the City's C-Cure system. City to provide contact information of contractors with access.
- 2.6.2.2. Contractor to install and program system. To facilitate programming, the security drawings and/or specifications are to indicate all intrusion zones and arming methods. Zone/room naming methodology to be submitted to the City for approval prior to start of programming.
- 2.6.2.3. Contractor to provide the City with defaulted installer code, verification reports and as-builts.
- 2.6.2.4. System to be ULC Certified.

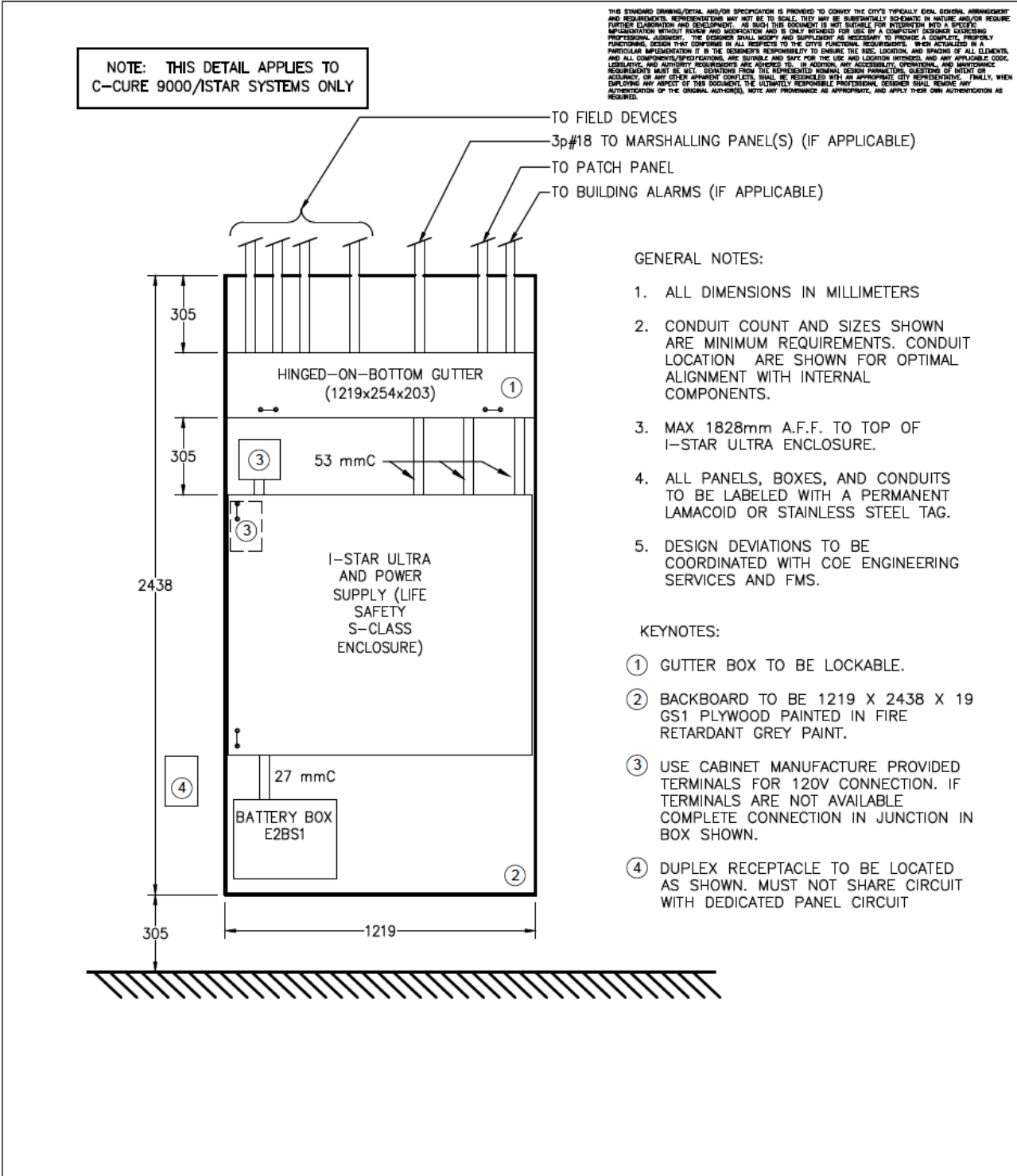
### **2.7. Design & Specifications**

- 2.7.1. Standard Security Drawings and Specification templates, for card and non-card access scenarios, included in Appendix [C1](#) and [C2](#).

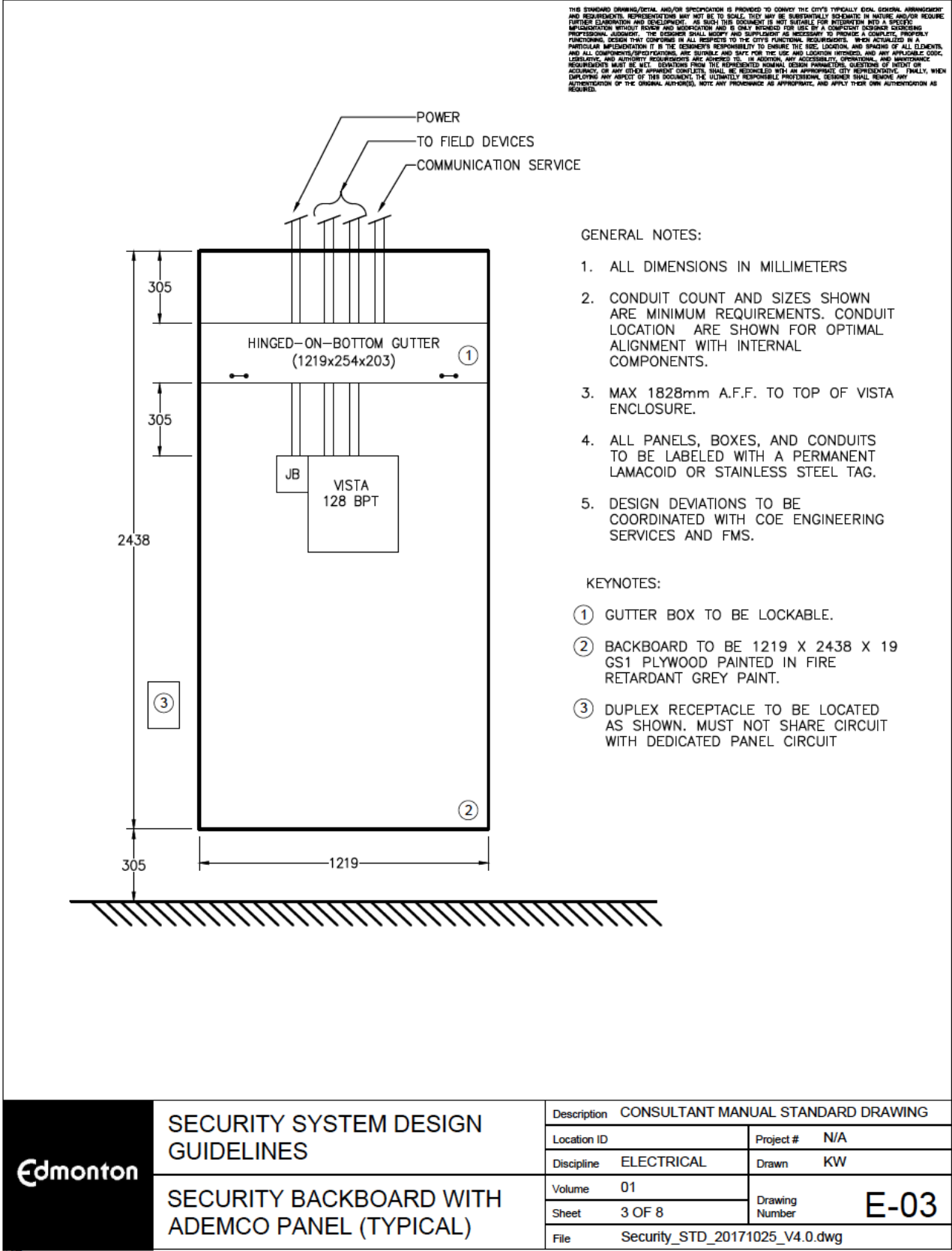


## **APPENDIX C1 - STANDARD SECURITY DRAWINGS**





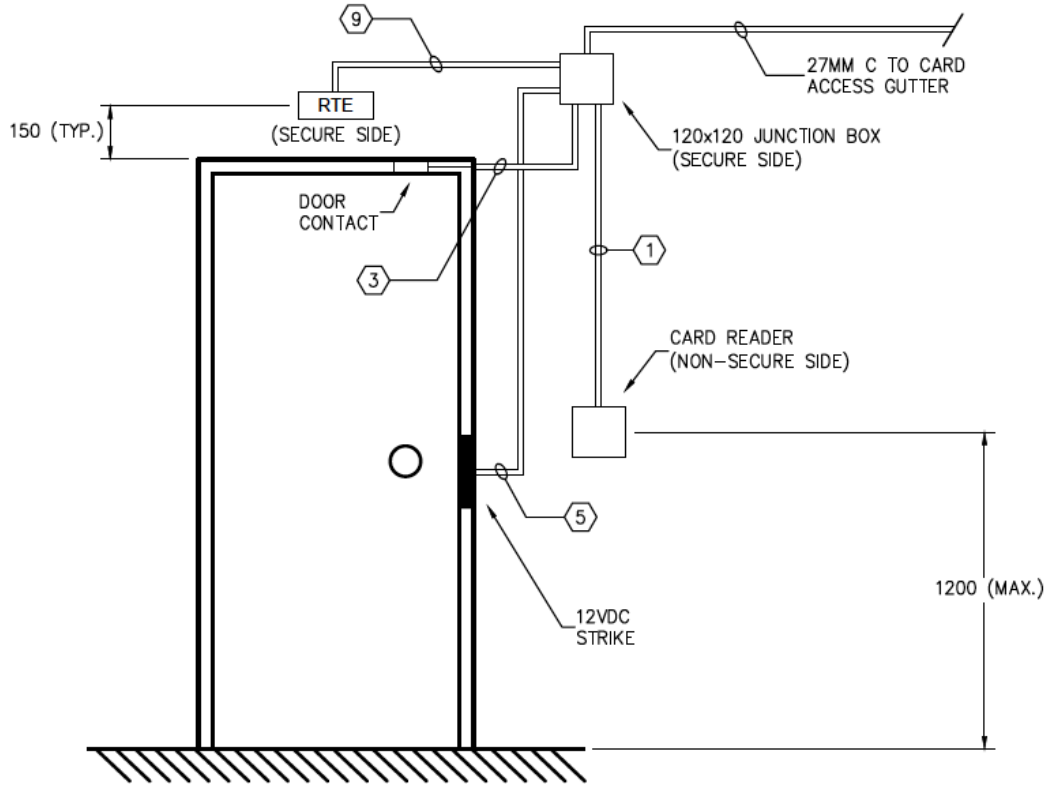
	<b>SECURITY SYSTEM DESIGN GUIDELINES</b>		Description <b>CONSULTANT MANUAL STANDARD DRAWING</b>	
			Location ID	Project # <b>N/A</b>
			Discipline <b>ELECTRICAL</b>	Drawn <b>KW</b>
			Volume <b>01</b>	<b>E-01</b>
			Sheet <b>1 OF 8</b>	
	<b>SECURITY BACKBOARD WITH ISTAR ULTRA (TYPICAL)</b>		File <b>Security_STD_20171025_V4.0.dwg</b>	



	<b>SECURITY SYSTEM DESIGN GUIDELINES</b>		Description CONSULTANT MANUAL STANDARD DRAWING	
			Location ID	Project # N/A
			Discipline ELECTRICAL	Drawn KW
	<b>SECURITY BACKBOARD WITH ADEMCO PANEL (TYPICAL)</b>		Volume 01	<b>E-03</b>
			Sheet 3 OF 8	
			File Security_STD_20171025_V4.0.dwg	

**NOTE: THIS DETAIL APPLIES TO C-CURE 9000/ISTAR SYSTEMS ONLY**

THIS STANDARD DRAWING/DETAIL AND/OR SPECIFICATION IS PROVIDED TO CONVEY THE CITY'S TYPICALLY IDEAL GENERAL ARRANGEMENT AND REQUIREMENTS. REPRESENTATIONS MAY NOT BE TO SCALE. THEY MAY BE SUBSTANTIALLY SCHEMATIC IN NATURE AND/OR REQUIRE FURTHER ELABORATION AND DEVELOPMENT. AS SUCH THIS DOCUMENT IS NOT SUITABLE FOR INCORPORATION INTO A SPECIFIC IMPLEMENTATION WITHOUT REVIEW AND MODIFICATION AND IS ONLY INTENDED FOR USE BY A COMPETENT DESIGNER EXERCISING PROFESSIONAL JUDGEMENT. THE DESIGNER SHALL VERIFY AND SUPPLEMENT AS NECESSARY TO PROVIDE A COMPLETE, PROPERLY FUNCTIONING DESIGN THAT CONFORMS IN ALL RESPECTS TO THE CITY'S FUNCTIONAL REQUIREMENTS. WHEN ACTUALIZED IN A PARTICULAR IMPLEMENTATION IT IS THE DESIGNER'S RESPONSIBILITY TO ENSURE THE SIZE, LOCATION, AND SPACING OF ALL ELEMENTS AND ALL COMPONENTS/SPECIFICATIONS ARE SUITABLE AND SAFE FOR THE USE AND LOCATION INTENDED, AND ANY APPLICABLE CODE, LEGISLATIVE, AND AUTHORITY REQUIREMENTS ARE ADHERED TO. IN ADDITION, ANY ACCESSIBILITY, OPERATIONAL, AND MAINTENANCE REQUIREMENTS MUST BE MET. DEVIATIONS FROM THE REPRESENTED GENERAL DESIGN PARAMETERS, QUESTIONS OF INTENT OR ACCURACY, OR ANY OTHER ELEMENTS CONFLICTS SHALL BE RESOLVED WITH AN APPROPRIATE CITY REPRESENTATIVE. FINALLY, WHEN EMPLOYING ANY ASPECT OF THIS DOCUMENT, THE ULTIMATELY RESPONSIBLE PROFESSIONAL DESIGNER SHALL REMOVE ANY AUTHENTICATION OF THE ORIGINAL AUTHOR(S), NOTE ANY PROVISIONS AS APPROPRIATE, AND APPLY THEIR OWN AUTHENTICATION AS REQUIRED.



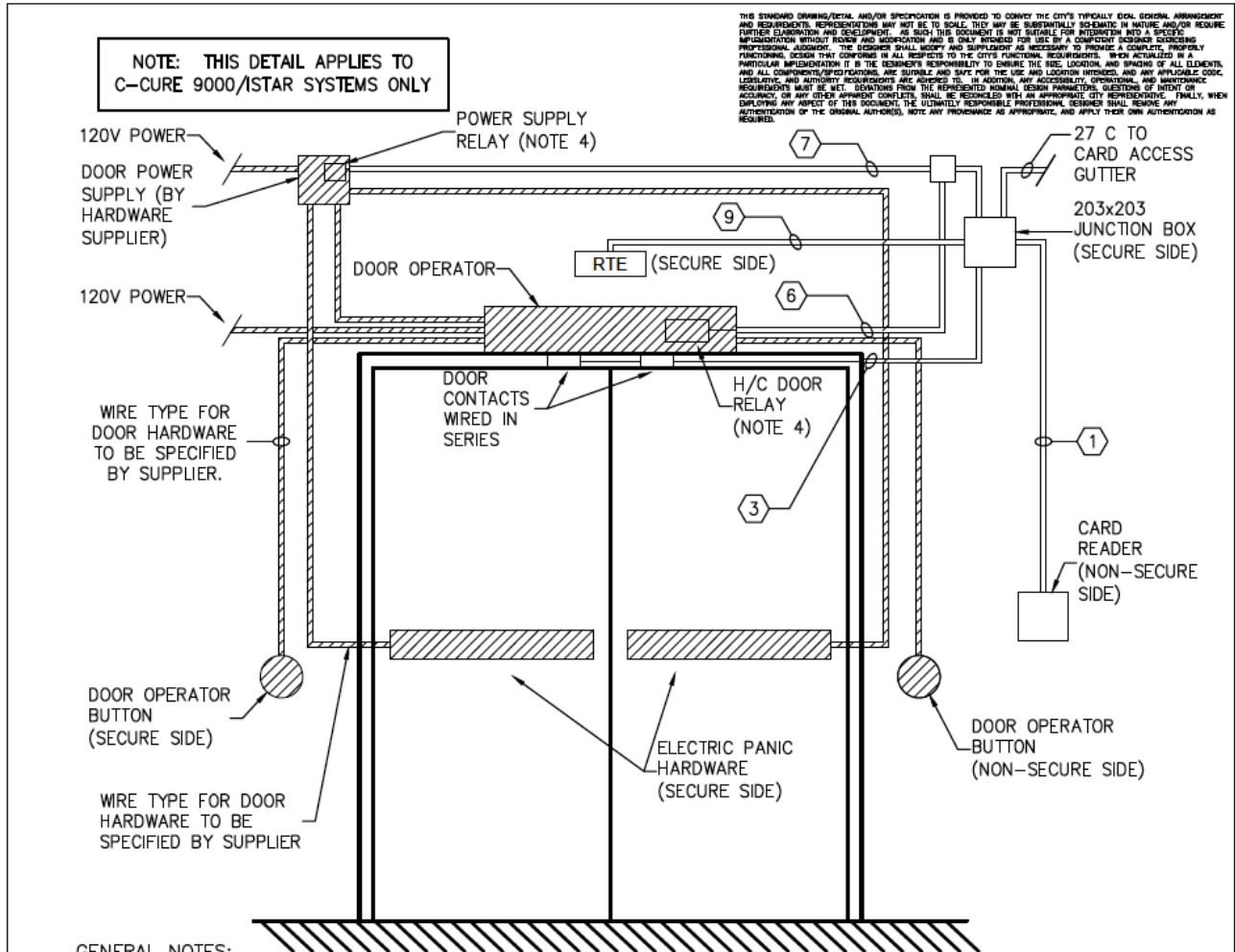
**GENERAL NOTES:**

1. DRAWING SHOWS TYPICAL NON-POWERED DOOR, SECURED WITH AN ELECTRIC STRIKE. MODIFY TO SUIT SPECIFIC CONDITIONS, INDICATING ANY ADDITIONAL REQUIREMENTS, DIMENSIONS/MOUNTING HEIGHTS, ETC
2. REFER CABLE SCHEDULE ON E-08 FOR WIRING REQUIREMENTS.
3. TYPICAL OPERATION:

ENTRY: WHEN A VALID CARD IS SWIPED, DOOR CONTACT IS DISABLED FOR A SHORT TIME, AND STRIKE IS RELEASED, ALLOWING USER TO PUSH OPEN DOOR.

EXIT: USER MANUALLY OPERATES DOOR HARDWARE TO OPEN DOOR WHILE THE REQUEST-TO-EXIT SENSOR TELLS THE SECURITY PANEL TO DISABLE THE DOOR CONTACT FOR A SHORT TIME, ALLOWING USER TO PASS THROUGH DOOR WITHOUT SETTING OFF AN INTRUSION ALARM.

	<b>SECURITY SYSTEM DESIGN GUIDELINES</b>		Description CONSULTANT MANUAL STANDARD DRAWING	
			Location ID	Project # N/A
			Discipline ELECTRICAL	Drawn KW
	<b>CARD ACCESS DOOR WITHOUT POWERED HARDWARE (TYPICAL)</b>		Volume 01	<b>E-04</b>
			Sheet 4 OF 8	
			File Security_STD_20171025_V4.0.dwg	



**GENERAL NOTES:**

1. THIS DRAWING AND OPERATION DESCRIPTION BELOW IS ONE OF MANY POSSIBLE POWERED DOOR AND GATE CONFIGURATIONS AND IS SHOWN ONLY TO ILLUSTRATE HOW TYPICAL POWERED DOOR HARDWARE COMPONENTS MAY INTERACT WITH SECURITY EQUIPMENT. PROVIDE A SEPARATE DETAIL FOR EACH UNIQUE TYPE OF POWERED DOOR THAT HAS SECURITY.
2. HATCHED AREAS DENOTE TYPICAL POWERED DOOR HARDWARE EQUIPMENT. UNHATCHED AREAS DENOTE TYPICAL SECURITY EQUIPMENT.
3. REFER CABLE SCHEDULE ON E-08 FOR WIRING REQUIREMENTS.
4. TYPICAL OPERATION:

**ENTRY:** WHEN A VALID CARD IS SWIPED, DOOR CONTACTS ARE TEMPORARILY SHUNTED, AND THE CARD ACCESS PANEL SENDS A SIGNAL TO THE 12VDC RELAY LOCATED IN THE DOOR OPERATOR. IF THERE IS NO DOOR OPERATOR THE 12VDC RELAY WILL BE LOCATED IN THE POWER SUPPLY. 12VDC RELAY AND BASE TO BE INSTALLED BY SECURITY CONTRACTOR. THE DOOR MAY THEN BE OPENED MANUALLY USING THE DOOR HARDWARE, OR AUTOMATICALLY BY PRESSING THE DOOR OPERATOR BUTTON.

**EXIT:** USER MANUALLY OPERATES PANIC HARDWARE OR PRESSES DOOR OPERATOR BUTTON TO ACTIVATE UNLOCK FUNCTION AND OPEN DOOR. WHILE THE REQUEST-TO-EXIT SENSOR SIGNALS THE SECURITY PANEL TO TEMPORARILY SHUNT THE DOOR CONTACTS, ALLOWING USER TO PASS THROUGH DOOR WITHOUT SETTING OFF AN INTRUSION ALARM.

	<b>SECURITY SYSTEM DESIGN GUIDELINES</b>		Description CONSULTANT MANUAL STANDARD DRAWING	
			Location ID	Project # N/A
			Discipline ELETTRICAL	Drawn KW
	<b>CARD ACCESS DOOR WITH POWERED HARDWARE (TYPICAL)</b>		Volume 01	<b>E-05</b>
			Sheet 5 OF 8	
			File Security_STD_20171025_v4.0.dwg	

THIS STANDARD DRAWING/DETAIL AND/OR SPECIFICATION IS PROVIDED TO CONVEY THE CITY'S TYPICALLY IDEAL GENERAL ARRANGEMENT AND REQUIREMENTS. REPRESENTATIONS MAY NOT BE TO SCALE. THEY MAY BE SUBSTANTIALLY SCHEMATIC IN NATURE AND/OR REQUIRE FURTHER ELABORATION AND DEVELOPMENT, AS SUCH THIS DOCUMENT IS NOT INTENDED FOR INTERPRETATION INTO A SPECIFIC IMPLEMENTATION WITHOUT REVIEW AND MODIFICATION AND IS ONLY INTENDED FOR USE BY A COMPETENT DESIGNER EXERCISING PROFESSIONAL JUDGEMENT. THE DESIGNER SHALL VERIFY AND SUPPLEMENT AS NECESSARY TO PROVIDE A COMPLETE, PROPERLY FUNCTIONING DESIGN THAT CONFORMS IN ALL RESPECTS TO THE CITY'S FUNCTIONAL REQUIREMENTS. WHEN ACTUALIZED IN A PARTICULAR IMPLEMENTATION IT IS THE DESIGNER'S RESPONSIBILITY TO ENSURE THE USE, LOCATION, AND SPACING OF ALL ELEMENTS, AND ALL COMPONENTS/SUBCOMPONENTS ARE SUITABLE AND SAFE FOR THE USE AND LOCATION INTRODUCED, AND ANY APPLICABLE CODE, LEGISLATIVE, AND AUTHORITY REQUIREMENTS ARE ADHERED TO. IN ADDITION, ANY ACCESSIBILITY, OPERATIONAL, AND MAINTENANCE REQUIREMENTS MUST BE MET. DEVIATIONS FROM THE REPRESENTED NOMINAL DESIGN PARAMETERS, QUESTIONS OF INTENT OR ACCURACY, OR ANY OTHER APPARENT CONFLICTS SHALL BE RESOLVED WITH AN APPROPRIATE CITY REPRESENTATIVE. FINALLY, WHEN EMPLOYING ANY ASPECT OF THIS DOCUMENT, THE ULTIMATELY RESPONSIBLE PROFESSIONAL DESIGNER SHALL REMOVE ANY AUTORIZATION OF THE ORIGINAL AUTHOR(S), NOTE ANY PROVISIONS AS APPROPRIATE, AND APPLY THEIR OWN AUTHORIZATION AS REQUIRED.

No.	DEVICE	TYPE	NO. OF POINTS	NOTES	CABLE
1	CARD READER	CARD READER	DIRECT WIEGAND		3P #18 AWG SHIELDED TWISTED PAIRS
2	ARMING CARD READER	CARD READER	RS485 PORT	CARD ACCESS SYSTEMS ONLY	3P #18 AWG SHIELDED TWISTED PAIRS
3	DOOR CONTACT CARD READER DOOR	DOOR INPUT	1	CARD ACCESS SYSTEMS ONLY	6C #22 AWG STRANDED
4	DOOR CONTACT NON CARD READER DOOR	DOOR INPUT	1	DOUBLE DOORS CAN BE WIRED IN SERIES 1 PT PER 2 DOORS	6C #22 AWG STRANDED
5	ELECTRIC STRIKE	DOOR OUTPUT	1	CARD ACCESS SYSTEMS ONLY	1P #16 AWG SHIELDED STRANDED
6	DOOR OPERATOR H/C ACTIVATION RELAY	DOOR OUTPUT	1	CARD ACCESS SYSTEMS ONLY	1P #16 AWG SHIELDED STRANDED
7	DOOR CONTROL RELAY	DOOR OUTPUT	1	CARD ACCESS SYSTEMS ONLY	1P #16 AWG SHIELDED STRANDED
8	SLIDING DOOR ACTIVATION RELAY	DOOR OUTPUT	1	CARD ACCESS SYSTEMS ONLY	1P #16 AWG SHIELDED STRANDED
9	REQUEST TO EXIT	INPUT	1	CARD ACCESS SYSTEM ONLY	6C #22 AWG STRANDED
10	SIREN	OUTPUT	1		2C #16 AWG SHIELDED STRANDED
11	STROBE	OUTPUT	1		4C #18 AWG SHIELDED STRANDED
12	SIREN STROBE COMBO	OUTPUT	1		4C #18 AWG SHIELDED STRANDED
13	LED INDICATOR	OUTPUT	1		2C #16 AWG SHIELDED STRANDED
14	KEYPAD	NON READER		NON CARD ACCESS SYSTEM ONLY	6C #22 AWG STRANDED
15	WINDOW CONTACT	INPUT	1		6C #22 AWG STRANDED
16	GLASS BREAK DETECTOR	INPUT	2	1 ALARM POINT, 1 TAMPER POINT	6C #22 AWG STRANDED
17	MOTION DETECTOR	INPUT	2	1 ALARM POINT, 1 TAMPER POINT	6C #22 AWG STRANDED
18	LOW TEMP SENSOR	INPUT	1	1 ALARM POINT	6C #22 AWG STRANDED
19	PANIC BUTTON	INPUT	1	1 ALARM POINT	6C #22 AWG STRANDED
20	WIRELESS PANIC RECEIVER	INPUT	1	1 ALARM POINT	6C #22 AWG STRANDED
21	BMS ALARM MONITORING	INPUT	1	1 ALARM POINT	6C #22 AWG STRANDED
22	WATER SENSOR	INPUT	1	1 ALARM POINT	6C #22 AWG STRANDED
23	GATE READER	INPUT	1	TO BE LONG RANGE HID MAXIPROX	3P #18 AWG SHIELDED STRANDED TWISTED PAIR
24	WATER GAS DETECTION	INPUT	1	MONITORING CABLES	6C #22 AWG STRANDED

	<b>SECURITY SYSTEM DESIGN GUIDELINES</b>	Description CONSULTANT MANUAL STANDARD DRAWING	
	<b>CABLE SCHEDULE (TYPICAL)</b>	Location ID	Project # N/A
		Discipline ELECTRICAL	Drawn KW
		Volume 01	Drawing Number <b>E-08</b>
		Sheet 8 OF 8	
		File Security_STD_20171025_V4.0.dwg	



# **APPENDIX C2 - SECURITY SPECIFICATIONS TEMPLATE CARD ACCESS (SPEC SECTION 28 13 00)**

## 1. General

### 1.1. Related Sections

- 1.1.1. Section 08 71 00 – Door Hardware – General.
- 1.1.2. Section 14 21 23 – Elevators.
- 1.1.3. Section 26 05 21 – Wires and Cables.
- 1.1.4. Section 27 10 05 - Structured Cabling for Communications Systems.

### 1.2. System Description

- 1.2.1. Security System: Control access to building and selected areas and detect unauthorized movement within building using card access readers, motion sensors, and glass-break sensors.
  - 1.2.1.1. Selected Exterior Doors: Control access into [and out of] building.
  - 1.2.1.2. Selected Building Areas: Control access into [mechanical room,] [electrical room,] [IT room,] [staff area,] [cash handling room/safe,] [\_\_\_\_\_].
  - 1.2.1.3. Selected Building Areas: Detect unauthorized access in [exterior offices,] [hallways,] [\_\_\_\_\_].
  - 1.2.1.4. System Arming: By [arming reader].
  - 1.2.1.5. Refer to the Intrusion Zone Schedule on drawings.
  - 1.2.1.6. Signaling: By local siren(s) and remote annunciation to City monitoring facility.
- 1.2.2. Security Access System is to be fully compatible with the CCure 9000 security management system.

### 1.3. Submittals

- 1.3.1. Refer to Section 01 33 00: Submittal Procedures.
- 1.3.2. Product Data: Provide electrical characteristics and connection requirements.
- 1.3.3. Shop Drawings: Provide system wiring diagram showing each device and wiring connection required.
- 1.3.4. Security system submittals are to be coordinated with Door Hardware submittals, specified in Section [\_\_\_\_\_].

### 1.4. Closeout Submittals

- 1.4.1. Refer to Section 01 78 10: Closeout Submittals.
- 1.4.2. Test Reports: Indicate satisfactory completion of required tests and inspections.
- 1.4.3. Record Documents: Record actual locations of Security equipment. Record field device number designation.

### 1.5. Quality Assurance

- 1.5.1. Installer Qualifications: Certified to purchase, install and program CCure 9000 systems and components. To also include any site specific requirements(Example: Police clearance).



## 2. Products

### 2.1. Manufacturers

- 2.1.1. All products must be compatible with the CCure 9000 security management system.

### 2.2. Control Panels

- 2.2.1. Software House IStar Ultra G2 with two ACM's:

- 2.2.1.1. 16 card readers.
- 2.2.1.2. 48 supervised inputs, expandable to 256.
- 2.2.1.3. 32 form C relay outputs, expandable to 256.
- 2.2.1.4. 2 GB memory.
- 2.2.1.5. Local ethernet port.
- 2.2.1.6. Support static IP addressing.
- 2.2.1.7. Panel Tamper.
- 2.2.1.8. Alternate products (including Ultra SE) will not be accepted.

- 2.2.2. Software House IStar Edge G2:

- 2.2.2.1. 2 card readers.
- 2.2.2.2. 8 supervised inputs, expandable to 32.
- 2.2.2.3. 4 form C relay outputs, expandable to 32.
- 2.2.2.4. 64 MB memory.
- 2.2.2.5. One Ethernet port, optional power-over-ethernet module.
- 2.2.2.6. Panel Tamper
- 2.2.2.7. Alternate products will not be accepted.

- 2.2.3. Powered Relay Boards:

- 2.2.3.1. Isolating relays for security device outputs, such as door strikes.
- 2.2.3.2. 8 fused outputs, configurable to NO or NC.
- 2.2.3.3. LED relay indicators.
- 2.2.3.4. Fire Alarm disconnect feature, where required.(Example: Maglocks - Fire Alarm requires interconnect contact to open doors)
- 2.2.3.5. Auxiliary contact for monitoring of disconnect feature with LED indicator for arm/disarming.

- 2.2.4. Power Supply (door control):

- .1 115VAC input(typical), 12VDC 20A output(typical).Coordinate ULC approved device with Door Hardware prior to supply/install.
- .2 Filtered and electronically regulated outputs.
- .3 Short circuit and thermal overload protection.

- .4 Battery backup: One 12VDC 18AH Batteries
- .5 LED indication of AC input and DC output.
- .6 Class 2 limited fused to be used.

## 2.3. Input Devices

### 2.3.1. Card Readers

- 2.3.1.1. Multiclass SE type.
- 2.3.1.2. Transmit frequency: 125 kHz.
- 2.3.1.3. Read range: [63.5mm (2.5") - 76mm (3")]
- 2.3.1.4. LED indicator light and beeper.
- 2.3.1.5. Operating Voltage: 5-12VDC.
- 2.3.1.6. Color: [black].
- 2.3.1.7. Enclosure/housing: Polycarbonate.
- 2.3.1.8. Mounting: Flush, surface, or mullion as indicated on drawings (for vehicles, please contact City Corporate Security).
- 2.3.1.9. Communication: Weigand compatible.
- 2.3.1.10. HID 40NKS-00-000000/HID 20NKS-00-000000 or approved equal.
- 2.3.1.11. Software House RM2L-SE Multiclass Arming Readers: Where indicated on drawings.

### 2.3.2. Request-to-Exit Sensors

- 2.3.2.1. Two Form C outputs.
- 2.3.2.2. Adjustable relay time of 0.5s to 60s.
- 2.3.2.3. Swivel optics for aiming.
- 2.3.2.4. 12VDC I/P voltage.
- 2.3.2.5. Color: [White] [Black].
- 2.3.2.6. Honeywell IS310 with IS-310WHTP trim plate or approved equal.

### 2.3.3. Door and Window Contacts

- 2.3.3.1. Closed loop type.
- 2.3.3.2. Wide gap 19 mm (3/4") or 23 mm (7/8") diameter recessed mount: GE 1078C or approved equal.
- 2.3.3.3. Surface mount: GRI 29AWGW or approved equal.
- 2.3.3.4. Overhead door rail mount: Sentrol SR-2325AL or approved equal.
- 2.3.3.5. Overhead door floor mount: Amseco AS-ODC-59A or approved equal.

### 2.3.4. Motion Sensors

- 2.3.4.1. Dual technology: PIR, Microwave.

- 2.3.4.2. Form C output.
- 2.3.4.3. Cover tamper.
- 2.3.4.4. Animal immunity.
- 2.3.4.5. Fluorescent light interference filter.
- 2.3.4.6. 12VDC I/P voltage.
- 2.3.4.7. Optics for long, medium or curtain applications, as required.
- 2.3.4.8. Bosch ISC-CDL-W15G or approved equal.
- 2.3.5. Glass Break Sensors
  - 2.3.5.1. Form C output.
  - 2.3.5.2. Cover tamper.
  - 2.3.5.3. Omni-directional microphone.
  - 2.3.5.4. RF Immunity.
  - 2.3.5.5. 12VDC I/P voltage.
  - 2.3.5.6. Residio FG-1625T or approved equal.
- 2.3.6. Panic Alarm
  - 2.3.6.1. Closed loop type.
  - 2.3.6.2. 12VDC I/P voltage.
  - 2.3.6.3. Sentrol 3045 (w/ panic switch) or approved equal.
  - 2.3.6.4. Inovonics wireless panic EN4204 or approved equal.
- 2.3.7. Intercom
  - 2.3.7.1. Please contact City Corporate Security for information.

## 2.4. Output Devices

- 2.4.1. Electric Door Strikes
  - 2.4.1.1. 12VDC
  - 2.4.1.2. Install blocking diode as per Softwarehouse Installation guide.
  - 2.4.1.3. [As specified in Section 08 71 00 – Door Hardware – General.]
- 2.4.2. LED
  - 2.4.2.1. 12VDC
  - 2.4.2.2. Provide LED to indicate system is armed
- 2.4.3. Relays
  - 2.4.3.1. 12VDC coil, 10A removable Ice Cube with base
  - 2.4.3.2. [Single] [Double] pole.

2.4.3.3. [As specified in Section 08 71 00 – Door Hardware – General.]

2.4.4. Sirens

2.4.4.1. 12VDC.

2.4.4.2. [100dB at 1.0m.]

2.4.4.3. Honeywell Wave 2 or approved equal.

### **3. Execution**

#### **3.1. Installation**

- 3.1.1. Install to manufacturer’s instructions and this specification.
- 3.1.2. All alarm inputs must have a supervisory/End of Line Resistor installed. Factory manufactured resistor packs to be used as field devices, no bare resistors permitted.
- 3.1.3. Ferrule connectors to be used for all headend terminations.
- 3.1.4. 12VDC Ice Cube relays and bases to be installed at door operators (i.e. barrier free doors, sliding doors, and gate operators).
- 3.1.5. Make conduit and wiring connections to door hardware devices provided and installed under Section 08 71 00. Power for all security devices, including door strikes and field relays, must be supplied from the security panel. Electronic hardware other than electric strikes will require a separate power supply designed for the hardware intended and supplied by the door hardware supplier. Power supply to be mounted on the secure side of the door and easily accessible. A 12VDC relay controlled by the card access system to be installed inside the power supply to activate function.
- 3.1.6. Security System Wiring and Conduit:
  - 3.1.6.1. Install all security wiring, including wiring on security backboard, in conduit.
  - 3.1.6.2. Composite cable and “Banana” cables not permitted, refer to cable schedule provided by consultant for requirements.
  - 3.1.6.3. Install security conduit on secure side of the wall.
  - 3.1.6.4. Provide minimum 21 mm conduit home-runs from field devices to security panel.
  - 3.1.6.5. Provide minimum 27 mm conduit home-runs from card reader equipped doors to security panel.
  - 3.1.6.6. Do not splice wiring between field devices and security panel.
  - 3.1.6.7. Mechanically label all wiring with the field device number at both the device and panel ends. Record field device number on record drawings.
- 3.1.7. Security Backboard:
  - 3.1.7.1. Plywood or pre manufactured Backboard: 1219 mm x 2438 mm x 19 mm G1S plywood backboard, painted grey with fire retardant paint or equivalent pre manufactured fire rated plywood board. Mount at 305 mm above finished floor.
  - 3.1.7.2. Gutter Box: A 1219 mm wide x 254 mm high x 203 mm deep gutter box, with internal metal backpan. Mount horizontally on backboard, [305 mm from the top,] hinged side on bottom.

- 3.1.7.3. Provide #6 insulated ground wire from [communications room] ground bus to security backboard and bond equipment.
  - 3.1.7.4. Install all conduits from field devices to the [top] and to the back of the gutter box. Run all field wiring to security backboard through the gutter.
  - 3.1.7.5. Provide two(2) individual dedicated 15A/120V circuits(emergency circuits are preferred when available), one for the power supply and one for the convenience duplex receptacle.
  - 3.1.7.6. Provide tamper contacts on the gutter and relay boxes, and wire to the IStar control panel.
  - 3.1.7.7. Do not install equipment not specified in this section on the security backboard.
  - 3.1.7.8. Refer to the standard backboard wiring diagrams at the end of this specification. These diagrams are provided for reference and do not represent specific project requirements.
- 3.1.8. Security Panels:
- 3.1.8.1. Provide expansion modules for card readers, inputs, and outputs based on the number of devices indicated on drawings and [25 percent] future capacity.
  - 3.1.8.2. To be installed in LifeSafety E8S enclosure or equivalent Software House ULC approved enclosure.
  - 3.1.8.3. Provide two(2) Cat [5e] [6] structured wiring cables in conduit between nearest City network rack and each IStar control panel. All cabling to be completed by Division 27 contractor.
  - 3.1.8.4. Provide connection between security control panel and building systems requiring remote annunciation:
    - .1 [BMS.]
    - .2 [Gas Detection.]
    - .3 [\_\_\_\_\_.]
  - 3.1.8.5. Do not monitor fire alarm system through security control panel. Refer to Section [\_\_\_\_\_] for fire alarm dialer specification.
- 3.1.9. Field Devices:
- 3.1.9.1. Card Access Doors:
    - .1 Mount card reader on non-hinged side of door at 1320 mm above finished floor, or as shown on drawings. Use single gang, vertically mounted device box.
    - .2 Where wire distance between card reader and security backboard exceeds 125 m, [\_\_\_\_\_]
    - .3 Mount request-to-exit sensor 300 mm above center of door, or as recommended by manufacturer. Adjust sensor for optimum coverage.
    - .4 Conceal door contacts in door frame. Mount on top of door, or non-hinged side, approximately 75 mm from edge.
    - .5 Fire-rated doors: Provide doors with pre-drilled hole for contact. Field-drilling fire-rated doors will not be accepted.

.6 Arming Readers: Provide 2-gang device box.

3.1.9.2. Intrusion Detection:

.1 Mount devices at elevation and spacing indicated on drawing and calibrate based on installation conditions. Confirm device quantities and locations for optimum coverage prior to installation.

3.1.9.3. Specialty Doors:

.1 [\_\_\_\_\_.]

### 3.2. System Programming

3.2.1. Programming MUST be completed Software House certified personnel with pre-approved access to the City's C-Cure 9000 system. All points are to report to monitoring through CCURE 9000.

3.2.2. Installer to program security system leaving the default CSID and installer code.

### 3.3. Field Quality Control

3.3.1. Intent

3.3.1.1. Arrange and pay for security system testing. Confirm system programming and operation, field device operation and calibration, alarms, and annunciation. Record all results.

3.3.1.2. If test results do not conform with applicable requirements, repair, replace, or adjust equipment. Repeat testing as necessary until acceptable results are achieved.

3.3.1.3. Provide all labor, materials, instruments and equipment necessary to perform the tests specified.

3.3.1.4. All tests are to be witnessed and approved by the City or City's designate.

3.3.1.5. Do not perform security system testing before IT network is configured and building communication service is established.

3.3.2. Reports

3.3.2.1. Log and tabulate test results on appropriate test report forms.

3.3.2.2. Submit completed test report forms for inclusion in Operations and Maintenance Manual.

3.3.3. Security System Testing Procedure

3.3.3.1. Verify and inspect installation of Card Access controller panel.

3.3.3.2. Verify and inspect DC power supplies. Record DC volts output of supply(s) and batteries.

3.3.3.3. Inspect and record all installed card access door components.

3.3.3.4. Verify and record operation of all card access doors:

- .1 Admit Entry.
- .2 Exit (Request-to-exit).
- .3 Forced open/held.
- .4 LED operation.

- .5 Door Latch Release (DLR) operation.
- .6 Provide copy of report to Project Manager for review and approval.
- 3.3.3.5. Inspect and record non-card access door components.
- 3.3.3.6. Verify alarm operation.
- 3.3.3.7. Verify strike operation.
- 3.3.3.8. Verify scheduled unlock operations.
- 3.3.3.9. Verify programmed event operations:
  - .1 Sirens.
  - .2 LEDs.
  - .3 Unlock schedules.
  - .4 [Relay outputs.]
- 3.3.3.10. Verify remote monitoring station alarms.
- 3.3.3.11. Verify remote monitoring station operations:
  - .1 Lock-unlock (if applicable).
- 3.3.3.12. Verify and record operation of all additional intrusion devices: Motion sensors, glass break sensors, device tampers, panel tamper.
- 3.3.3.13. Verify and record operation of all building alarm devices annunciated through the security system: Temperature sensors, BMS interconnection.
- 3.3.3.14. Verify security panel communication fail alarm.

### **3.4. Closeout Activities**

- 3.4.1. Demonstrate Security System operation. Refer to Section 01 79 00 – Demonstration and Training.





# **APPENDIX C3 - SECURITY SPECIFICATIONS TEMPLATE NON-CARD ACCESS (SPEC SECTION 28 13 00)**

## **1. General**

### **1.1. Related Sections**

- 1.1.1. Section 08 71 00 – Door Hardware – General.
- 1.1.2. Section 26 05 21 – Wires and Cables.
- 1.1.3. Section 27 10 05 - Structured Cabling for Communications Systems.

### **1.2. SYSTEM DESCRIPTION**

- 1.2.1. Security System: Protect building perimeter by means of door contacts and glass-break detectors.
- 1.2.2. Detect unauthorized movement within building using motion sensors.
  - 1.2.2.1. System Arming: By [arming keypad].
  - 1.2.2.2. Refer to the Partition Zone Schedule on drawings.
  - 1.2.2.3. Signaling: By local siren(s) and remote annunciation to City monitoring facility.

### **1.3. SUBMITTALS**

- 1.3.1. Refer to Section 01 33 00: Submittal Procedures.
- 1.3.2. Product Data: Provide electrical characteristics and connection requirements.
- 1.3.3. Shop Drawings: Provide system wiring diagram showing each device and wiring connection required.

### **1.4. Closeout Submittals**

- 1.4.1. Refer to Section 01 78 10: Closeout Submittals.
- 1.4.2. Test Reports: Indicate satisfactory completion of required tests and inspections.
- 1.4.3. Record Documents: Record actual locations of Security equipment. Record field device number designation.

### **1.5. Quality Assurance**

- 1.5.1. Installer Qualifications: Certified to purchase, install and program Honeywell Ademco Vista or approved equal.

## **2. Products**

### **2.1. Manufacturers**

- 2.1.1. Honeywell or approved equal

### **2.2. Control Panels**

- 2.2.1. Honeywell Ademco Vista (model 128 BPT or higher):
  - 2.2.1.1. Nine style B hardwired zones, with support for up to 119 additional zones and 127 wireless zones.
  - 2.2.1.2. 150 user codes with seven authority levels

- 2.2.1.3. Logging for 512 events.
- 2.2.1.4. 96 programmable outputs
- 2.2.2. Power Supply:
  - 2.2.2.1. 115VAC input, 12VDC 10A output. Coordinate ULC approved device with Door Hardware prior to supply/install.
  - 2.2.2.2. Filtered and electronically regulated outputs.
  - 2.2.2.3. Short circuit and thermal overload protection.
  - 2.2.2.4. Battery backup: Two 12VDC 7AH Batteries
  - 2.2.2.5. LED indication of AC input and DC output.
  - 2.2.2.6. Four (4) class 2 limited fused or PTC outputs.
  - 2.2.2.7. Lifesafety Flex or ULC approved equal

## 2.3. Input Devices

- 2.3.1. Arm/Disarm Keypads
  - 2.3.1.1. .Alpha numeric 32 character display keypad.
  - 2.3.1.2. Honeywell 6160 or approved equal.
- 2.3.2. Door and Window Contacts
  - 2.3.2.1. Closed loop type.
  - 2.3.2.2. Wide gap 19 mm (3/4") or 23 mm (7/8") diameter recessed mount: GE 1078C or approved equal.
  - 2.3.2.3. Surface mount: GRI 29AWGW or approved equal.
  - 2.3.2.4. Surface mount with armoured cable: GRI 4460A or approved equal.
  - 2.3.2.5. Overhead door rail mount: Sentrol SR-2325AL or approved equal.
  - 2.3.2.6. Overhead door floor mount: Amseco AS-ODC-59A or approved equal.
- 2.3.3. Motion Sensors
  - 2.3.3.1. Dual technology: PIR, Microwave.
  - 2.3.3.2. Form C output.
  - 2.3.3.3. Cover tamper.
  - 2.3.3.4. Animal immunity.
  - 2.3.3.5. Fluorescent light interference filter.
  - 2.3.3.6. 12VDC I/P voltage.
  - 2.3.3.7. Optics for long, medium or curtain applications, as required.
  - 2.3.3.8. Bosch ISC-CDL-W15G or approved equal.
- 2.3.4. Glass Break Sensors
  - 2.3.4.1. Form C output.
  - 2.3.4.2. Cover tamper.
  - 2.3.4.3. Omni-directional microphone.

- 2.3.4.4. RF Immunity.
- 2.3.4.5. 12VDC I/P voltage.
- 2.3.4.6. GE Shatter Pro3 5815NT or approved equal.
- 2.3.4.7. Closed loop type.
- 2.3.5. Panic Alarm (hard wired)
  - 2.3.5.1. Lever type
  - 2.3.5.2. Normally closed
  - 2.3.5.3. Sentrol 3045 (w/ panic switch) or approved equal
- 2.3.6. Wireless Panic Alarm
  - 2.3.6.1. Pendant single button activation
  - 2.3.6.2. Inovonics EN4204R or higher as needed or approved equal
  - 2.3.6.3. 12VDC I/P voltage
- 2.3.7. Low Temperature Sensors
  - 2.3.7.1. 40 degrees Fahrenheit (4.4 degrees Celsius)
  - 2.3.7.2. Normally closed, opens at 40 degrees Fahrenheit (4.4 degrees Celsius)
  - 2.3.7.3. Temp Alert TA-40 or approved equal

## **2.4. OUTPUT DEVICES**

- 2.4.1. Sirens
  - 2.4.1.1. 12VDC.
  - 2.4.1.2. [100dB at 1.0 m.]
  - 2.4.1.3. Honeywell Wave 2 or approved equal.

## **3. Execution**

### **3.1. Installation**

- 3.1.1. Install to manufacturer's instructions and this specification.
- 3.1.2. Make conduit and wiring connections to door hardware devices provided and installed under Section 08 71 00.
- 3.1.3. All security devices shall be in a separate conduit system from device to panel from all other electrical systems (fire alarm, lighting, IT, etc). Similar security devices may be combined in the same conduit for example door contacts, glass break, motion detectors, keypads, etc.
- 3.1.4. There shall be no splices between the security control panel and the end security devices.
- 3.1.5. All materials supplied must be new and approved for their intended use.
- 3.1.6. For retrofit and renovation work, open wiring installed within existing wall cavities will be considered as acceptable, subject to all authorities listed below.
- 3.1.7. Flexible conduit may be used for device drops on T-Bar ceilings.
- 3.1.8. Installation of any holes through the building roofing materials must be coordinated through a roofer

designated by the City. All roof penetrations need to meet the requirements listed in [Section - Roofs](#).

- 3.1.9. Upon completion of the work all penetrations in building surfaces must be properly sealed, prepared and primed ready for finish paint.
- 3.1.10. The contractor must implement good housekeeping practices and provide a safe work environment for all employees at the work site.
- 3.1.11. An approved electrical inspection authority permit number is required for all electrical work completed and must be submitted to Facility and Landscape Infrastructure.
- 3.1.12. Security System Wiring and Conduit:
  - 3.1.12.1. Install all security wiring, including wiring on security backboard, in conduit.
  - 3.1.12.2. Install security conduit on secure side of the wall.
  - 3.1.12.3. Conduit to be sized at 40% fill to allow for future expansion.
  - 3.1.12.4. Conduit runs to be concealed as best as possible.
  - 3.1.12.5. Provide minimum 21mm conduit home runs from field devices to security panel.
  - 3.1.12.6. Do not splice wiring between field devices and security panel.
  - 3.1.12.7. Mechanically label all wiring with the field device number at both the device and panel ends. Record field device number on record drawings.
- 3.1.13. Security Backboard:
  - 3.1.13.1. Plywood or pre manufactured Backboard: 1219 mm x 2438 mm x 19 mm G1S plywood backboard, painted grey with fire retardant paint or equivalent pre manufactured fire rated plywood board. Mount at 305 mm above finished floor.
  - 3.1.13.2. Gutter Box: A 1219 mm wide x 254 mm high x 203 mm deep hinged bottom, lockable gutter box, with internal metal backpan. Mount horizontally on backboard, [305mm from the top,] hinged side on bottom.
  - 3.1.13.3. Provide insulated bond wire from [communications room] ground bus to security backboard and bond equipment.
  - 3.1.13.4. Provide two(2) individual dedicated 15A/120V circuits(emergency circuits are preferred when available) for panel and to duplex receptacle (located adjacent to each intrusion detection alarm panel).
  - 3.1.13.5. Do not install equipment not specified in this section on the security backboard.
- 3.1.14. Security Panels:
  - 3.1.14.1. Provide expansion module inputs, and outputs based on the number of devices indicated on drawings and [25 percent] future capacity. Output expansion modules may be required if strobes, LED indicators or additional sirens are used. Expansion modules to be installed at the panel in a separate lockable cabinet unless otherwise specified.
  - 3.1.14.2. Security Control Panel area requires a minimum of 1 m of clearance in front of the cabinets.
  - 3.1.14.3. Provide one (1) Cat [5e] [6] structured wiring cable in 21 mm conduit between nearest telephone

board and Security Control Panel backboard. All cabling to be completed by Division 27 contractor.

- 3.1.14.4. Provide two (2) 3P #22 in 21mm conduit between Security Control Panel and BMS panel.
- 3.1.14.5. Provide connection between security control panel and building systems requiring remote annunciation:
  - .1 [BMS.]
  - .2 [Gas Detection.]
  - .3 [\_\_\_\_\_.]
- 3.1.14.6. Do not monitor fire alarm system through security control panel. Refer to Section [\_\_\_\_\_] for fire alarm dialer specification.
- 3.1.15. Field Devices:
  - 3.1.15.1. Motion Sensors
    - .1 Wall mounted motion sensor conduits and wiring shall terminate in a standard single gang device box vertically mounted, a minimum of 300 mm below finished ceiling with a max. height of 2440 mm above finished floor. Locate all devices where they can be easily accessed for maintenance.
    - .2 Ceiling mount 360 motion sensor conduits and wiring shall terminate in a ceiling mounted octagon device box and located as marked on the drawings. Device boxes must be securely mounted using T-Bar support bracket.
  - 3.1.15.2. Glass Break Sensors
    - .1 Conduits and wiring shall terminate in a standard, single gang device box, within 1828 mm (6'), of the window being monitored; preferably on the ceiling or facing window as per the manufacturer's instructions. Devices boxes must be securely mounted using T-Bar support bracket.
    - .2 One (1) glass break device shall be placed every 6096 mm (20') along exterior glass walls or as identified on drawings.
  - 3.1.15.3. Door Contacts
    - .1 Conduit and wiring to be installed on the top of door, non-hinged secure side of door, three inches from the outside edge of the non-hinged side of door frame. Install one (1) deep 100 mm x 100 mm box face down on top of frame approx. 75 mm from edge of frame of center of box if frame is going into block wall and is not pre-prepped.
    - .2 Conduit to be concealed within wall and wiring to contact location to be concealed within door frame.
    - .3 Where not possible to conceal conduits and wiring, terminate conduit and wiring in a standard single gang electrical device box, surface mount horizontally on the top of the non-hinged side of the door frame approx.. 75 mm from edge.
    - .4 Surface mount contacts may be used if recessing is not possible.
    - .5 Double doors, the two contacts shall be wired in series.

3.1.15.4. Arming Keypad

- .1 Provide 2-gang device box and locate near the main staff entry or as indicated on drawings. Mounting height to be 1400 mm above finished floor. Keypad to have LCD display

3.1.15.5. Intrusion Detection:

- .1 Mount devices at elevation and spacing indicated on drawing and calibrate based on installation conditions. Confirm device quantities and locations for optimum coverage prior to installation.

3.1.15.6. Specialty Overhead/Rolling Shutter Doors:

- .1 Overhead Doors:
  - .1 Overhead door contact conduit and wiring to terminate in a vertically mounted surface or flush device box, 300 mm above finished grade, within 300 mm of the overhead door track. On the non-chain side of door. Depending on the type of door a rail mount or floor mounted contact is required.
  - .2 Roll up type doors will require a floor mounted contact.

.2 [\_\_\_\_\_.]

3.1.15.7. End of Line Resistors:

- .1 All alarm inputs must have a supervisory resistor installed as per the manufacturer's equipment.

**3.2. System Programming**

- 3.2.1. System programming must be coordinated with Facility Infrastructure Delivery. Notify appropriate City Corporate Security [2 weeks] prior to programming to arrange for access.

**3.3. Field Quality Control**

3.3.1. Intent

- 3.3.1.1. Arrange and pay for security system testing. Confirm system programming and operation, field device operation and calibration, alarms, and annunciation. Record all results.
- 3.3.1.2. If test results do not conform with applicable requirements, repair, replace, or adjust equipment. Repeat testing as necessary until acceptable results are achieved.
- 3.3.1.3. Provide all labor, materials, instruments and equipment necessary to perform the tests specified.
- 3.3.1.4. All tests are to be witnessed and approved by the City or City's designate.

3.3.2. Reports

- 3.3.2.1. Log and tabulate test results on appropriate test report forms.
- 3.3.2.2. Submit completed test report forms for inclusion in Operations and Maintenance Manual.
- 3.3.2.3. Provide Red Line drawings of the complete security system layout.
- 3.3.2.4. Provide Report to Project Manager For review and approval.



### 3.3.3. Security System Testing Procedure

- 3.3.3.1. Verify and inspect installation of security panel.
- 3.3.3.2. Verify and inspect DC power supplies. Record DC volts output of supply(s) and batteries.
- 3.3.3.3. Inspect and record all installed components.
- 3.3.3.4. Verify and record operation of all devices:
- 3.3.3.5. Verify alarm operation.
- 3.3.3.6. Verify Alarm Signaling:
  - .1 Sirens.
  - .2 LEDs/Strobes
- 3.3.3.7. Verify remote monitoring station alarms.
- 3.3.3.8. Verify and record operation of all additional intrusion devices: Motion sensors, glass break sensors, device tampers, panel tamper.
- 3.3.3.9. Verify and record operation of all building alarm devices annunciated through the security system: Temperature sensors, BMS interconnection.

## 3.4. CLOSEOUT ACTIVITIES

- 3.4.1. Demonstrate Security System operation. Refer to Section 01 79 00 – Demonstration and Training.



## **APPENDIX D - VIDEO SURVEILLANCE SYSTEM DESIGN GUIDELINES**

## 1. GENERAL

### 1.1. Overview

- 1.1.1. This guideline is to be used in conjunction with project program requirements to design a Video Surveillance System that meets the needs of the facility and is compatible with the City of Edmonton's requirements.
- 1.1.2. This guideline assumes a new digital IP-based Video Surveillance System is being installed. When working in a facility with an existing Video Surveillance System, consult with the Project Manager.

### 1.2. References

- 1.2.1. "Safety Audit Guide for Crime Prevention", City of Edmonton, Jan 2000. This document can be found on the City of Edmonton website.
- 1.2.2. CSA C22.1, Canadian Electrical Code, Part 1

### 1.3. Responsibilities of the Prime Consultant

- 1.3.1. Incorporate the requirements described in the Functional Security Program, provided by the City.
- 1.3.2. Incorporate Crime Prevention through Environmental Design (CPTED) principles in design.
- 1.3.3. Consider video surveillance when determining site layout, sightlines, interior & exterior lighting, landscaping, program relationships, etc. Effective video surveillance system design will seek to minimize the amount of video surveillance devices needed through the use of coordinated design.
- 1.3.4. Where video surveillance equipment is used:
  - 1.3.4.1. Specify and locate all cameras, wiring and head-end equipment.
  - 1.3.4.2. Coordinate video surveillance design across disciplines, including architecture, landscape design, and electrical.
  - 1.3.4.3. Prepare the video surveillance system drawings and specifications, and perform contract administration relating to the video surveillance system.
- 1.3.5. Structured wiring cables (CAT6 or Fibre) to be supplied, installed and tested by Division 27 cabling contractor as per the [Appendix B - IT Infrastructure Design Guidelines](#).

### 1.4. Submission Requirements:

- 1.4.1. All progress review submissions are to include video surveillance system information.
  - 1.4.1.1. Refer to the Professional Service Agreement and the latest edition of "Consultant Manual Volume 1, Design Process and Guidelines" for a complete list of submission requirements.
  - 1.4.1.2. If a submission is not sufficiently detailed to review, it will be returned for resubmission.

## 2. TECHNICAL

### 2.1. System Architecture

- 2.1.1. The system architecture consists of various cameras, each of which are connected via dedicated home run data cables (Cat-6 or fiber optic) to termination/patch panels in the nearest IT network rack located in a secure Network Access Room (NAR). The Video Surveillance recording equipment shall be located in a separate wall mounted lockable equipment rack as per Corporate Security directive A1435.

### 2.2. Raceway/Cable Infrastructure

- 2.2.1. Contractor shall provide all raceway infrastructures necessary for a complete and fully functioning IP Video Surveillance System.
- 2.2.2. Dedicated raceway required and shall be continuous from Head-end equipment rack to field end devices. Ensure compliance where cameras are mounted to light poles or other equipment that may have both line and low voltage.
- 2.2.3. Minimum 21 mm trade size conduit shall be used for Cat-6.
- 2.2.4. Minimum 27 mm trade size conduit shall be used for Fiber.
- 2.2.5. Accepted raceways are EMT, flexible metal conduit, metal liquid tight and rigid conduit. Poly based forms of raceways such as rigid PVC may only be used underground.
- 2.2.6. All boxes and fittings shall adhere to minimum cable bend radius specifications.
- 2.2.7. PVC bushings are to be used on all connectors
- 2.2.8. The use of LB, LL or LR conduit fittings are prohibited.
- 2.2.9. Cable fill standards shall comply with the Canadian Electrical Code
- 2.2.10. Provide a minimum of 1 meter extra cable at all camera locations and minimum of 3 meters extra cable at all rack locations.
- 2.2.11. Provide a minimum of three (3) Cat-6 network drops between the head-end equipment rack and the nearest City domain network switch.
- 2.2.12. Wire and conduit is to be concealed where possible. Where conduit is exposed, it should be run in non-public secure areas where possible.
- 2.2.13. All cables are to be labeled at both ends using permanent mechanical labels. Cables to cameras are to use the format xx-yy, where xx is the floor number and yy is the camera number. This unique label number is to appear next to each camera on the record drawings.

### 2.3. Cable

- 2.3.1. Refer to the [Appendix B - IT Infrastructure Design Guidelines](#) for camera cabling requirements

### 2.4. Termination/Certification

- 2.4.1. Network lines at cameras are to be terminated with approved RJ-45 modular plug (Crystal), such as

Paladin PA-9655. NOTE: Platinum Tools EZ-RJ45 modular plugs are NOT approved for use.

- 2.4.2. Camera jacks at Network head end equipment are to be terminated using standard TIA/EIA T568A with Category 6 Yellow jacks such as the Hubbell HXJ6Y or approved equal.
- 2.4.3. Certification of Cat-6 lines to be done with an approved Network Certifier such as the Fluke DTX-1800, and all certification reports to be included in O&M Manuals (Note: Partial Pass test results will not be accepted).
- 2.4.4. Fiber to be terminated in Fiber Trays with LC Duplex Connectors.
- 2.4.5. Certification of Fiber lines to be done with an approved Network Certifier such as the Fluke DTX-1800, and all certification reports to be included in Operations and Maintenance Manuals.

## 2.5. Head End Equipment

- 2.5.1. All equipment to be mounted to a 1219 mm x 2438 mm x 19 mm G1S plywood backboard, painted grey with fire retardant paint or equivalent pre manufactured fire rated plywood board mounted at 305mm above finished floor.
- 2.5.2. Field conduits are to terminate at the City network rack.
- 2.5.3. Ensure that gutter door opens down and is supplied with ventilation slots and a lockable door .
- 2.5.4. Equipment rack requires one 120V/20 Amp dedicated circuit, provide a 120V, 20A 5-20R "T-Slot" duplex receptacle in a surface mount device box positioned at the bottom right corner of the racks interior.
- 2.5.5. Provide one #6 bonding conductor from Video Surveillance Rack to electrical system ground buss as per CEC.

## 2.6. Camera Mounting

- 2.6.1. Electrical Box Mount – 2 Gang and 100 mm x 100 mm electrical box mounting is acceptable.
- 2.6.2. Hanging Cameras - Minimum 21 mm grade size rigid metal conduit. Mounted on approved box only (Example: MOOG CA15) with explicit approval from City Corporate Security
- 2.6.3. Exterior Pendant Mount Cameras – Cameras to be hung from factory pendant mounts.
- 2.6.4. Exterior Surface Wall Mount - Require 21 mm liquid tight flex with 27 mm slack through wall and factory weather shield.
- 2.6.5. T-Bar Ceiling Mount - Require a 100 mm x 100 mm Box and T-Bar support bracket.
- 2.6.6. Pole Mount - Refer to Section Exterior Lighting.

## 2.7. Equipment Specifications

### 2.7.1. Camera Rack Equipment

#### 2.7.1.1. Large Equipment Rack

- .1 Rack: wall mount 12U minimum rack with 813 mm depth. Middle Atlantic DWR-18-32 or approved equal. If larger racks are required, floor mount rack models can be provided upon request, please contact City Engineering Services and PRT.

2.7.1.2. Fans: 2 x 50 CFM, 30dBA, 114mm per Rack. Middle Atlantic QFAN or approved equal.

## 2.7.2. UPS Equipment

2.7.2.1. Rackmount 1U 1kVA Line Interactive Sine Wave UPS. Tripp Lite SMART1500RM1U or approved equal.

## 2.7.3. Video Surveillance System Recording Equipment

2.7.3.1. Rack mountable in a standard 482 mm rack mounting frame

2.7.3.2. Linux Operating System.

2.7.3.3. Video Recording Devices shall record IP based video streams. The number of video streams managed and recorded by a server shall be determined in accordance with the selected manufacturers' recommendations.

2.7.3.4. Storage capacity is to meet a minimum retention requirement of 21 days or as specified by Corporate Security.

2.7.3.5. Appliance to be licensed through ExacqVision for a duration of 6 years.

2.7.3.6. Hardware must have a three year manufacturer warranty on parts and labor.

2.7.3.7. ExacqVision Pro VMS with Enterprise License or approved equal.

## 2.7.4. Cameras

### 2.7.4.1. Fixed Dome Camera

- .1 The camera input power shall be Power over Ethernet (PoE) (IEEE 802.3af/IEEE 802.3at compliant, Class 3).
- .2 Cameras shall have a composite analog MONITOR output in addition to streaming video via Ethernet. The composite analog video output can be used for monitoring while installing the camera to adjust the field of view and focus.
- .3 Cameras shall have an Easy Focus function, which adjusts the camera focus by using the Easy Focus button on the camera unit or remotely via the GUI. When the camera is switched between day and night modes, the Easy Focus function is automatically activated to keep the camera focused.
- .4 Shall also have a zoom/focus adjustment capability via the ZOOM/FOCUS switch on the camera unit or remotely via the GUI.
- .5 Simultaneously encoding up to 3 of the following streams in any combination, including multiple instances of the same compression format: JPEG and/or H.264 (High/Main/Baseline Profile)
- .6 IP66-rated waterproof and dust-tight feature: The camera shall be IP66 rated in accordance with the IEC 605292 standard for outdoor surveillance, or indoor where water ingress may pose an issue.
- .7 IK10-rated vandal-resistant feature: The camera shall be IK10 rated in accordance with the IEC 62262 standard to vandal-resistant feature for protecting the camera from destructive behaviors.

- .8 The camera shall utilize a 1/2.8-type progressive scan Exmor CMOS sensor.
- .9 The camera shall have an equivalent Forensic 120 dB wide dynamic range capability.
- .10 The video signal-to-noise ratio shall be more than 50 dB (Auto gain control maximum rate 0 dB).
- .11 The electronic shutter speed shall be set from 2 to 1/65,500 second.
- .12 The camera shall have an integrated 3X IR compensated DC auto-iris type Varifocal lens as a standard equipment.
- .13 The ranges (typical) shall be: Pan: 360°, Tilt: -80° to +80°, Rotate: -175° to +175°.
- .14 The focal length shall be 9mm to 22mm with horizontal field of view coverage of 105° to 36°.
- .15 The aperture range for the lens (F number) shall be F 1.3 (Wide) to F 1.6 (Tele).
- .16 The camera operating temperature shall be within the following range:
  - .1 Indoor Application: -14 °F to +122 °F (-10 °C to +50 °C)
  - .2 Outdoor Application: -58 °F to +140 °F (-50 °C to +60 °C)
- .17 Cold start temperature must be greater than:
  - .1 -40 °F (-40 °C).
- .18 Axis Q3536-LV/Axis Q3536-LVE or approved equal

2.7.4.2. 360 Degree Dome Camera

- .1 The camera input power shall be a power voltage of IEEE 802.3af/802.3 at Type 1 Class 3 Typical 738W, Max 12.95W compliant (PoE system), DC 12V ± 10%.
- .2 IP66-rated waterproof and dust-tight feature: The camera shall be IP66 rated in accordance with the IEC 605292 standard for outdoor surveillance or indoor where water ingress may pose an issue.
- .3 IK10-rated vandal-resistant feature: The camera shall be IK10 rated in accordance with the IEC 62262 standard to vandal-resistant feature for protecting the camera from destructive behaviors.
- .4 The camera shall utilize a 1/1.7"-type progressive scan RGB CMOS sensor.
- .5 The number of effective pixels shall be approx. 12 Megapixels.
- .6 The camera shall have up to 120 dB wide dynamic range capability.
- .7 The electronic shutter speed shall be set from 2 to 1/22,500 second.
- .8 The viewing angle shall be: Horizontal: 181°. Vertical: 181°.
- .9 The focal length shall be 1.3 mm
- .10 The aperture range for the lens (F number) shall be F 2.2.
- .11 The camera operating temperature shall be within the following range:



- .1 -40 °F to +122 °F (-40 °C to +50 °C)
- .12 Cold start temperature must be greater than:
  - .1 -40 °F (-40 °C)
- .13 Axis M4318-PLVE or approved equal
- .14 All other Cameras to be approved by City prior to use.
- .15 Recording Appliance Settings and Camera Settings are to be configured to Building Facility Maintenance requirements.

2.7.4.3. Pan, Tilt, Zoom Camera

- .1 The camera input power shall be Power over Ethernet (PoE) (IEEE 802.3af compliant, Class 0) or Power over Ethernet + (PoE+) (IEEE 802.3at compliant, Class 4).
- .2 Cameras shall have a composite analog MONITOR output in addition to streaming video via Ethernet. The composite analog video output can be used for monitoring while installing the camera to adjust the field of view and focus.
- .3 The camera shall utilize a 1/2.8-type progressive scan CMOS sensor.
- .4 The number of effective pixels shall be approx. 2.38 Megapixels.
- .5 The camera shall have an equivalent 120 dB wide dynamic range capability.
- .6 The electronic shutter speed shall be set from 2 to 1/66,500 second.
- .7 The camera shall be capable of 360° endless pan rotation.
- .8 The focal length shall be 4.3 mm to 137.6 mm with horizontal field of view coverage of 58.3° to 2.4° and a vertical field of view coverage of 34.9° to 1.3°
- .9 The aperture range for the lens (F number) shall be F 1.4 (Wide) to F 4.0 (Tele).
- .10 IP66-rated waterproof and dust-tight feature: The camera shall be IP66 rated in accordance with the IEC 605292 standard for outdoor surveillance, or indoor where water ingress may pose an issue.
- .11 IK10-rated vandal-resistant feature: The camera shall be IK10 rated in accordance with the IEC 62262 standard to vandal-resistant feature for protecting the camera from destructive behaviors.
- .12 Streams in any combination, including multiple instances of the same compression format: JPEG and/or H.264 (MPEG-4 Part 10/AVC) and/or H.265 (MPEG-H Part 2/HEVC)
- .13 The camera operating temperature shall be within the following range:
  - .1 -22°F to +122°F (-30°C to +50°C) (30W)
  - .2 -58°F to +122°F (-50°C to +50°C) (60W)
- .14 Cold start temperature must be greater than
  - .1 -40°F (-40°C) (AC 24 V)
- .15 Axis Q6135-LE or approved equal

.16 All other Cameras to be approved by City prior to use.

.17 Recording Appliance Settings and Camera Settings are to be configured to Building Facility Maintenance requirements.

## **2.8. Commissioning**

2.8.1. Commissioning of the entire system including all camera views to be completed in the presence of a Corporate Security Advisor

2.8.2. Report shall be provided to advisor, shall include but not limited to

2.8.2.1. All camera views,

2.8.2.2. Camera IP addresses,

2.8.2.3. Make and model of camera,

2.8.2.4. Confirmation of recording,

2.8.2.5. Minimum retention time,

2.8.2.6. NVR IP address,

2.8.2.7. UPS ip ADDRESS,

2.8.2.8. Make and model of NVR.,

2.8.2.9. Name of camera

2.8.3. Naming convention for all cameras to be:

2.8.3.1. DIRECTION - AREA - VIEW (ex: NW - ARENA - CORRIDOR)

2.8.3.2. NVR Server to be named by building I.D. (ex: TER101 - NVR SERVER)

## **2.9. Documentation and Training**

2.9.1. Documentation: A detailed report with the following information shall be provided to Project Manager in an acceptable electronic form.

2.9.1.1. Equipment Location

2.9.1.2. Equipment Type

2.9.1.3. Equipment Number

2.9.1.4. IP Address

2.9.1.5. MAC Address

2.9.1.6. Cable ID

2.9.1.7. Camera Screen Shot

2.9.2. Training

2.9.2.1. Training shall be provided to the end users.



## **APPENDIX E - ARC FLASH DESIGN GUIDELINES**

# 1. General

## 1.1. Overview

- 1.1.1. All electrical equipment installed in buildings maintained by the City of Edmonton must be labelled with an Arc Flash and Electrical Shock warning label. This document describes the consultant's responsibilities to ensure these requirements are met when designing a new or existing facility.
- 1.1.2. The technical information contained in this document is to be used as a guide only. The consultant is expected to follow his or her professional judgment as well as all applicable codes and regulations. When a deviation from these guidelines is either required or requested by the consultant or the City, it is to be documented in writing.

## 1.2. Approved softwares:

- 1.2.1. Studies are to be performed using ETAP or SKM software. There shall be no exception.
- 1.2.2. The latest software version shall be used when preparing said studies.

## 1.3. Consultant and City Interactions:

### 1.3.1. Responsibilities of the City of Edmonton

- 1.3.1.1. Provide these guidelines to the Prime Consultant prior to the start of design.
- 1.3.1.2. The assigned City of Edmonton Project Manager will be the primary point of contact, and will facilitate communication between the Prime Consultant and City, as required
- 1.3.1.3. Provide a point of contact for the site scheduled to be within the scope of the study. This contact will provide access to the site
- 1.3.1.4. Attend the study review meeting and coordinate with the consultant to validate the study trade fee proposed by the consultant
- 1.3.1.5. The city will not:
  - .1 Collect the study data on behalf of the consultant,
  - .2 Contact the utility provide on behalf of the consultant,
  - .3 Organise and supply the man power for the shut down required to inspect the distribution system of the site
  - .4 Supply the equipment to dowload relay setting files, or download the relay setting files. If available, the city will supply the files which are in the city's record, but the consultant will be responsible to compare said file to those present in the relays in active service,
  - .5 These responsibilities will be solely under the scope of the consultant

### 1.3.2. Responsibility of the Consultant

- 1.3.2.1. Consultant hired by the city of Emdonton to prepare a design package for any facilities will be mandated to update or create a short circuit, coordination and arc flash optimisation study for said facility.

1.3.2.2. When a pre existing study is available, the consultant in charge of doing an arc flash study shall revalidate all base data which formed the basis of this pre existing study. There shall be no exception to this condition. This includes, but is not limited to:

- .1 Utility data (to be confirmed by contacting the local utility provider) to request at least:
  - .1 The equivalent Thevenin model for the upstream network supplying power to the site falling within the scope of the study. Said equivalent model shall be provided as part of the deliverables and shall factor the minimum and maximum utility contribution levels if applicable for the site,
  - .2 The utility protective device located immediately upstream of the facility. This includes its type, model and settings,
- .2 All equipment nameplate data (transformers, motors, generators, etc...). For generators (alternators, solid state inverters), the consultant shall identify the short circuit capacity of said components, and their built in protective features (e.g.: genertor's governor built in overcurrent and overload protections, etc...
- .3 Cables length and type/size,
- .4 Protective device type, model, manufacturer and existing setting as found on site. This includes confirming the protective data characteristics published the the manufacturer (Time Current Characteristics or TCC, available setting range for adjustable units, interrupting capacity, etc...) and confirming the accuracy of the software libraries components used to prepare the study,

1.3.2.3. All studies (new and updated) shall cover 100% of a facility's electrical distribution system. **Partial study or partial study updates are not acceptable.**

## 1.4. Submission Requirements (Study Deliverables)

- 1.4.1. The Consultant responsible for the design of the electrical system (new or modification), or the consultant hired for the sole purpose of preparing a study is to prepare a Short Circuit, Coordination, and Arc Flash optimisation Study. Optimisation means:
  - 1.4.1.1. Proposing protective device setting adjustments to obtain the best achievable balance between low incident energy levels and a good protection device selectivity
  - 1.4.1.2. The operation requirements of a facility shall be reviewed with site personnel while collecting the data required for the study. Facilities with high uptime requirements shall not have their protective scheme discoordinated for the sole purpose of achieving low arc flash incident energy levels
  - 1.4.1.3. The consultant shall involve the city when tradeoffs are required (giving precedence to a good protective device coordination or to low arc flash incident energy levels). A meeting shall be organised to discuss the merit of the tradeoff when compared to the facility's uptime requirements
- 1.4.2. When a study is prepared as part of a new design, a facility refurbishment, or a facility modification project:
  - 1.4.2.1. A preliminary study is to be submitted prior to the issuance of the design document package

for construction tender:

- .1 This study will be reviewed to ensure equipment ratings are properly specified, proper coordination is possible, and the distribution is designed to minimize available incident energy as much practically achievable.
- .1 The study shall serve as the basis of the protective device scheme design & specification and identify if advanced protective device schemes are required to meet the energy target levels as listed below. This can include, but is not limited to specifying and designing protective systems with:
  - .1 Transformers or bus differential protection (IEEE 87)
  - .2 Using zone interlocking scheme or protection (ZIS or ZIP) features to establish simple yet highly selective communication network between upstream and downstream protective devices
  - .3 This includes the incorporation of mitigating techniques and technologies where high incident energy levels are anticipated. The target maximum incident energy level for all City facilities is 8 cal/cm<sup>2</sup>. 12 cal/cm<sup>2</sup> can be acceptable if the consultant demonstrates that the protection system is not capable of achieving the 8 cal/m<sup>2</sup>. Where the incident energy is greater than 8 cal/cm<sup>2</sup>, the Consultant is to include additional measures that mitigate the risk to Electrical Workers as per Z462.
  - .4 Prior to construction and equipment procurement:
    - .1 It is understood that some information affecting study results is not finalized (or in some cases known) prior to construction.
    - .2 Consultants are to use professional judgement to ensure preliminary assumptions are reasonable, and ensure high-risk assumptions and their consequences are explained to the City project manager.
- 1.4.2.2. Following completion of the shop drawing approval and commissioning of the system:
  - .1 A final study is to be submitted at the conclusion of the project. The computer model developed for the preliminary study is to be updated with as-built conditions, including Utility transformer data. Where final incident energy values differ substantially from the preliminary report (ie. higher incident energy) and exceeds 12 cal/cm<sup>2</sup>, provide an explanation and propose modifications to rectify the issue. Refer to Submission Requirements for Arc Flash Study format.
  - .2 The construction specifications are to indicate the Contractor's responsibility to provide as-built information necessary for the design Consultant to prepare the final study, and instructions to prepare and affix all labels. The final study is to indicate all information to be printed on each label. Refer to Arc Flash and Shock Label Requirements for format and content to be included on each label.
- 1.4.3. When a study is finalized and completed, the following deliverables shall be supplied to the city on a USB thumb drive of sufficient capacity:
  - 1.4.3.1. The full study report (PDF format). The report must include:

- .1 An executive summary presenting any issues which cannot be eliminated with the existing equipment and which require remediation due to resulting dangerous conditions,
  - .2 An introduction presenting all base data used to prepare the study and all assumptions, if any. This section shall discuss any applicable study and switching scenario if the facility is equipped with a complex distribution system with multiple power sources. Study scenario shall, factor normal, emergency and maintenance operating modes and shall be confirmed with site personnel.
  - .3 A section presenting and discussing the results of the short circuit study,
  - .4 A section presenting and discussing the results of the coordination study,
  - .5 A section presenting and discussing the results of the arc flash circuit study,
  - .6 A conclusion summarising the study findings and recommended setting adjustments, if any
  - .7 Appendices showing :
    - .1 The site's single line diagram, its software generated version as modelled in the study software. The software generated SLD shall provide a comprehensive overview of all characteristics programmed in the model (cables, transformers, protective devices, generators, motors, utility data) and includes notes as applicable regarding the applicable switching scenarios,
    - .2 the utility data supplied by the local utility supplier,
    - .3 Manufacturer's published protective device data including setting ranges and TCCs,
    - .4 Summary tables with as found and as recommended protective device settings,
    - .5 Arc flash result summary tables with as found and as recommended protective device settings for all study scenarios, and one master table summarizing the worst case study results used to prepare the arc flash labels. This last table shall clearly identify the applicable scenarios yielding the worst case results,
    - .6 All templates for the arc flash table to be posted on site,
- 1.4.3.2. The software generated model complete with all libraries files used to prepare the study (native file format of the software used to prepare the study):
- .1 The Preliminary and Final Arc Flash study and model are to be submitted to the City via file sharing system .
  - .2 The study engineer shall come on site and install the labels on equipment enclosures and interact with site personnel to provide explanations on the situations where the posted information shall be considered.

## **2. Study Methodology Basis: Minimum Requirements**

### **2.1. Applicable References Documents**

- 2.1.1. The consultant shall prepare its study using the latest edition of the following industry reference standards:



- 2.1.1.1. CSA-C22.1, Canadian Electrical Code (latest adopted edition)
- 2.1.1.2. CSA-Z462, Workplace Electrical Safety (latest published edition)
- 2.1.1.3. IEEE 1584, IEEE Guide for Performing Arc-Flash Hazard Calculations
- 2.1.1.4. IEEE 399 - IEEE Recommended Practice for Industrial and Commercial Power Systems Analysis (Brown Book)
- 2.1.1.5. When distributed energy resources are present at the site:
  - .1 IEEE 1547a Interconnecting Distributed Resources with Electric Power Systems and subsequent IEEE 1547 part 1, 2, 3, 4, 6, 7, and 8
  - .2 UL Subject 1741 SA and SB Standard for Inverters, Converters, Controllers and Interconnection System Equipment for Use with Distributed Energy Resources.
- 2.1.2. Additionally, all applicable rules of the Canadian electrical Code Part 1 (CEC C22.1) shall be factored in the study, especially for studies paired with design activities.

## 2.2. Study Criteria

- 2.2.1. The IEEE 1584 Incident Energy Method must be used for:
  - 2.2.1.1. New Sites:
    - .3 A new facility with a secondary utility voltage exceeding 240V, and with greater than 25KA short circuit current available; or,
    - .4 A new facility where there are long clearing times leading to available incident energy exceeding 8 cal/cm<sup>2</sup>; or,
  - 2.2.1.2. Existing Sites:
    - .1 An existing site where no arc flash study was prepared.
    - .2 An existing site where no arc flash study was prepared more than 5 years ago
    - .3 An existing site scheduled for a refurbishment or expansion and where Additions or renovations to an existing facility that has previously had an Arc Flash Study performed. The City will inform the consultant when this is the case and provide documentation and computer model of the existing distribution system, as/if available. When available, the existing model may be in either SKM or ETAP and shall be updated using same program or regenerated in the other; or,
    - .4 Addition or replacement of significant components of the electrical distribution within an existing facility that has not had an Arc Flash Study performed and that also has a secondary utility voltage exceeding 240V, and greater than 25KA short circuit current available; or, where there are extraordinarily long clearing times leading to available incident energy exceeding 8 cal/cm<sup>2</sup>.
- 2.2.2. A general Arc Flash Hazard label may be used in all other circumstances. Refer to the sample "Label Requirements" below for a complete description of all information to be printed on each label.

## 2.3. Electrode Configuration Choices

- 2.3.1. The study shall follow the IEEE 1584-2018 initiated changes related to the electrode configuration,
- 2.3.2. The study engineer shall visually confirm the configuration of the buswork by means of site inspection or by reviewing the equipment shop drawings, or by interacting with the equipment manufacturer,
- 2.3.3. The city acknowledges the added complexity resulting from this review and accepts conservative software generated model simplifications for distribution centers sporting more than one electrode configuration. For those distribution systems, calculations can be based on the electrode configuration resulting in the worst case incident energy levels. Producing labels for each compartment / cubicles / buckets sporting different electrode configurations is not perceived as desirable by the city due to the overwhelming level of information and the confusion this can generate with city operators.

**2.4. Line VS load side of main protection devices:**

- 2.4.1. The study engineer shall confirm if distribution centers main protective devices have their line and load side physically segregated or not. For those devices with confirmed barriers preventing arc flash plasma to bypass said protection devices, the calculated incident energy levels shall be calculated at both the line and the load / bus side of the device.
- 2.4.2. The study engineer shall carefully indicate where each label shall be placed on the equipment for those situations where a “load” and “line” side labels are provided. The labels shall include additional wording indicating their applicability.

### **3. Submission Requirements**

- 3.1. Short Circuit, Coordination and Arc Flash Study, is to follow the format described in the document, ‘Engineering Report Guidelines’, included as Appendix A of “City of Edmonton Consultant Manual Volume 1 – Design Process and Guidelines”.
- 3.2. As a minimum, include in the report the following information:
  - 3.2.1. Short Circuit/Fault Current Study:
    - 3.2.1.1. Maximum available short circuit current in amperes RMS symmetrical at each point of the electrical distribution system, including utility supply termination point, switchgear, MCC’s, and panelboards.
    - 3.2.1.2. Maximum fault conditions are to be determined by studying the distribution under normal (utility) and alternate power sources, and all possible switching configurations.
    - 3.2.1.3. Demonstrate that equipment and cables withstand the maximum short-circuit current for a time equivalent to the tripping time of the primary relay protection or tripping time of the fuse.
  - 3.2.2. Coordination Study:
    - 3.2.2.1. In tabular format, show settings for overcurrent protective devices. Indicate circuit breaker sensor rating, as well as long time, short time and instantaneous settings. Indicate ground-fault relay pickup and time delay settings. Indicate fuse current rating and type.
    - 3.2.2.2. Using Time Current Coordination Curves (TCC) for overcurrent protective devices, graphically illustrate that adequate time separation (Current Time Interval or CTI) exists between devices installed in series, **for all possible switching configurations and based**

**on all possible fault current range, from LL arcing fault to LLL bolted fault..**

- .5 Prepare separated TCC for phase and for ground fault protective elements. It is not acceptable to plot both ground and phase protective curves on the same TCC,
  - .6 Where applicable, separated TCC shall be plotted for both existing/as found and recommended protective device settings
- 3.2.3. Demonstrate that equipment and cables withstand the maximum short-circuit current for a time equivalent to the tripping time of the primary relay protection or tripping time of the fuse.
- 3.2.4. Arc Flash Study Optimization study:
- 3.2.4.1. The study shall be coordinated with the coordination study as described above. Arcing Current and Permissible Arc Flash Incident Energy Levels (AFIEL) shall be plotted on all TCC
  - 3.2.4.2. Calculate incident energy in calories per square centimeter (cal/cm<sup>2</sup>) with the as found settings and the settings recommended as art of the study
  - 3.2.4.3. Analyse scenarios for both minimum and maximum available fault contribution from the utility and determine which provides the highest available incident energy. Where only one fault level is published by the utility, assume +/-15% of that value for the maximum and minimum contribution.
  - 3.2.4.4. Where multiple sources exist (i.e. utility, generator), document and base calculations on the source that provides the highest possible incident energy. All possible system configuration shall be studied in separated study / switching scenarios and all results shall be submitted per scenario, and summarized (worst case scenarios).
  - 3.2.4.5. Prove 8 cal/cm<sup>2</sup> is not exceeded at any point in the distribution. In tabular format, indicate information to be printed on each piece of equipment. This will include incident energy, PPE level, flash hazard boundary, flash protection boundary, shock hazard boundaries (limited approach, restricted approach, prohibited approach), and study date. Refer to the Label Requirements section below for a complete description of all information to be printed on each label and samples.
  - 3.2.4.6. Provide a Single Line Diagram and include cal/cm<sup>2</sup> for all overcurrent devices on both the line and load side of all transformers, including the Utility transformer.

## 4. Special Considerations:

### 4.1. DC Systems

- 4.1.1. The presence of DC distribution systems shall form an integral part of the site's arc flash study scope. This includes but is not limited to:
  - 4.1.1.1. Battery Storage Systems (BSS),
  - 4.1.1.2. Photovoltaic Systems (PVS)DC collectors,,
  - 4.1.1.3. Other large energy storage devices such as battery bank paired with Uninterruptible Power Supplies and exceeding a running time of 15 min for a total output power exceeding 150kW,
  - 4.1.1.4. DC charger bank for Electric Vehicle (EV) charging system when used in bank and in

conjunction with complex and facility wide wiring system including retractable pantographs such as those used to charge the city of Edmonton electric bus fleet. For such a system, the study engineer shall carefully consider scenarios where the EV battery may also contribute to a DC arcing fault, if it is confirmed that the EV can allow a reverse power flow from its battery toward the DC charging system.

4.1.2. The study engineer shall carefully factor the different modes of operation of these complex systems including but not limited to seasonal sun irradiance changes, string VS optimize VS micro inverter based PV installations, battery state of charge, DC charger maximum possible output during short circuits, etc...as applicable.

**4.2. Use of the “two second rule” : Calculating Meaningful Results For Existing Systems**

4.2.1. The study engineer shall apply proper caution when choosing to make use of the two second rule for maximum fault clearing time. This rule shall not be used if:

4.2.1.1. A field site visit is achievable to confirm the characteristics of the distribution and protective scheme.

4.2.1.2. To achieve a more conservative and higher incident energy level results: Energy levels shall be based on confirmed protective device characteristics and fault contribution first and foremost.

4.2.1.3. If the study engineer can contact the equipment manufacturer to confirm the equipment’s characteristics.

4.2.2. This rule shall be applied for those parts of the system where the protection scheme’s total clearing time cannot be identified due to:

4.2.2.1. The inability of identifying a protective device tripping characteristics, or the inability to understand how a source will be interrupted as a result of a fault (arcing or bolted):

.1 The study engineer shall justify why the base data information could not be retrieved and clearly identify this fact in the study scenario

4.2.2.2. The presence of abnormally low arcing current resulting in protective device trip in their overload tripping band exceeding several seconds or minutes:

.1 In such scenario, the study engineer shall apply a judgement based on experience and practical considerations to avoid publishing abnormally high and questionable calculated incident energy levels

.2 If the abnormally low arcing current calculation results from study assumptions, the study engineer shall apply sound engineering judgement and revise his/her assumption(s) to achieve a meaningful result. If this is not possible, the study engineer shall clearly flag this problem as a study limitation including a proper justification explaining why no better result could be calculated.

4.2.3. When the use of the two second rule result in calculating very high energy level at low voltage system rated not more than 240Vac, the study engineer shall provide an interpretation of said result including but not limited to:

4.2.3.1. Accuracy of the result , and whether said result should be considered when choosing PPE.

4.2.3.2. Recommendation to use better estimation methods (other than IEEE 1584) such as the

Z462 tables.

#### **4.3. Use of the “two second rule”: Calculating Meaningful Results For New or Modified Systems**

4.3.1. The same conditions as those listed above for existing systems are applicable.

4.3.2. For existing sites:

4.3.2.1. The preliminary study shall be used to identify all areas of the distribution system where abnormally long tripping time related to abnormally low arcing current may be present.

4.3.2.2. These issues shall form an integral part of the design scope and be addressed as part of the facility expansion or refurbishment project. Where practical, the protective scheme shall be designed to address and eliminate such issues.

4.3.3. For new sites:

4.3.3.1. The preliminary study shall be used to prevent the installation of distribution systems and protection schemes abnormally long tripping time related to abnormally low arcing current may be present,

4.3.3.2. Where practical, the protective scheme shall be designed to prevent the apparition of such issues.

4.3.4. In all cases, the site’s physical layout shall be factored in the study considerations and result in practical design choices as follows:

4.3.4.1. Do not locate protective devices or distribution centers where workers cannot easily move away from an electrical hazard within two (2) seconds.

4.3.4.2. Interact with other design disciplines to appraise possible options to modify the physical layout of the electrical room and provide proper means of egress.

### **5. Software Generated Time Current Curves (TCCs)**

5.1. Software generated TCCs shall provide the following minimum information and be fully described in the short circuit study narrative of the report:

5.1.1. Partial single line diagram showing the interconnection topology between the protection device plotted on the TCC,

5.1.2. TCC specific to each protective device,

5.1.3. Transformer curves, when present:

5.1.3.1. Damage curves inclusive of short time, thermal  $i^2T$  and both infrequent and frequent fault components

5.1.3.2. Inrush point at 12x FLA for transformers up to 112.5kVA. A full inrush curves shall be provided for size above 112.5kVA

5.1.4. Cable damage curves

5.1.5. Motor curves, when present:

5.1.5.1. The starting curves shall be inclusive of the stabilized FLA zone, the starting current zone (full voltage or reduced, as applicable), and the inrush zone,

- 5.1.5.2. The presence of delta/Wye, solid state starters and other form of non full voltage starter shall be accurately depicted for any device larger than 100HP,
- 5.1.6. Current Time Intervals (CTI) between a downstream total clearing time band and the upstream device pickup time band:
- 5.1.6.1. The CTI shall be measured in seconds and clearly outline the presence of proper coordination or the presence of race conditions between upstream and downstream protective devices,
- 5.1.6.2. As applicable: When a ZIP/ZIS or IEEE-87 protection scheme is present, there shall be a mention of such system in the TCC and in the report to outline the fact if a CTI is not sufficient, these other system are still able to achieve a proper selectivity of the protection scheme depicted on the TCC.
- 5.1.7. Each device's TCC shall be interrupted at the maximum bolted fault levels (P-G, or 2P-G, or 2P, or 3P, whichever is the worst case):
- 5.1.7.1. Both the worst case arcing and bolted fault currents shall be plotted on the TCC diagram for each protective device. Fault levels shall be identified in both name & location and Kilo Amps values,
- 5.1.7.2. The study engineer shall use this information in coordination with the plotted CTI to confirm if there are race conditions or miscoordinations between protective devices for both bolted faults and arcing faults,
- 5.1.7.3. As applicable: For branch circuits equipped with current limiting devices, the equipment let through curves shall be used to plot the maximum bolted fault levels and the reduced level. The let through curves shall form a part of the deliverables,
- 5.1.8. TCC Curve types:
- 5.1.8.1. Separated phase and ground fault TCC diagram shall be prepared. it is not acceptable to plot both phase and ground trip bands on the same TCC.
- 5.1.8.2. Parallel branch circuits shall each be on a dedicated software generated TCC diagram. It is not acceptable to plot parallel branch circuit protective devices on the same diagram.
- 5.1.8.3. Special considerations: As applicable
- .1 Applications equipped with distributed generators (DG) such as cogenerators, photovoltaic systems, wind generators, etc... and equipped with directional overcurrent protection shall be clearly identified on the TCC. Dedicated TCC corresponding to different fault scenarios located both downstream and upstream of the directional overcurrent device shall be prepared to outline the system response to faults.
- .2 The TCC shall include notes referring to the applicable fault scenario and describing peculiar protective device responses such as the inability to sense a fault, or an overreaching / miscoordination issue where the device would trip before other devices meant to interrupt a targeted fault event.
- 5.2. TCC plotting format:
- 5.2.1. Software generated TCC shall be plotted on an 11x17 paper format. The left half side of the page

shall be reserved for the TCC.

- 5.2.2. The central part shall be reserved for the sample single line diagram outlining which devices are plotted on the TCC.
- 5.2.3. The right side of the page shall be kept to add notes, protective device settings (if not plotted on the TCC, let through curves data, and relevant information on additional protection features (e.g. ZIP/ZIS, generator governors, IEEE-87 etc...), and any notes which may support the interpretation of the plotted TCC diagram on the left side of the page



5.3. Sample software generated TCC (General layout)

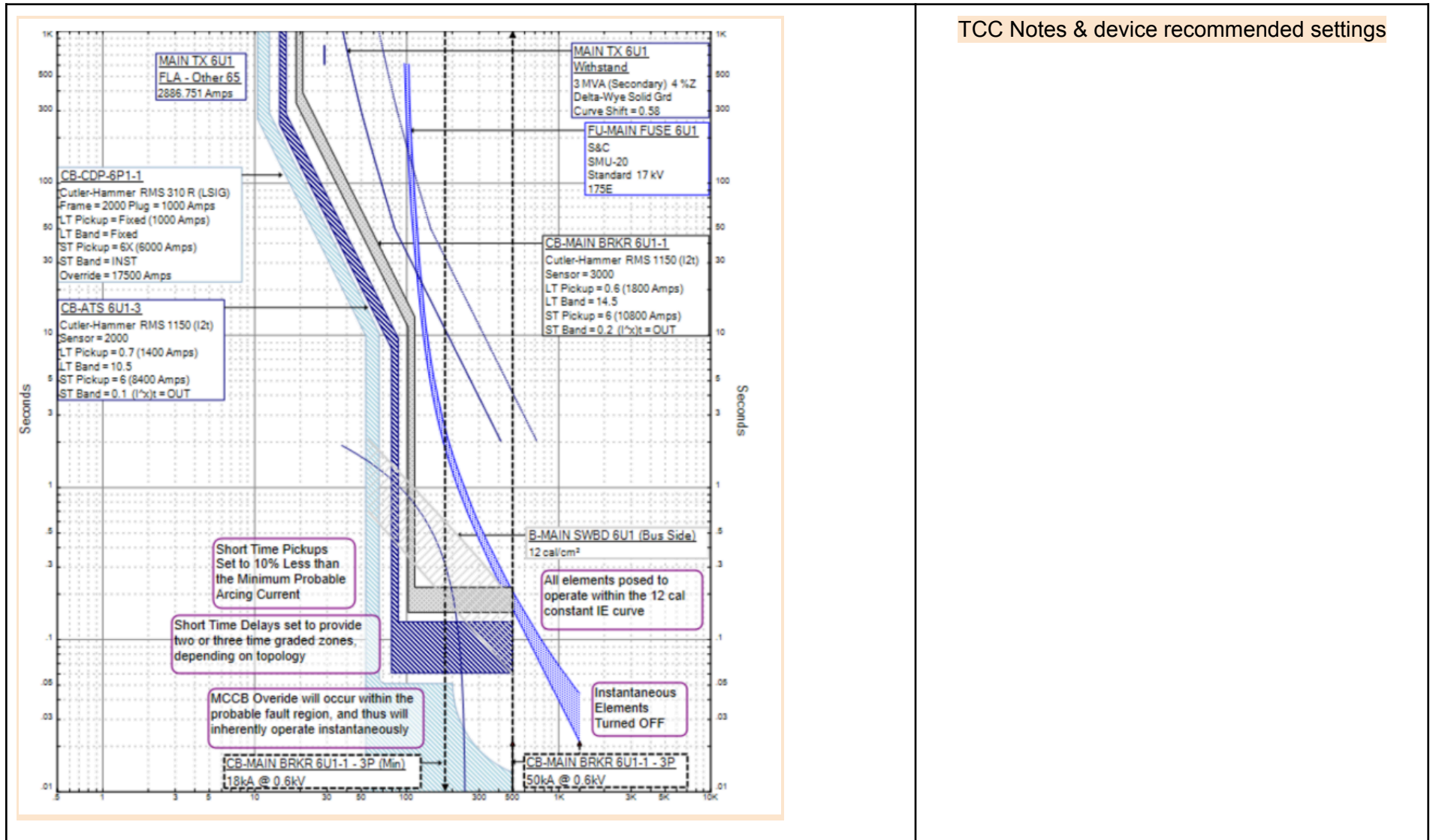
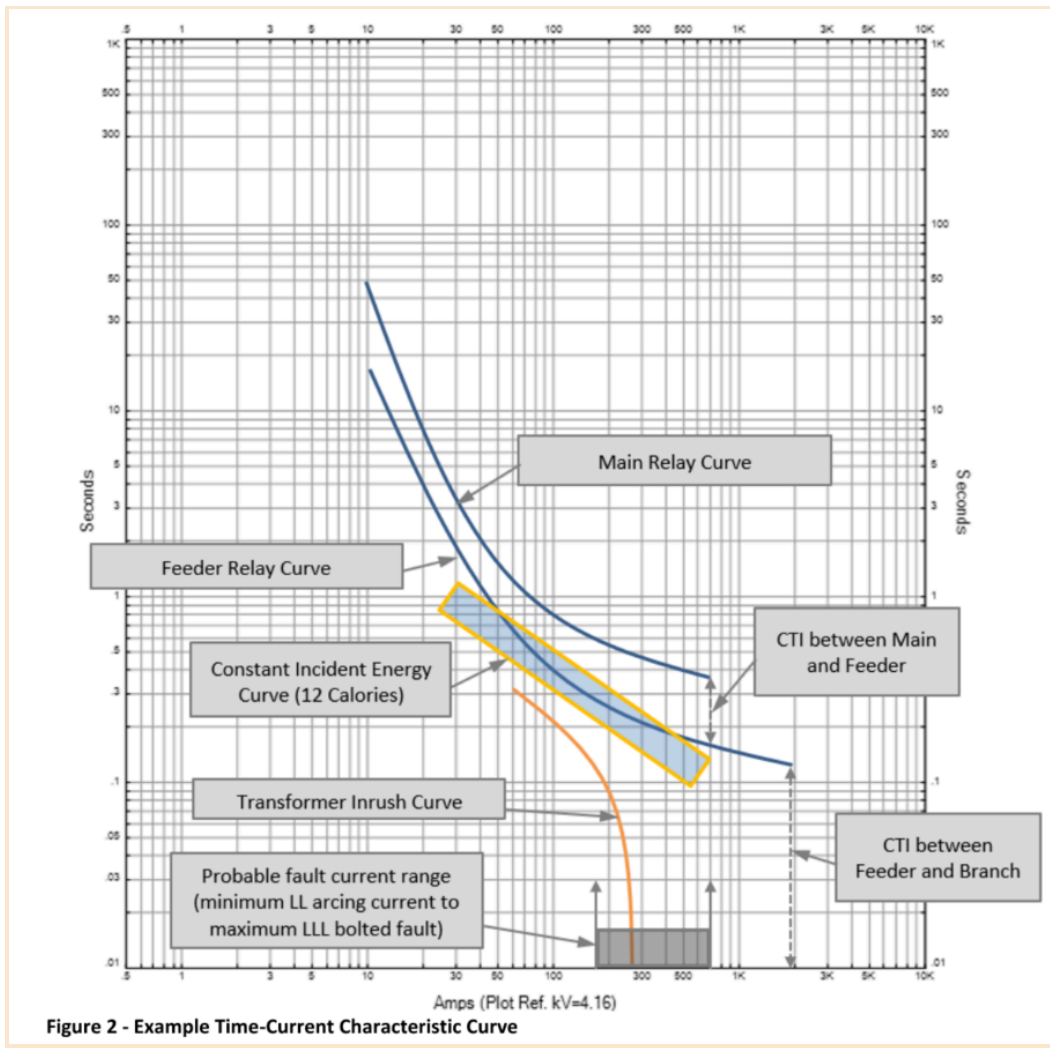


Figure E1 – Preferred 11x17 TCC Layout - Overall Presentation



**Figure E2: Typical TCC - Information details**

## 6. Arc Flash and Shock Label Requirements

- 6.1. Arc Flash and Shock Labels to be generated by the design Consultant using as-built information provided by the Contractor. Labels to be affixed to the front of equipment and be readily visible to the approaching worker.
- 6.2. Size and construction:
  - 6.2.1. Label to be 89 mm x 127 mm thermal transfer type warning label of high adhesion polyester
- 6.3. Colours:
  - 6.3.1. Warning Label: word WARNING to be safety black letters on a safety orange background
  - 6.3.2. Danger Label: word DANGER to be safety white letters on a safety red background
- 6.4. The label shall include the following information, at a minimum:
  - 6.4.1. Breaker/Disconnect Designation
  - 6.4.2. Location designation
  - 6.4.3. Nominal voltage
  - 6.4.4. Flash protection boundary
  - 6.4.5. Hazard risk category
  - 6.4.6. Incident energy
  - 6.4.7. Working distance
  - 6.4.8. PPE category and description including glove rating
  - 6.4.9. Limited approach distance
  - 6.4.10. Restricted approach distance
  - 6.4.11. Prohibited approach distance
- 6.5. Sample Labels:



Figure E3 – Simple Arc Flash & Shock Warning Label Sample


 <b>WARNING</b>																	
Arc Flash and Shock Hazard																	
ARC FLASH PROTECTION	SHOCK PROTECTION																
<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 40%;">Working Distance</td> <td style="text-align: right;">18 inches</td> </tr> <tr> <td>Incident Energy</td> <td style="text-align: right;">5.0 cal/cm<sup>2</sup></td> </tr> <tr> <td>Arc Flash Boundary</td> <td style="text-align: right;">43 inches</td> </tr> <tr> <td>&lt;Company&gt; PPE Level =</td> <td style="text-align: right;">2</td> </tr> </table> <p><i>Refer to &lt;Company&gt; Electrical Safety Program for PPE Requirements.</i></p>	Working Distance	18 inches	Incident Energy	5.0 cal/cm <sup>2</sup>	Arc Flash Boundary	43 inches	<Company> PPE Level =	2	<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 40%;">Shock Hazard when covers removed</td> <td style="text-align: right;">600 VAC</td> </tr> <tr> <td>Limited Approach</td> <td style="text-align: right;">42 inches</td> </tr> <tr> <td>Restricted Approach</td> <td style="text-align: right;">12 inches</td> </tr> <tr> <td>Rubber Insulating Glove Class</td> <td style="text-align: right;">0</td> </tr> </table>	Shock Hazard when covers removed	600 VAC	Limited Approach	42 inches	Restricted Approach	12 inches	Rubber Insulating Glove Class	0
Working Distance	18 inches																
Incident Energy	5.0 cal/cm <sup>2</sup>																
Arc Flash Boundary	43 inches																
<Company> PPE Level =	2																
Shock Hazard when covers removed	600 VAC																
Limited Approach	42 inches																
Restricted Approach	12 inches																
Rubber Insulating Glove Class	0																
<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 60%;">Location: MCC #1 Building</td> <td style="text-align: right;">Study provided by: ESPS</td> </tr> <tr> <td>Equipment: LOAD SIDE of <b>MCC #1 MAIN BREAKER</b></td> <td style="text-align: right;">Date: <b>2015-01-01</b></td> </tr> <tr> <td>Report #: ESPS-XXX-YYY-AHA-ZZZ Rev 1.0</td> <td style="text-align: right;">Label #: 1</td> </tr> </table>		Location: MCC #1 Building	Study provided by: ESPS	Equipment: LOAD SIDE of <b>MCC #1 MAIN BREAKER</b>	Date: <b>2015-01-01</b>	Report #: ESPS-XXX-YYY-AHA-ZZZ Rev 1.0	Label #: 1										
Location: MCC #1 Building	Study provided by: ESPS																
Equipment: LOAD SIDE of <b>MCC #1 MAIN BREAKER</b>	Date: <b>2015-01-01</b>																
Report #: ESPS-XXX-YYY-AHA-ZZZ Rev 1.0	Label #: 1																

Figure E4 – Detailed Arc Flash & Shock Warning Label for SWGR/MCC/ Electrical Distribution Equipment where Incident Energy is 40 cal/cm<sup>2</sup> or less

 <span style="font-size: 2em; font-weight: bold; margin-left: 10px;">DANGER</span>			
Arc Flash and Shock Hazard			
ARC FLASH PROTECTION		SHOCK PROTECTION	
Working Distance	18 inches	Shock Hazard when covers are removed	480 VAC
Incident Energy	143 cal/cm <sup>2</sup>	Limited Approach	42 inches
Arc Flash Boundary	25 feet	Restricted Approach	12 inches
Refer to <Company> Electrical Safety Program		Rubber Insulating Glove Class	0
Location: MCC #1 Building		Study provided by: Danatec	
Equipment: LINE SIDE of SWGR #1 Main BreakerK		Date: 2018-01-30	
Report #: Danatec-XXX-YYY-AHA-ZZZ Rev 1.0		Label #: 3	

Figure E5 – Detailed Arc Flash & Shock Danger Label for MCC/SWGR and other distribution equipment where Incident Energy is above 40 cal/cm<sup>2</sup>



## **APPENDIX F - FIRE ALARM COMMUNICATION DESIGN GUIDELINES**

## 1. General

### 1) Overview

1. This document describes the City of Edmonton’s requirements when installing and verifying Fire Alarm Communications Equipment (Dialer). All City of Edmonton facilities require a monitored Fire Alarm System, unless specifically stated otherwise. Dialers are to be provided for ULC compliant systems.
2. Questions related to this document are to be directed to the Engineering Services/Project Review Team (PRT) through the City of Edmonton project manager.

### 2) References

1. National Building Code (Alberta Edition), latest edition.
2. Alberta Fire Code, latest edition.
3. CSA C22.1, Canadian Electrical Code, Part 1, latest edition.
4. CAN/ULC-S537 - Standard for the Verification of Fire Alarm Systems, latest edition.
5. CAN/ULC-S561 - Installation and Services for Fire Signal Receiving Centres and Systems, latest edition

## 2. TECHNICAL

### 1) List of Approved Equipment

ULC Compliant Install	Notes:
<a href="#">DSC Power Series Neo HS2032 Control Panel</a>	
<a href="#">DSC HS2LCD Full Message LCD Keypad</a>	See mounting details.
<a href="#">DSC TL280LE(R) Dual Path - Fully Redundant Cellular and Internet Communicator</a>	Depending on the signal strength, TL280LE might need to be mounted on the separate enclosure near the exterior wall. See additional notes.



<p><u>Two (2) DSC PCL-422 Communicator Remote Mounting Module</u>  <u>* (for communicator to be mounted on separate enclosure from panel)</u></p>	<p>Verify the exact location of the second enclosure to mount the antenna. Preferred location to be inside the exterior wall of the building before stub-out.</p>
<p><u>HSM2300 Power Supply Module</u>  <u>* (for antenna requiring more than 50')</u></p>	<p>To be mounted on the separate enclosure.</p>
<p>Two (2) 7AH 12VDC batteries. DSC BD7-12</p>	
<p>6 pin telephone single port jack RJ31X</p>	
<p><u>DSC LTE-50ANT, 50ft antenna extension</u></p>	
<p><u>PC4050CR red cabinet for commercial fire</u>  <u>14.8" x 12" x 5" (LxWxD)</u></p>	<p>Verify the number of required cabinets. Minimum two.</p>

## 2) Installation Instructions

1. Install equipment on a 1200 mm x 2400 mm plywood backboard painted with fire retardant gray paint in a secure room, and mount equipment between 1000 mm and 2000 mm above finished floor. Provide 1.0 m working clearance in front of all equipment.
2. Mount keypad to the cover of a separate dedicated PC4050CR red box (375x304x127 mm) with Keypad mounted to the box using machine screws.
3. Provide one (1) 6 pin telephone single port jack within 100x100 mm junction box (no cover) mounted above the dialer panel via 15mm conduit. (see detail).
4. To comply with future changes to telephone provider (e.g. Telus) on power supply and back-up power using Telus GPON ONT equipment. Provide dedicated circuit and receptacle near RJ31X telephone jack.
5. Mount digital cellular communicator, HS2302, & batteries inside PC4050R red cabinet using machine screws.
6. Wire the DSC HS2032 with a tamper alarm. Alarm to sound when the door of the dialer is opened in accordance with CAN/ULC-S537.
7. Wiring specifications:
  - a. Cat 6 cable between the fire alarm communication panel and single jack in item 3 above. Terminate and test cable.

- b. 6c#18 FAS cable between the main fire alarm panel and fire alarm communication panel.
  - c. All other wiring to be #18 AWG FAS cable and labeled appropriately. All wiring to be run direct without breaks or splices.
  - d. For remote communicator wiring (if needed), see other instructions in this appendix for required PCLink cables, RS-422 bus, and antenna coax cables.
8. All cabling to be mechanically protected in conduit; flex conduit is not permitted. Do not pull into conduit any other wire than fire alarm communication cable. Paint RED all conduit fittings and junction boxes carrying fire alarm monitoring cable.

**3) DSC Power Series Neo HS2032 Fire Monitoring System Control Panel**

- 1. Provide 120VAC 15 amp power from a dedicated circuit. Where available, provide power from an emergency power source. Paint the circuit breaker RED to signify it is part of the Fire Alarm system and install a position lock. Provide a label on the fire alarm monitoring panel indicating the panel name and circuit number, in accordance with CAN/ULC-S537.
- 2. Refer to Drawing E01.1 Fire Alarm ULC Dialer for elevation mounting details.
- 3. Terminate on the panel as follows:

<b>Terminal No.</b>	<b>ULC Compliant</b>	<b>Non ULC Compliant</b>
BAT +	Battery + Terminal 1	Battery + Terminal 1
BAT -	Battery - Terminal 2	Battery - Terminal 2
1)	Power from Transformer 16.5VDC - 40VA	Power from Transformer 16.5VDC - 40VA
2)	Power from Transformer 16.5VDC - 40VA	Power from Transformer 16.5VDC - 40VA
3) AUX +	Left Open	Left Open
4) AUX -	Left Open	Left Open
5) BELL +	Insert EOL Resistor	Insert EOL Resistor

6) BELL -	Insert EOL Resistor	Insert EOL Resistor
7) RED	Positive (red) wire from HS2LCD Keypad	Positive (red) wire from HS2LCD Keypad
8) BLK	Negative (blk) wire from HS2LCD Keypad	Negative (blk) wire from HS2LCD Keypad
9) YLW	Data Out (ylw) wire from HS2LCD Keypad	Data Out (ylw) wire from HS2LCD Keypad
10) GRN	Data In (grn) wire from HS2LCD Keypad	Data In (grn) wire from HS2LCD Keypad
11) PGM 1	Option Only - for Door Contact from HS2LCD Keypad	Option Only - for Door Contact from HS2LCD Keypad
12) PGM 2	Left Open	Left Open
13) PGM 3	Left Open	Left Open
14) PGM 4	Left Open	Left Open
15) Z1	Zone 1 (red) wire from the fire alarm panel for Normally Open input "Fire Alarm" point.	Zone 1 (red) wire from the fire alarm panel for Normally Open input "Fire Alarm" point.
16) COM	Zone 1 (black) wire, other half of the Normally Open input "Fire Alarm" point AND Zone 2 (orange) wire, other half of the Normally Open input "Fire Trouble" point.	Zone 1 (black) wire, other half of the Normally Open input "Fire Alarm" point AND Zone 2 (orange) wire, other half of the Normally Open input "Fire Trouble" point.
17) Z2	Zone 2 (blue) wire from the fire alarm panel for Normally Open input " Fire Trouble" point.	Zone 2 (blue) wire from the fire alarm panel for Normally Open input " Fire Trouble" point.
18) Z3	Zone 3 (brown) wire from the fire alarm alarm panel for Normally Open input " Fire Supervisory" point.	Left Open
19) COM	Zone 3 (green) wire other, half of Normally Open input "Fire Supervisory" point.	Left Open

20) Z4	SPARE	SPARE
21) Z5	SPARE	SPARE
22)	SPARE	SPARE

COM		
23) Z6	SPARE	SPARE
24) Z7	SPARE	SPARE
25) COM	Zone 4 other half of the Normally Closed input "Fire Tamper Alarm" point (TBD with FMS)	Zone 4 other half of the Normally Closed input "Fire Tamper Alarm" point (TBD with FMS)
26) Z8	Zone 4 from the fire alarm panel for a Normally Closed input "Fire Tamper Alarm" point (TBD with FMS)	Zone 4 from the fire alarm panel for a Normally Closed input "Fire Tamper Alarm" point (TBD with FMS)
27) EGND	Earth Ground Connection (bonding jumper)	Earth Ground Connection (bonding jumper)
28) RING	Red wire (In) Telephone Connection 1 to POTs thru RJ31X alarm interface	Red wire (In) Telephone Connection 1 to POTs thru RJ31X alarm interface
29) TIP	Green wire (In) Telephone Connection 2 to POTs thru RJ31X alarm interface	Green wire (In) Telephone Connection 2 to POTs thru RJ31X alarm interface
30) R1	Gray wire (Out) Phone Connection point 1 to POTs thru RJ31X alarm interface	Gray wire (Out) Phone Connection point 1 to POTs thru RJ31X alarm interface
31) T1	Brown wire(Out) Phone Connection point 2 to POTs thru RJ31X alarm interface	Brown wire(Out) Phone Connection point 2 to POTs thru RJ31X alarm interface
PC Link 1	SPARE	SPARE
PC Link 2	To PCL-422 remote mounting communicator thru RS-422 Bus going to TL280LE Communicator Cabinet	To PCL-422 remote mounting communicator thru RS-422 Bus going to TL280LE Communicator Cabinet

**4) BSM and Two (2) 7AH 12VDC Batteries**

1. All leads are provided in the package. Do not use the set of leads provided with two wires going to one terminal end. Terminate as follows:

Terminal No.	Item
1	Positive (red) from battery A to positive post of BSM marked battery A
2	Negative (blk) from battery A to negative post of BSM marked battery A

3	Positive (red) from battery B to positive post of BSM marked battery B
4	Negative (blk) from battery B to negative post of BSM marked battery B
5	Positive post of DSC HS2302 to positive post of BSM marked panel
6	Negative post of DSC HS2302 to negative post of BSM marked panel

**5) HS2LCD Full Message LCD Keypad**

1. LCD keypad shall be mounted to PC4050 (2nd red enclosure) door. See detail.
2. Supply keypad with 4c #18 FAS cable from DSC HS32 control module.
3. Before wiring the unit, ensure that all power (AC transformer and battery) is disconnected from the control panel.
4. Connect the four Corbus wires from the control module (red, black, yellow, and green) to the keypad terminals.
5. Once wiring is complete, and equipment is secured to the building structure, apply power to the control panel and start the required programming.
6. Terminate as follows:

Terminal No.	Item
1	+ Terminal (red wire) from terminal 7 of DSC HS2032
2	- Terminal (black wire) from terminal 8 of DSC HS2032
3	Y Terminal (yellow wire) from terminal 9 of DSC HS2032
4	G Terminal (green wire) from terminal 10 of DSC HS2032

**6) TL280LE(R) Internet & Cellular Network Dual Path Communicator**

1. If so desired, HSPA Internet is a provision only, if another active/passive communication is required. This system is to follow ULC monitoring requirements for Passive Communication combined with Public Switched Telephone Network (PSTN) also known as POTS with GSM antenna (Rogers, Telus) owners account.
2. (TL Models Only): A Category 6 (CAT 6) Ethernet cable must be run from a source with internet connectivity to the communicator module inside the panel. The communicator end of the cable must be terminated with an RJ45 plug, which will connect to the

communicator’s RJ45 jack after the communicator is installed. All requirements for installation of CAT6 Ethernet cable must be observed for correct operation of the communicator.

3. Communicator can be mounted and housed in a separate cabinet using two (2) PCL-422 Communicator Remote Monitoring Modules. This is required if the antenna requires more than 50 foot cable length and GSM signal is a concern. The PCL-422 module facilitates remote mounting of the PowerSeries. Neo alternate communicator outside the alarm controller cabinet. Two PCL-422 modules are required, one mounted in the alarm controller cabinet and one in a remote cabinet with the alternate communicator.

### 7) GSM Antenna

[DSC LTE-50ANT, 50ft antenna extension](#)

[\\* \(install frequency boost module as required\)](#)

1. Required with [DSC TL280LE\(R\)](#) Cellular Communicator Antenna on all new installations.
2. Note: No part of the antenna may be grounded or bonded to the boxes or pipes that are installed with the DSC HS2032 panel as this will result in earth ground issues with the panel.
3. Coordinate to manufacturer if there is a need for longer distance antenna cable.

\* Only if there is an issue of signal lost depending on the mounting location of the communicator

### 8) Two (2) DSC PCL-422 Communicator

\*\* To Connect TL280E(R) and HS2032 in a separate enclosure with RS422 bus cable.

1. PCL-422 module facilitates remote mounting alternate communicator outside the alarm controller cabinet. Two PCL-422 modules are required, one mounted in the alarm controller cabinet, and one in a remote cabinet with an alternate communicator.
2. First communicator shall be mounted on the main control cabinet dialer. The second communicator shall be mounted in a non-hazardous location (preferably in the main floor near antenna location stub-out).
3. This second separate enclosure (if required) shall have both [TL280LE\(R\)](#) and PCL-422. Connect Communicator to HS2032 through PC-Link. See Diagram.

4. Provide fully supervised AC failure, low battery, and AUX failure power supply module [HSM 2300](#) with two 12V 7AH stand-by batteries in the second cabinet box.
5. Ensure the remote mounted PCL-422 is installed on the left wall of the enclosure, as illustrated in the diagram, to allow for the battery.
6. Ensure correct orientation of the PCLink cable as shown in the diagram.

**9) Existing Fire Alarm Panel**

1. Regardless of type of panels where there is an on-board DACT or none, an IP communicator built-in, connect monitoring cables from outside transmitter (dialer) to fire alarm relay outputs for 3rd party monitoring center. This is only for general “alarm”, “trouble”, & “supervisory” contact signals.
2. Set all alarm point relays as Normally Open with a supervisory 2K resistor placed in parallel with wires coming from Zones of HS2032. Do not twist or solder resistors to wires in accordance with CAN/ULC-S561.
3. Terminate as follows:

Contact	Item
Fire Alarm Contact	Wired to terminals 15 and 16 for Zone 1 from DSC HS2032
Fire Trouble Contact	Wired to terminals 17 and 16 for Zone 2 from DSC HS2032
Fire Supervisory Contact	Wired to terminals 18 and 19 for Zone 3 from DSC HS2032

Note: Non-ULC installation does not require Fire Supervisory contact.

**10) Programming and Verification**

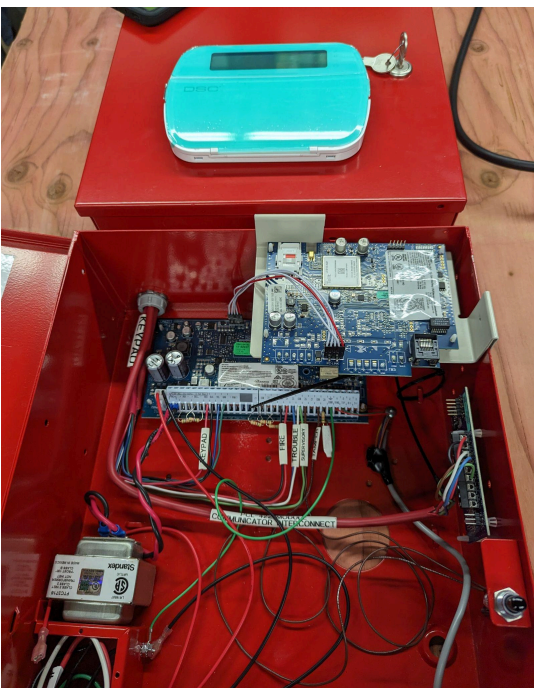
1. City requires a minimum 14 days notification for creation of monitoring accounts and programming/commissioning of Dialers. Programming of Dialer must occur prior to Fire Alarm Verification and after the following:
  - a. All equipment is installed,
  - b. Communication services have been verified as active,
  - c. Monitoring Account is “active” and dedicated phone number assigned.



2. Dialer testing to be completed in conjunction with the main fire alarm system verification, and to verify compliance with CAN/ULC-S537 – Standard for the Verification of Fire Alarm Systems.



**DSC H32-612TLLEC Fire Monitoring Typical Installation Photo**



**Communicator and Keypad Monitoring Typical Installation Photo**



## **APPENDIX F1 - STANDARD FIRE ALARM DIALER DRAWINGS**

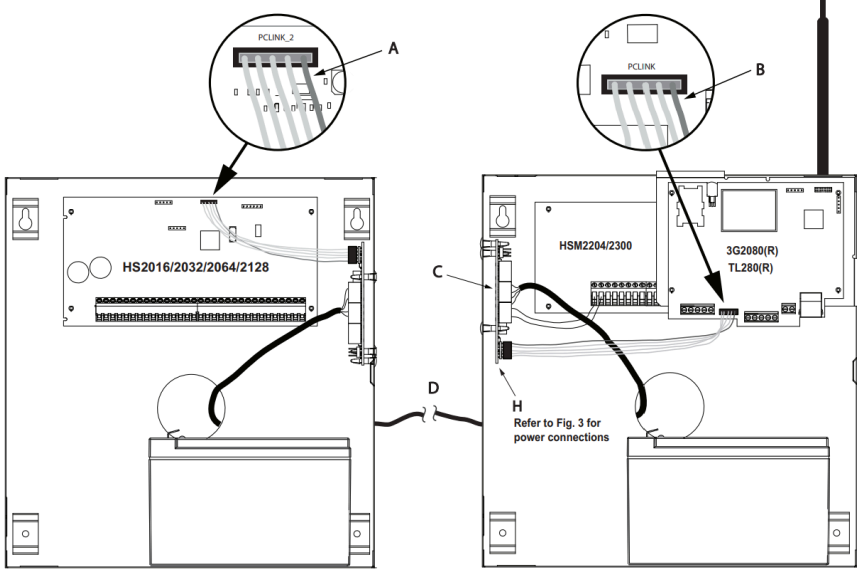


Fig. 1: PCL-422 Mounted in Alarm Controller Cabinet

Fig. 2: PCL-422 Mounted in Remote Cabinet (with communicator)

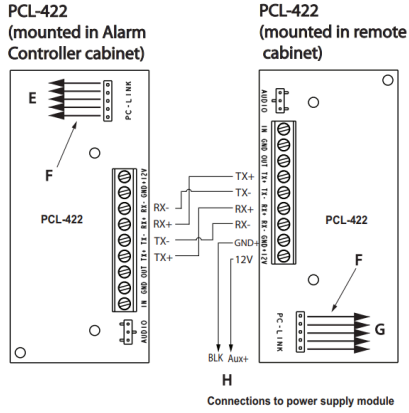
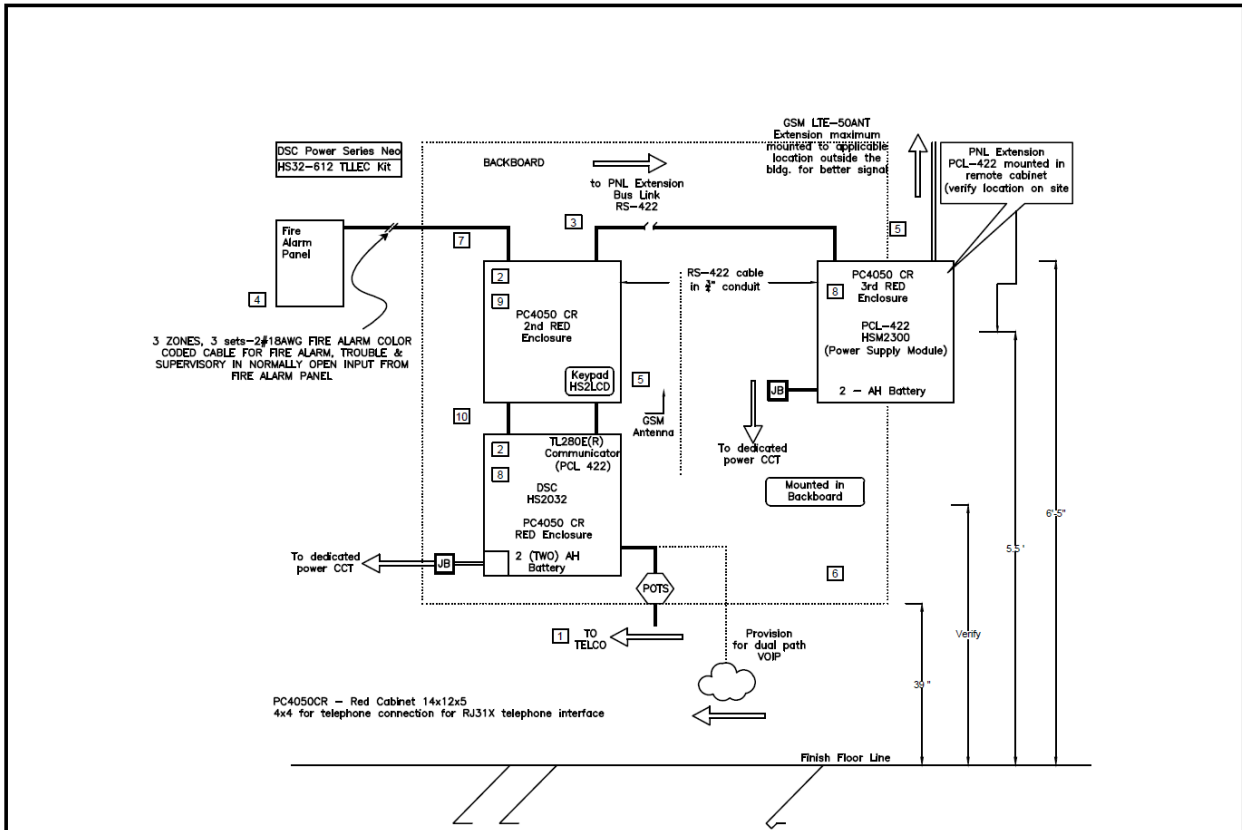


Fig. 3: Wiring Details for RS-422 Connections

- Connection Details**
- A – Red wire on alarm controller PCLINK header
  - B – Red wire on alternate communicator PCLINK header
  - C – Install PCL-422 to left side of remote mount cabinet
  - D – RS-422 bus
  - E – To PCLINK\_2 header on alarm controller
  - F – Red wire
  - G – To PCLINK header on alternate communicator
  - H – To power supply module (HSM2204/2300)

**PCL-422 Communicator Remote Mounting Module**



- NOTES:
- 1 CONTINUE CONDUIT TO TELEPHONE DEMARCATION, INSTALL JB WITH WIRE GROMMET AND BRING WIRES TO BIX BLOCK
  - 2 SECURE DEVICES / EQUIPMENT TO EXISTING (3/4" MIN) BACKBOARD OR INSTALL NEW (PAINT MATTE GREY).
  - 3 ANTENNA IS REQUIRED FOR ALL ULC SET-UPS. CONDUIT FOR ANTENNA TO BE 1" DIA.
  - 4 ENSURE CONDUIT ROUTING IS COMPLIANT WITH ULC REQUIREMENTS, FIRE ALARM CABLES SHALL BE 2 HR FIRE RATED IN CONDUIT.
  - 5 ALL CONDUIT TO BE 3/4" EMT PAINT ALL COUPLINGS AND COVER PLATES RED.
  - 6 ALLOWABLE AREA FOR INSTALLATION
  - 7 TOP OF THE MAIN DIALER ENCLOSURE TO BE AT 1800MM ABOVE FINISHED FLOOR.
  - 8 FIELD DRILLING/CUTTING/PUNCHING HOLES OR ENLARGING KNOCKOUTS ARE NOT PERMITTED. PRE-MANUFACTURED CONDUIT ENTRY SHALL ONLY BE USED. COMPROMISING ULC ENCLOSURE IS NOT PERMITTED.
  - 9 2nd RED ENCLOSURE (PC4050 CR) TO HOUSE REQUIRED ANTENNA COILED AND EXCESS CABLE. KEYPAD WILL BE MOUNTED HERE.
  - 10 PROVIDE 3/4" X 2.5" CONDUIT NEEDLE AS SHOWN. USE ONLY EXISTING KNOCKOUTS IN THE RED ENCLOSURE BOX TO COMPLY WITH ULC REQUIREMENTS.

THIS STANDARD DRAWING/DETAIL AND/OR SPECIFICATION IS PROVIDED TO CONVEY THE CITY'S TYPICALLY IDEAL GENERAL ARRANGEMENT AND REQUIREMENTS. REPRESENTATIONS MAY NOT BE TO SCALE, THEY MAY BE SUBSTANTIALLY SCHEMATIC IN NATURE AND/OR REQUIRE FURTHER ELABORATION AND DEVELOPMENT. AS SUCH THIS DOCUMENT IS NOT SUITABLE FOR INTEGRATION INTO A SPECIFIC IMPLEMENTATION WITHOUT REVIEW AND MODIFICATION AND IS ONLY INTENDED FOR USE BY A COMPETENT DESIGNER EXERCISING PROFESSIONAL JUDGMENT. THE DESIGNER SHALL MODIFY AND SUPPLEMENT AS NECESSARY TO PROVIDE A COMPLETE, PROPERLY FUNCTIONING, DESIGN THAT CONFORMS IN ALL RESPECTS TO THE CITY'S FUNCTIONAL REQUIREMENTS. WHEN ACTUALIZED IN A PARTICULAR IMPLEMENTATION IT IS THE DESIGNER'S RESPONSIBILITY TO ENSURE THE SIZE, LOCATION, AND SPACING OF ALL ELEMENTS, AND ALL COMPONENTS/SPECIFICATIONS, ARE SUITABLE AND SAFE FOR THE USE AND LOCATION INTENDED, AND ANY APPLICABLE CODE, LEGISLATIVE, AND AUTHORITY REQUIREMENTS ARE ADHERED TO. IN ADDITION, ANY ACCESSIBILITY, OPERATIONAL, AND MAINTENANCE REQUIREMENTS MUST BE MET. DEVIATIONS FROM THE REPRESENTED NOMINAL DESIGN PARAMETERS, QUESTIONS OF INTENT OR ACCURACY, OR ANY OTHER APPARENT CONFLICTS, SHALL BE RECONCILED WITH AN APPROPRIATE CITY REPRESENTATIVE. FINALLY, WHEN EMPLOYING ANY ASPECT OF THIS DOCUMENT, THE ULTIMATELY RESPONSIBLE PROFESSIONAL DESIGNER SHALL REMOVE ANY AUTHENTICATION OF THE ORIGINAL AUTHOR(S), NOTE ANY PROVENANCE AS APPROPRIATE, AND APPLY THEIR OWN AUTHENTICATION AS REQUIRED.

### FIRE ALARM ULC DIALER SETUP

SCALE: N.T.S.

	FIRE ALARM ULC DESIGN GUIDELINES		CONSULTANT MANUAL STANDARD DETAIL	
	Location ID		Project #	N/A
	Discipline	ELECTRICAL	Drawn	SG
	Volume	01	Drawing Number	E01
	Sheet	1 OF 1		
File	Elec_STD_Fire_Alarm_Dialer.dwg			



## **APPENDIX G - GUIDELINES FOR GAS DETECTION SYSTEMS**



## **Table of Contents**

1. Background
2. General
  - 2.1. Application of this document
  - 2.2. Alarm concentration thresholds
  - 2.3. System performance criteria
  - 2.4. System design process
  - 2.5. Location
  - 2.6. Preventing false alarms
  - 2.7. Labels
  - 2.8. Signs
  - 2.9. Visual alarms
  - 2.10. Audible alarms
  - 2.11. Ventilation systems in gas detection zones
  - 2.12. System configuration
3. Carbon monoxide (CO) - Bulk Storage, repair garages, specified mechanical rooms
4. Carbon monoxide (CO) - Storage garages / parking garages
5. Nitrogen dioxide (NO<sub>2</sub>) - Bulk Storage, repair garages, specified mechanical rooms
6. Nitrogen dioxide (NO<sub>2</sub>) - Storage garages / parking garages
7. Chlorine (Cl<sub>2</sub>)
8. Hydrocarbons – i.e. natural gas and methane (CH<sub>4</sub>), propane (C<sub>3</sub>H<sub>8</sub>), acetylene (C<sub>2</sub>H<sub>2</sub>)
9. Refrigerants (i.e. Ammonia [NH<sub>3</sub>], R-22, R-422B, R-410A, R-134a)
10. Ozone (O<sub>3</sub>)
11. Carbon dioxide (CO<sub>2</sub>)
12. Hydrogen (H<sub>2</sub>)

Table 1 – Alarm and ventilation activation concentrations

Table 2 – Visual alarm, label, and sign colours

Table 3 – Occupational exposure limits and lower explosive limits



## 1. Background

- 1.1. The City of Edmonton has established guidelines for all permanent gas detection systems installed in its facilities. These guidelines are designed to:
  - 1.1.1. Achieve high quality and reliability in gas detection systems
  - 1.1.2. Eliminate failed and improper gas detection system installations
  - 1.1.3. Optimize for occupant safety and operational efficiency
  - 1.1.4. Achieve consistency across gas detection systems
- 1.2. The following gases are included in these guidelines:
  - 1.2.1. Carbon monoxide (CO)
  - 1.2.2. Nitrogen dioxide (NO<sub>2</sub>)
  - 1.2.3. Chlorine (Cl<sub>2</sub>)
  - 1.2.4. Hydrocarbons – i.e. natural gas and methane (CH<sub>4</sub>), propane (C<sub>3</sub>H<sub>8</sub>), acetylene (C<sub>2</sub>H<sub>2</sub>)
  - 1.2.5. Refrigerants (i.e. R-22, R-422B, R-410A, R-134a)
  - 1.2.6. Ammonia (NH<sub>3</sub>)
  - 1.2.7. Ozone (O<sub>3</sub>)
  - 1.2.8. Carbon dioxide (CO<sub>2</sub>)
  - 1.2.9. Hydrogen (H<sub>2</sub>)
- 1.3. These guidelines cover the following concepts, in order of appearance in the document:
  - 1.3.1. General requirements to which all gas detection systems must adhere
  - 1.3.2. Additional detailed requirements specific to each gas
  - 1.3.3. Tables containing requirements specific to each gas
- 1.4. The requirements under this document are sourced, in part, from the following codes and standards:
  - 1.4.1. Alberta Building Code
  - 1.4.2. Alberta Fire Code
  - 1.4.3. NFPA 52
  - 1.4.4. NFPA 55
  - 1.4.5. CSA B52
  - 1.4.6. CSA B149
  - 1.4.7. CSA B401.3 (upcoming)
  - 1.4.8. ASHRAE 15 & 34
  - 1.4.9. OH&S Code
  - 1.4.10. ASHRAE Handbook – Refrigeration

- 1.4.11. Industrial Ventilation Manual – Appendix A
  - 1.4.12. International Programme on Chemical Safety – Data Sheets
  - 1.4.13. WCB Alberta – Chlorine and ammonia
  - 1.4.14. WorkSafeBC – Chlorine, ammonia, and ozone
  - 1.4.15. Health and Safety Laboratory – Review of alarm setting for toxic gas and oxygen detectors – Research Report
- 1.5. This document has been developed in collaboration with the following City of Edmonton groups:
- 1.5.1. Facility Engineering
  - 1.5.2. Facility Maintenance
  - 1.5.3. Corporate Safety and Employee Health
  - 1.5.4. Fire Rescue Services
  - 1.5.5. Community and Recreation Facilities

## 2. General

- 2.1. Application of this document
- 2.1.1. The general guidelines contained in this section (section 2) shall be applied to all gas detection systems included in subsequent sections (sections 3, 4, etc.).
  - 2.1.2. In addition to the requirements described in 2.1.1, the guidelines contained in sections 3, 4, etc. shall apply to the gas detection systems corresponding to each respective section's title.
  - 2.1.3. New gas detection systems and existing systems that are modified shall conform to this document in its entirety.
- 2.2. Alarm concentration thresholds
- 2.2.1. The following definitions shall apply:
- 2.2.1.1. **8-hour exposure limit:** Maximum time-weighted average concentration to which nearly all persons may be repeatedly exposed for 8 hours per day and 40 hours per week without adverse effect.<sup>4</sup>
  - 2.2.1.2. **15-minute exposure limit:** Maximum time-weighted concentration to which nearly all persons may be exposed over any 15 minute period, occurring a maximum of four times separated by a 60-minute period within an 8-hour period, without suffering from irritation, chronic or irreversible tissue damage, or narcosis of sufficient degree to increase the likelihood of accidental injury, impair self-rescue or materially reduce work efficiency, and provided the 8-hour exposure limit is not otherwise exceeded.
  - 2.2.1.3. **Ventilation activation concentration:** The measured gas concentration at which the gas shall be mitigated using an engineered ventilation system. The ventilation system shall be activated or increased to high flow in order to exhaust the gas and replace it with outdoor air.
  - 2.2.1.4. **Low alarm activation concentration:** The concentration at which the gas concentration is not

<sup>4</sup> Industrial Ventilation Manual – 23rd edition – 1998 – Appendix A: Threshold Limit Values for Chemical Substances in the Work Environment

harmful but would become harmful if it increases to higher concentrations. The visual alarms shall be activated to indicate the low concentration and a notification of low concentration shall be sent to City of Edmonton Corporate Security for non-emergency response (local or maintenance personnel). It is not necessary for occupants to vacate the space—the low alarm serves as a notification to occupants that there is some gas concentration in the space, which should be mitigated by the local or maintenance personnel.

- 2.2.1.5. **High alarm activation concentration:** The minimum concentration at which the gas concentration is harmful. The visual and audible alarms shall be activated to indicate the high concentration and a notification of high concentration shall be sent to City of Edmonton Corporate Security for response from Fire Rescue Services. Occupants are expected to vacate any space in which an audible alarm can be heard—the high alarm serves as a means to evacuate the occupants of a harmful space.
- 2.2.2. All gas detection systems shall employ the concentration thresholds listed in Table 1 according to the guidelines set for each gas as outlined in the rest of this document:
  - 2.2.2.1. Ventilation activation concentration
  - 2.2.2.2. Low alarm activation concentration
  - 2.2.2.3. High alarm activation concentration
- 2.3. System performance criteria
  - 2.3.1. The City's basis of design is Honeywell 301-C (non-BACnet) controller with compatible Honeywell sensors. Other alternative manufacturers and models shall be vetted by the City of Edmonton before being specified.
  - 2.3.2. All gas detection components shall be pre-manufactured, pre-assembled, CSA-approved devices. No custom, one-off, field-assembled, or contractor-assembled equipment shall be specified or installed as any part of a gas detection system.
  - 2.3.3. All gas detection controllers shall have the capability of achieving call-outs to external monitoring agencies (such as security services, dispatch services, etc.).
  - 2.3.4. All gas detection controllers shall have the capability of achieving call outs to Corporate Security Monitoring on a fault/trouble condition. If required, contact Facility Engineering for further discussion.
  - 2.3.5. The controller shall be located in an easily visible location and visually indicate low and high concentration status. If it is to be mounted in an enclosure the enclosure will have a clear transparent front so the readouts are visible. The controller shall display the current measured concentration or percent of lower explosive limit. Use the same units (e.g. PPM or %) as shown in Table 1 for the gas in question.
  - 2.3.6. All sensors, controllers, wiring, systems, etc. shall be properly shielded and resistant to all common environmental sources of electromagnetic interference or radio-frequency interference. This includes, but is not limited to, cell phones, radios, other electronics, motor drives, and appliances. To this effect, internal communication protocol (i.e. from sensors to controllers, shall be digital, not analog).
  - 2.3.7. All gas detection system components shall be robust and of sufficient quality to resist all foreseeable interaction with users and moderate human-powered impact. All devices shall have a

NEMA rating that is appropriate for their environment (i.e. NEMA 3).

- 2.3.8. For gas detection systems installed in the following locations, all devices shall be NEMA 4X rated as a minimum, or as determined by the Hazardous Classification Study if the NEMA 4X rating is insufficient for the space:
  - 2.3.8.1. Natatoriums
  - 2.3.8.2. Chlorine rooms
  - 2.3.8.3. Ice-resurfacing-machine rooms
  - 2.3.8.4. Parking garages
  - 2.3.8.5. Any space where water will be sprayed
- 2.3.9. All gas detection systems shall record and log the instantaneous gas concentration measured by the systems. The data shall be stored in the controller. The data-logging shall occur at every gas concentration change (with appropriate concentration change threshold).
- 2.3.10. No permanent gas detection system shall employ time-weighted averaging gas concentration measurement.
- 2.3.11. All gas detection controllers shall allow a specified time delay to be set with a maximum resolution of 10 seconds. Manufacturer–pre-set time delays will not be accepted (i.e. controllers only providing a set number of delay periods, such as 10, 30, or 60 seconds, are not acceptable).
- 2.3.12. No gas detection system, nor any of its components, shall have any mechanism to allow a low or high alarm to be deactivated while the system is in alarm status (i.e. while the conditions at which a low or high alarm would normally activate are in place or satisfied). This means no “mute” or “silence” features or ability to disable this feature.
- 2.3.13. The gas detection system designer shall include a requirement in the specifications that lubricants or sealants used for threaded conduit connections contain no substance that might adversely affect the gas detection system sensors.
- 2.3.14. All gas detection system components shall be installed such that their exposure to vibration is minimized.
- 2.3.15. All gas detection system components shall be installed such that their exposure to water is minimized, and their design shall drain water effectively.
- 2.3.16. When interconnecting ancillary devices, maximum current and voltage ratings of the instruments’ outputs (i.e. interposing relay contacts) shall be observed. This includes barriers, isolation devices, and other intrinsically safe components.
- 2.3.17. All circuits exceeding 30 V RMS or 42.4 V peak-to- peak and all circuits 30 V RMS or less that are not Class 2 power-limited—as defined by the Canadian Electrical Code (CSA 22.1)—shall be protected from accidental contact through appropriate mechanical guards or barriers.
- 2.3.18. If gas detection system components or ancillary components are installed in a hazardous (classified) location, these instruments or components shall be approved for the area in which they are installed and shall be clearly marked.<sup>5</sup> Hazardous (classified) locations are defined by the

---

<sup>5</sup> ISA RP92.0.02, Part II-1998 and CSA 22.1

Canadian Electrical Code (CSA 22.1).

- 2.3.19. All gas detection equipment shall be installed as per their manufacturer’s specifications.
- 2.3.20. Each gas detection zone shall have two points out to the applicable City of Edmonton Corporate Security panel—one point for low alarm, and one point for high alarm.

E.g. For refrigerants, wherever there are two zones—machinery room and adjacent public area—each zone shall have two points out to the security panel: machinery room low, machinery room high, public area low, and public area high.

#### 2.4. System design process

- 2.4.1. All gas detection systems shall be authenticated by a professional engineer. The engineer shall have relevant experience designing gas detection systems, including ancillary systems, such as ventilation, control interlock with mechanical refrigeration or combustion equipment, sensor layouts, call-outs to external monitoring, etc. The engineering consulting services shall be procured by the City of Edmonton or by the prime contractor—not by the gas detection system vendor or contractor. All gas detection design contract documents shall be reviewed by the City of Edmonton.
- 2.4.2. The engineer’s design process shall include the following:
  - 2.4.2.1. Gas hazard assessment.
  - 2.4.2.2. Identify location and severity of potential gas sources, gas accumulation, and contact with occupants.
  - 2.4.2.3. Consider airflow patterns within the space. For systems involving hydrogen a CFD analysis will be required to inform the design. CFD analysis shall consider both scenario where emissions form a part of the normal operating conditions, and abnormal issues such as equipment failure resulting in leaks". The analysis shall also be used to inform the Hazard and Operability (HAZOP) study. CFD analysis will also review ventilation or exhaust air flow impacts on sensor performance.
  - 2.4.2.4. Review of any other flammable gasses or compounds or other sensor arrays that may have an impact on the design or operation of various systems including but not limited to ventilation and fire suppression equipment.
  - 2.4.2.5. Review of other sensors and equipment (existing or new) that may inadvertently serve as ignition sources for flammable gasses.
  - 2.4.2.6. Review of sensor cross sensitivity with other types of compounds and airborne substances which may also be present at the site under both normal and abnormal conditions.
- 2.4.3. Sensor layouts shall be designed such that sensor range radii overlap one-another to cover the gas detection zone’s complete horizontal plane.
- 2.4.4. A sensor layout plan indicating the sensing radii and the sensors’ specific and dimensioned locations—on plan and in section—shall be submitted as part of the project contract documents.
- 2.4.5. A schematic diagram showing all the components of the gas detection system and interconnections with HVAC equipment and controls shall be submitted as part of the project contract documents.
- 2.4.6. All gas detection system components shall be specified in the contract documents, including the

manufacturer and model number.

- 2.4.7. All gas detection system sequences of operation shall be explicitly specified by the engineer, with appropriate interdisciplinary coordination. The sequence shall be included in the mechanical controls specification section.
- 2.4.8. Hazardous location designation for fire protection:
  - 2.4.8.1. The designer shall determine each space's hazardous location designation (i.e. Zone 0 or Zone 1, etc.). The hazardous location designation for each project shall be reviewed by the City of Edmonton.
  - 2.4.8.2. The gas detection system, including all its components, shall conform to the requirements of this classification.
  - 2.4.8.3. Refer to [Appendix M - Hazardous Classification Studies](#)
  - 2.4.8.4. For all projects with a gas detection component, a dedicated gas detection meeting shall be hosted by the design team with Facility Engineering and FMS Project Review Team (PRT) representatives after completion of the working drawings submission package and prior to issuance of the pre-tender review package.

## 2.5. Location

- 2.5.1. All gas detection system components shall be installed in clearly visible locations.
- 2.5.2. If the controller is installed within an enclosure, the enclosure shall have a fully or partially clear cover such that the controller display is clearly visible and able to be read through the closed cover.
- 2.5.3. Any components that requires access or interaction (controllers, switches, display screens) shall be mounted in highly accessible locations.
- 2.5.4. All points of access for periodic testing and calibration shall be located and installed such that they are highly accessible by trades.
  - 2.5.4.1. For all ceiling or remote mounted sensors, which are not easily accessible, the sensor and transmitter pair shall be equipped with the following options:
    - .1 Remote Sensor Mounting Kit for XNX EC Sensors (S3KRMK)
    - .2 Remote Gassing Kit (1226A0354)
- 2.5.5. All visual and audible alarms shall be installed in highly visible locations. All relevant occupants in the zone must be able to see and hear the alarms whenever they are in the space.
- 2.5.6. All gas detection sensing components shall be installed in locations and elevations as prescribed by the manufacturer and taking into account the gas being detected, the sensor's sensing radius, any effect of air currents in the space, or interference from architectural features.
- 2.5.7. Do not locate sensors where they will be impacted by erroneous locally-high concentrations of gas, where the application does not warrant detection of such high concentrations before being diluted into the space. For example, do not locate carbon monoxide or nitrogen dioxide in front of a vehicle exhaust pipe.
- 2.5.8. Sensors and controllers shall be located such that they are free from any environmental factors that could damage them, such as dust, debris, water, aerosols, and physical impacts.



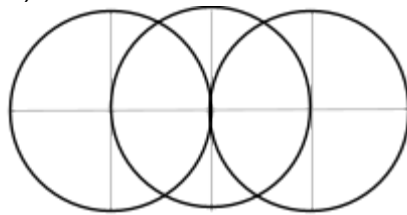
- 2.5.9. Whenever practicable, stand-alone sensors (i.e. separate from other components such as a controller) shall be mounted facing downward (preferred) or horizontally (acceptable).
- 2.5.10. Sensors shall not be located near supply air outlets.
- 2.5.11. Sensors shall not be located where contaminated air will short-circuit around the sensor to an exhaust inlet.
- 2.5.12. Consideration shall be given to spaces that are immediately adjacent to spaces that are gas detection zones, where leaked gas from the gas-detection- zone-space could infiltrate the adjacent space. If such a risk exists, the adjacent space shall have a permanent gas detection system similar to the one used in the gas detection zone space and shall be on a separate zone from the gas detection zone space.
- 2.5.13. Sensors at high elevation will be provided with calibration kits, tubing or other accessories as needed so they can be calibrated from ground level. This may involve installing the transmitters at ground elevation with a calibration tube to the sensor.
- 2.5.14. Where vehicles are present the sensors and transmitters are to be suitably protected via mechanical barriers or enclosures from collisions.
- 2.5.15. Preference should be given to utilising a single sensor manufacturer to further eliminate the possibility of cross sensitivities.
- 2.5.16. Elevations:
  - 2.5.16.1. **Low elevation:** 150 mm above the finished floor.
  - 2.5.16.2. **Occupant breathing elevation:** 1,500 mm above the finished floor.
  - 2.5.16.3. **High elevation:** Minimum 2,000 mm and maximum 2,500 mm above the finished floor or above an accessible platform. Must be accessible from an 8 ft step ladder.
- 2.6. Preventing false alarms
  - 2.6.1. All gas detection system alarms shall have a delay function (referred-to herein as “alarm delay”). The delay period (i.e. magnitude, in seconds) for each gas shall be set according to the “alarm delay period” specification in the section corresponding to the gas in question (section 3, 4, etc.).
    - 2.6.1.1. **Low alarm:** If a sensor measures a concentration exceeding the low alarm activation concentration stated in Table 1, the low alarm shall only activate if, after the prescribed delay period, the measured concentration has not, at any point during the prescribed delay period, fallen below the low alarm activation concentration
    - 2.6.1.2. **High alarm:** If a sensor measures a concentration exceeding the high alarm activation concentration stated in Table 1, the high alarm shall only activate if, after the prescribed delay period, the measured concentration has not, at any point during the prescribed delay period, fallen below the high alarm activation concentration
  - 2.6.2. If a gas detection zone requires prevention of false alarms, a voting scheme may be employed. Sensors may employ a voting scheme if all of the conditions, below, are satisfied:
    - 2.6.2.1. The sensors are located in the same single physical space
    - 2.6.2.2. There are 3 or more sensors



2.6.2.3. The sensors achieve the same function:

- .1 Example—sensors that *do* achieve the same function: Three sensors are located in a single space. All sensors are at the same elevation, are dispersed roughly equally throughout the space, and are located roughly at the same distance from the probable source of a gas leak and from the probable location of gas accumulation.
- .2 Example—sensors that *do not* achieve the same function: Three sensors are located in a single space. One sensor is located near the probable source of a gas leak; one sensor is located near an exhaust fan inlet; one sensor is located in the probable location of gas accumulation.

2.6.2.4. Range of each sensor shall overlap the adjacent sensor’s range up to, at minimum, its midpoint (see figure, below).



Minimum overlap of sensor ranges  
employed in a voting scheme

2.6.3. The voting scheme shall have the following sequence:

- 2.6.3.1. **Low alarm:** If at least one of the sensors in the voting scheme measures a concentration exceeding the low alarm activation concentration stated in Table 1 and at least one other sensor in the voting scheme whose range overlaps with the first sensor measures any non-zero concentration, then the low alarm shall be activated
- 2.6.3.2. **High alarm:** If at least one of the sensors in the voting scheme measures a concentration exceeding the high alarm activation concentration stated in Table 1 and at least one other sensor in the voting scheme whose range overlaps with the first sensor measures a concentration exceeding the low alarm activation concentration stated in Table 1, then the high alarm shall be activated.

2.7. Labels

- 2.7.1. All gas detection devices (sensors, controllers, and manual push buttons) shall be identified using small or medium engraved plastic plate tags<sup>6</sup> mounted on or near the device on the wall.

---

<sup>6</sup> Also known as “lamacoids”



2.7.2. The controller label shall be medium engraved plastic plate tags<sup>7</sup> mounted near the controller on the wall, as shown in the annotated picture below.

2.7.3. The controller label shall include the following content:

- 2.7.3.1. The name and chemical formula of the gas being detected
- 2.7.3.2. The source of the gas (i.e. “gasoline combustion” for some cases of CO, “diesel combustion” for some cases of NO<sub>2</sub>)
- 2.7.3.3. The stages of gas detection: low and high gas concentration levels (defined in Table 1) and the corresponding control sequence actions
- 2.7.3.4. Where its associated sensors are located.
- 2.7.3.5. A statement that the gas is remotely monitored.

2.7.4. All label colours shall conform to the specifications listed in Table 2.

2.8. Signs

2.8.1. In general, all visual alarms shall be identified using large engraved plastic plate tags<sup>8</sup> mounted near the visual alarm, as shown in the pictures below.



2.8.2. In maintenance spaces, such as vehicle maintenance garages, all visual alarms shall be identified using large signs mounted near the visual alarm.

2.8.3. All signs shall include the following content:

- 2.8.3.1. The name of the gas being detected

<sup>7</sup> Also known as “lamacooids”

<sup>8</sup> Also known as “lamacooids”

2.8.4. All sign colours shall conform to the specifications listed in Table 2.

## 2.9. Visual alarms

2.9.1. Visual alarms shall be strobe/beacon lights.

2.9.2. Visual alarms shall be located at an elevation where it is clearly visible from all areas of the space containing the gas and out of reach of occupants. As many visual alarms as needed shall be installed for at least one visual alarm to be visible from every point within the space.

2.9.3. For closed gas-monitored spaces, a visual alarm shall be located immediately outside the space such that it clearly indicates the detection of a gas from outside the space without needing to enter the space.

2.9.4. For gas-monitored spaces with direct access to the outdoors, a visual alarm shall be located outside the space, on the outside of the building, such that it clearly indicates the detection of a gas from outside the space without needing to enter the space.

2.9.5. All visual alarm colours shall conform to the specifications listed in Table 2.

## 2.10. Audible alarms

2.10.1. Audible alarms shall be horns or speakers specifically designed and manufactured for use as audible alarm annunciation. The system must have one audible alarm per system / gas and no sharing of horns.

2.10.2. The sound made by the audible alarm shall be unique. It shall not be similar to a fire alarm, or any other alarm common to the facility, or to facilities in general.

2.10.3. In general, audible alarms should have a sound pressure level (SPL) of 15 dBa (decibels) above the ambient sound level and 5 dBa above the maximum sound level of the area in which it is installed.

2.10.3.1. Audible alarms in loud mechanical spaces shall generate a sound pressure of minimum 95 dB at 3 m and shall be clearly audible from all areas of the space containing the gas.

2.10.3.2. Audible alarms at non-mechanical spaces such as guest services counters and rink attendant offices shall create a sound pressure of between 50 dB and 60 dB at 3 m.

2.10.3.3. Audible alarms in chlorine rooms and other similar-sized small rooms shall create a sound pressure of between 50 dB and 60 dB at 3 m.

2.10.3.4. The preferred audible alarm is the Federal Signal SLM700 or SLM800 (depending on SPL requirements).

2.10.4. If a gas detection zone is contained within a closed space (i.e. a mechanical room) and the system has no audible alarm outside the space, then the audible alarm shall be loud enough that it is clearly audible from outside the space containing the zone.

## 2.11. Ventilation systems in gas detection zones

2.11.1. Ventilation systems shall be installed in any space where detection or ventilation of a hazardous gas is required, for the purpose of removing / purging hazardous gases. This ventilation system shall:

2.11.1.1. Follow all relevant standards, including:

- .1 OSHA Technical Manual – Section III – Chapter 3: Ventilation Investigation – Appendix III: 3-1. Ventilation Primer
  - .2 ASHRAE Handbook – Fundamentals – Chapter 11. Air Contaminants
  - .3 Industrial Ventilation Manual
  - .4 Where applicable: Use intrinsically safe electrical equipment as defined in the CEC C22.1 and based on the hazardous classification study done for the site and the type of compounds which will be purged by mechanical systems.
- 2.11.2. Conform to all gas-specific ventilation requirements, including:
- 2.11.2.1. CSA B52 (2013) – 6.2 and 6.3
  - 2.11.2.2. ASHRAE 15 & 34 – 8.11
  - 2.11.2.3. CSA B149 (2010) – 10.1
  - 2.11.2.4. Alberta Building Code
  - 2.11.2.5. Occupational Health and Safety Code (2009) – Part 26
  - 2.11.2.6. NFPA 55 – Chapter 3
  - 2.11.2.7. WorkSafeBC – Chlorine Safe Work Practices – Ventilation
  - 2.11.2.8. BSR/IIAR 2-201x – 6.14
  - 2.11.2.9. Additional reference documents for hydrogen:
    - .1 API RP 505 “Recommended Practice for Classification of Locations for Electrical Installations at Petroleum Facilities Classified as Class I, Zone 0, Zone 1, and Zone 2”,
    - .2 NFPA 2A “Hydrogen Technologies Code”, CAN/BNQ 1784-000 “Canadian Hydrogen Installation Code”,
    - .3 IEC 60079-10-1 “Explosive atmospheres - Part 10-1: Classification of areas - Explosive gas atmospheres”,
    - .4 CSA B401 maintenance facilities code series (.1 natural gas, .2 propane and upcoming .3 hydrogen).
- 2.11.3. Be designed according to best practices specific to:
- 2.11.3.1. The gas in question
  - 2.11.3.2. The systems and equipment containing the gas in question
  - 2.11.3.3. Presence of other contaminants including other flammable and explosive gases and compounds which can result in cross sensitivity issues and nuisance alarm
- 2.11.4. Employ control sequences designed to interlock with the gas detection system
- 2.11.5. Ensure adequate outdoor air flow to make-up exhaust air flow
- 2.11.6. Be engineered to achieve sufficient dilution of the gas, accounting for the following:
- 2.11.6.1. Density of the gas relative to that of the ambient air
  - 2.11.6.2. Location of exhaust inlets

- 2.11.6.3. Location of make-up or supply air outlets relative to exhaust inlet locations to avoid short-circuiting of ventilation
- 2.11.6.4. Location in the space where the gas is most likely to accumulate
- 2.11.7. Installation and commissioning
- 2.11.8. All gas detection systems shall be installed by either of the following:
  - 2.11.8.1. Red seal journeyman electrician
  - 2.11.8.2. Certified factory installer
- 2.11.9. Sensors must be kept clean, and clear of any dust or debris, throughout construction. Where available, use manufacturer recommended cover or lid kits to prevent contaminant ingress.
- 2.11.10. All gas detection systems shall be commissioned. The City of Edmonton commissioning manual shall be followed, in addition to the commissioning guidelines listed below.
- 2.11.11. Commissioning shall be verified by an independent commissioning agent, and not by the controls contractor.
- 2.11.12. The commissioning process must confirm that all gas detection systems:
  - 2.11.12.1. Are properly installed in conformance to the guidelines stated herein
  - 2.11.12.2. Measure the correct concentration of gases, as tested by an independent calibrated gas
  - 2.11.12.3. Activate correct ventilation equipment as per the design control sequence according to the corresponding gas concentration stages
  - 2.11.12.4. Engage correct audible and visual alarms according to the corresponding gas concentration stages
  - 2.11.12.5. Signal to correct external monitoring parties (i.e. City of Edmonton Corporate Security for response from Facility Maintenance and Fire Rescue Services) according to the corresponding gas concentration stages
- 2.11.13. The commissioning process shall include static and functional check sheets that confirm, in writing, all points listed under 2.12.5.
- 2.11.14. The ventilation system shall be balanced to confirm proper flow is achieved through each supply inlet and exhaust outlet.
- 2.11.15. A separate verification sheet is to be completed for each sensor and each input and output point on all controllers. Each verification sheet is to be dated and signed by the commissioning provider. Each sheet shall include the expected value for the point being tested and the actual value measured with an independent portable device at the time of the commissioning dynamic test.
- 2.11.16. Each sequence shall be recorded in a separate verification sheet. The sheet shall be dated and signed by the commissioning agent and include a description of the sequence.
- 2.11.17. If the gas detection system has building automation system connection capability, the system's integration with the building automation system shall be verified in the commissioning process.
- 2.11.18. For any spaces that require ventilation for both normal operation and high flow operation, a single variable speed fan shall not be used to satisfy both conditions. An additional fan is required for high

flow operation.

## 2.12. System configuration

- 2.12.1. All gas detection system components (i.e. sensors, controllers, visual and audible alarms) shall have hard-wired power and control connections to each other. The only digital communication allowed is from a sensor to the controller and from the controller to a remote display.
  - 2.12.1.1. Wireless communication is not acceptable.
  - 2.12.1.2. Digital communication from the controller to any other components (i.e. fans, alarms, etc.) is not acceptable.
  - 2.12.1.3. Splices within wiring are not acceptable. Marrettes shall not be installed within wiring. If multiple wires are required, a terminal block shall be installed either in dedicated enclosures or in the enclosures where sensor array controllers are located. Additional manufacturer relay modules are also acceptable.
- 2.12.2. All gas detection systems shall use dedicated gas detection controllers to control dependent components, such as visual and audible signaling devices, and exhaust and supply fans. The gas detection system shall be a standalone control system. Sensors shall not be routed directly to a building automation system. The exception to this is CO and NO<sub>2</sub> in parking garages, arenas, and fire station apparatus bays which can activate ventilation via the BAS.
- 2.12.3. Gas detection system outputs for control of mechanical equipment, such as ventilation, shall be made through dry contact connections. There shall be a separate status signal using a current transducer for all mechanical equipment to the building automation system. Where the BAS is needed to control equipment under regular circumstances, the gas detection controller command shall override the BAS control signal.
- 2.12.4. Gas detection system shall, to the extent practical, have the capability to output data (including measured gas concentrations) for trending to the building automation system through analog outputs (4–20 mA or 0–10 V) or binary outputs (i.e. relays). Digital communication is not acceptable.
- 2.12.5. All gas detection systems shall be monitored for status by the building automation system (where it exists). The following points (application-dependent) shall be monitored:
  - 2.12.5.1. Measured gas concentration
  - 2.12.5.2. Low concentration gas detection status
  - 2.12.5.3. High concentration gas detection status
  - 2.12.5.4. Call for low ventilation rate
  - 2.12.5.5. Call for high ventilation rate
- 2.12.6. All gas detection system-related wiring shall be installed in conduit. The system shall not have any exposed wiring. All conduits shall have colour indication (painted in a contrasting colour or with coloured banding) to distinguish it as a safety system. All gas detection system-related wiring shall be protected by means appropriate for the area classification.
- 2.12.7. Gas detection call-outs to City of Edmonton Corporate Security shall be achieved by a dry contact connection from the gas detection system to the security system, and not through the building

automation system.

- 2.12.8. A single gas detection system controller shall not be used to detect two or more different gas types. Exception: Carbon monoxide and nitrogen dioxide will be allowed to be detected by a single, combined gas detection system comprised of one controller, provided it is designed for that purpose. In this case, all outputs and alarms shall be independent for each gas.
- 2.12.9. Please ensure that the 120V power source for the gas detection is on a dedicated circuit with a lockable breaker. Please contact Facility Engineering to see if the device needs to be placed on emergency power or have an uninterruptible power source.
- 2.12.10. Please ensure to use manufacturer approved 24VDC power supply. City basis of design is the Honeywell M600400 or approved equal.

### **3. Carbon monoxide (CO) - Repair garages, specified mechanical rooms, fire station apparatus bays**

#### 3.1. Application

- 3.1.1. A gas detection system shall be installed in any location where the concentrations of the gas is plausible in a concentration exceeding the low alarm point stated in Table 1.<sup>9</sup>
- 3.1.2. A carbon monoxide gas detection system is required in all arenas and associated mechanical spaces where ice resurfacing machines are operated and stored.
- 3.1.3. All mechanical/electrical rooms in recreational facilities housing non-sealed-combustion gas burning equipment shall include carbon monoxide (CO) monitoring.

#### 3.2. System performance criteria

- 3.2.1. No additional specific requirements.

#### 3.3. System configuration

- 3.3.1. Sensors shall be mounted at occupant breathing elevation or low elevation, at the engineer's discretion, according to the following considerations:
  - 3.3.1.1. Location of the gas source
  - 3.3.1.2. Airflow patterns in the space
  - 3.3.1.3. Location where the gas is most likely to accumulate

#### 3.4. Alarm delay period

- 3.4.1. The alarm delay period, as specified in 2.6.1, shall be 60 seconds, unless otherwise determined by the design engineer.

#### 3.5. Visual and audible alarm specifications

- 3.5.1. Visual and audible alarms shall be located at each of the following locations:
  - 3.5.1.1. Inside the space containing the gas
  - 3.5.1.2. Any other location required to provide warning of the hazardous gas concentration

<sup>9</sup> Occupational Health & Safety Code – Part 4: An employer must ensure that a worker's exposure to any substance [...] does not exceed its occupational exposure limits [...]. The high alarm point is set to indicate that the gas concentration has reached a potentially harmful level.



### 3.6. Label and sign specifications

3.6.1. No additional specific requirements.

### 3.7. Control sequence of operation requirements

3.7.1. Upon exceeding a concentration equal to the ventilation activation concentration (stated in Table 1), the mechanical ventilation system complying with 2.11 shall be activated or increased to high speed to exhaust air from the space and introduce outdoor air to the space.

3.7.2. Upon exceeding a concentration equal to the low alarm activation concentration (stated in Table 1), the visual alarms shall be activated. A notification of low concentration shall be sent to City of Edmonton Corporate Security for response from Facility Maintenance and the Facility Supervisor.

3.7.3. Upon exceeding a concentration equal to the high alarm activation concentration (stated in Table 1), the audible alarms shall be activated. A notification of high concentration shall be sent to City of Edmonton Corporate Security for response from Fire Rescue Services and notification to Facility Maintenance.

## 4. **Carbon monoxide (CO) - Storage garages / parking garages**

### 4.1. Application

4.1.1. Storage garages (as defined by the Alberta Building Code) require gas detection systems to monitor and control the gas concentration.

### 4.2. System performance criteria

4.2.1. No additional specific requirements.

### 4.3. System configuration

4.3.1. Sensors shall be mounted at an elevation conforming to the Alberta Building Code for storage garages.

### 4.4. Alarm delay period

4.4.1. The alarm delay period, as specified in 2.6.1, shall be 60 seconds, unless otherwise determined by the design engineer.

### 4.5. Visual and audible alarm specifications

4.5.1. No visual or audible alarms required.

### 4.6. Label and sign specifications

4.6.1. No additional specific requirements.

### 4.7. Control sequence of operation requirements

4.7.1. Meet Alberta Building Code requirements under 'Ventilation of Storage Garages'

## 5. **Nitrogen dioxide (NO<sub>2</sub>) - Repair garages, specified mechanical rooms, fire station apparatus bays**

### 5.1. Application

5.1.1. A gas detection system shall be installed in any location where the concentrations of the gas

corresponding to this section is plausible in a concentration exceeding the low alarm point stated in Table 1.<sup>10</sup>

- 5.1.2. System performance criteria
- 5.1.3. No additional specific requirements.
- 5.2. System configuration
  - 5.2.1. Sensors shall be mounted at occupant breathing elevation or low elevation, at the engineer's discretion, according to the following considerations:
    - 5.2.1.1. Location of the gas source
    - 5.2.1.2. Airflow patterns in the space
  - 5.2.2. Location where the gas is most likely to accumulate
- 5.3. Alarm delay period
  - 5.3.1. The alarm delay period, as specified in 2.6.1, shall be 60 seconds, unless otherwise determined by the design engineer.
- 5.4. Visual and audible alarm specifications
  - 5.4.1. Visual and audible alarms shall be located at each of the following locations:
    - 5.4.1.1. Inside the space containing the gas
    - 5.4.1.2. Any other location required to provide warning of the hazardous gas concentration
- 5.5. Label and sign specifications
  - 5.5.1. No additional specific requirements
- 5.6. Control sequence of operation requirements
  - 5.6.1. Upon exceeding a concentration equal to the ventilation activation concentration (stated in Table 1), the mechanical ventilation system complying with 2.11.1 shall be activated or increased to high speed to exhaust air from the space and introduce outdoor air to the space.
  - 5.6.2. Upon exceeding a concentration equal to the low alarm activation concentration (stated in Table 1), the visual alarms shall be activated. A notification of low concentration shall be sent to City of Edmonton Corporate Security for response from Facility Maintenance and the Facility Supervisor.
  - 5.6.3. Upon exceeding a concentration equal to the high alarm activation concentration (stated in Table 1), the audible alarms shall be activated. A notification of high concentration shall be sent to City of Edmonton Corporate Security for response from Fire Rescue Services and notification to Facility Maintenance.

## **6. Nitrogen dioxide (NO<sub>2</sub>) - Storage garages / parking garages**

- 6.1. Application
  - 6.1.1. Storage garages (as defined by the Alberta Building Code) require gas detection systems to monitor and control the gas concentration ("where the majority of the vehicles stored are powered

---

<sup>10</sup> Occupational Health & Safety Code – Part 4: An employer must ensure that a worker's exposure to any substance [...] does not exceed its occupational exposure limits [...]. The high alarm point is set to indicate that the gas concentration has reached a potentially harmful level.

by diesel-fuelled engines”).

6.2. System performance criteria

6.2.1. No additional specific requirements.

6.3. System configuration

6.3.1. Sensors shall be mounted at an elevation conforming to the Alberta Building Code.

6.4. Alarm delay period

6.4.1. The alarm delay period, as specified in 2.6.1, shall be 60 seconds, unless otherwise determined by the design engineer.

6.5. Visual and audible alarm specifications

6.5.1. No visual and audible alarms required.

6.6. Label and sign specifications

6.6.1. No additional specific requirements

6.7. Control sequence of operation requirements

6.7.1. Meet Alberta Building Code requirements under 6.3.1.4—Ventilation of Storage Garages

## 7. Chlorine (Cl<sub>2</sub>)

7.1. Application

7.1.1. A gas detection system shall be installed in any location where the concentrations of the gas corresponding to this section is plausible in a concentration exceeding the low alarm point stated in Table 1.<sup>11</sup>

7.1.2. A gas detection system shall be installed in any pool chlorine room.

7.2. System performance criteria

7.2.1. No specific requirements.

7.3. System configuration

7.3.1. Sensor(s) shall be located at low elevation.

7.3.2. A minimum of one sensor shall be installed at an optimal location for sensing a gas leak from the most probable source and where the gas is most likely to accumulate. The sensor(s) shall be installed as close as practical to the chlorine cylinders and their associated tubing, valves, regulators, etc., without impeding the movements necessary to change chlorine bottles.

7.3.3. An additional gas detection sensor shall be installed at occupant breathing elevation if the room is large enough that the sensor at low elevation does not have sufficient range for detecting chlorine gas at occupant breathing elevation where occupants will most probably be located while inside the chlorine room. Within that elevation’s horizontal plane, the sensor(s) shall be located where the gas is most likely to accumulate, and where occupants will most probably be located whilst inside the

---

<sup>11</sup> Occupational Health & Safety Code – Part 4: An employer must ensure that a worker’s exposure to any substance [...] does not exceed its occupational exposure limits [...]. The high alarm point is set to indicate that the gas concentration has reached a potentially harmful level.

chlorine room.

- 7.3.4. The gas detection controller shall be located immediately outside the chlorine room, inside the building. The controller shall be clearly visible before entering the chlorine room. The controller shall be located adjacent to the viewing window.
- 7.3.5. All requirements under the Alberta Building Code - Aquatic Facilities section with respect to the chlorine gas detection system and the associated ventilation system shall be followed.

7.4. Alarm delay period

- 7.4.1. There shall be no alarm delay.

7.5. Visual and audible alarm specifications

- 7.5.1. Visual and audible alarms shall be located at each of the following locations:

- 7.5.1.1. Outside the building near the chlorine room door
- 7.5.1.2. Inside the building but outside the chlorine room near the chlorine room's viewing window
- 7.5.1.3. Inside the chlorine room
- 7.5.1.4. On the pool deck in a clearly visible location
- 7.5.1.5. At the guest services counter

- 7.5.2. Audible alarms shall be located such that the complete natatorium and its related spaces (locker room, pool mechanical room) are covered by the audible range of the alarms.

7.6. Label and sign specifications

- 7.6.1. No additional specific requirements.

7.7. Control sequence of operation requirements

- 7.7.1. The exhaust ventilation system shall be turned on only manually by the chlorine room ventilation wall switch. The chlorine detection system shall not activate the exhaust ventilation system.
- 7.7.2. Upon exceeding a concentration equal to the low alarm activation concentration (stated in Table 1), the visual alarms shall be activated.
- 7.7.3. Upon exceeding a concentration equal to the high alarm activation concentration (stated in Table 1), the audible alarms shall be activated. A notification of high concentration shall be sent to City of Edmonton Corporate Security for response from Fire Rescue Services and notification to Facility Maintenance.

**8. Hydrocarbons – i.e. natural gas and methane (CH<sub>4</sub>), propane (C<sub>3</sub>H<sub>8</sub>), acetylene (C<sub>2</sub>H<sub>2</sub>)**

8.1. Application

- 8.1.1. A gas detection system shall be installed in any location where the concentrations of the gas corresponding to this section is plausible in a concentration exceeding the low alarm point stated in Table 1.<sup>12</sup>

---

<sup>12</sup> Occupational Health & Safety Code – Part 4: An employer must ensure that a worker's exposure to any substance [...] does not exceed its occupational exposure limits [...]. The high alarm point is set to indicate that the gas concentration has reached a potentially harmful level.

8.1.2. A natural gas detection system is required in all arenas and associated mechanical spaces where ice resurfacing machines are operated.

8.2. System performance criteria

8.2.1. Consider specifying a spark resistant exhaust fan for hydrocarbon extraction..

8.3. System configuration

8.3.1. Any gas with sufficiently low density to require a sensor or sensors to be installed at high elevation (i.e. natural gas and methane, as stated in 6.4.7), the sensor or sensors shall be capable of being calibrated without using a ladder.

8.3.2. If the gas is less dense than air, the sensor(s) shall be located at high elevation.

8.3.3. If the gas's density is similar to air, the sensor(s) shall be mounted at occupant breathing elevation.

8.3.4. If the gas is more dense than air, the sensor(s) shall be mounted at low elevation.

8.3.5. The gas detection sensor shall be located in the same space as the hydrocarbon gas equipment and source. The specific location must be designed according to the gas type, room configurations, and manufacturer's recommendations.

8.3.6. The gas detection controller shall be located immediately outside the space containing the natural gas appliance. If this is not possible, then the controller shall be located a safe distance away from the natural gas equipment and source, and be rated for the location in which it is installed.

8.3.7. Where a vehicle is fuelled indoors:

8.3.7.1. The gas detection sensors shall:<sup>13</sup>

- .1 Be interlocked to shut off the vehicle refuelling appliance

8.3.7.2. The mechanical ventilation system serving the fuelling area shall:<sup>14</sup>

- .1 Vent the fuelling area to the outdoors at a flow rate of 25 times the flow rate of the vehicle refuelling appliance
- .2 Provide for minimum clearances from the discharge as specified in Table 5.2 in CSA B149.1 (see the table directly in the CSA standard)

8.4. Alarm delay period

8.4.1. The alarm delay period, as specified in 2.6.1, shall be 10 seconds, unless otherwise determined by the design engineer.

8.5. Visual and audible alarm specifications

8.5.1. A visual and audible alarm shall be located outside the building near the space containing the gas equipment and source, near the outside door.

8.5.2. Visual and audible alarms shall be located at each of the following locations:

8.5.2.1. Inside the building but outside the space containing the gas equipment and source, near the door to the space

---

<sup>13</sup> CSA B149.1 – 10.1.6

<sup>14</sup> CSA B149.1 – 10.1.7

- 8.5.2.2. Inside the space containing the gas equipment and source
- 8.5.2.3. Outside the space near each door accessing the space
- 8.5.2.4. Inside the rink attendant office.
- 8.5.2.5. If the arena facility has a pool, at the guest services counter.
- 8.6. Label and sign specifications
  - 8.6.1. No additional specific requirements.
- 8.7. Control sequence of operation requirements
  - 8.7.1. The ventilation system shall be turned on automatically any time the ice resurfacing machine fuelling station is active.
  - 8.7.2. Upon exceeding a concentration equal to the ventilation activation concentration (stated in Table 1), the mechanical ventilation system complying with 2.11.1 shall be activated to exhaust air from the space and introduce outdoor air to the space. The vehicle refuelling appliance shall be switched off automatically.
  - 8.7.3. Upon exceeding a concentration equal to the low alarm activation concentration (stated in Table 1), the visual alarms shall be activated. A notification of low concentration shall be sent to City of Edmonton Corporate Security for response from Facility Maintenance and the Facility Supervisor. The vehicle refuelling appliance shall be switched off automatically.
  - 8.7.4. Upon exceeding a concentration equal to the high alarm activation concentration (stated in Table 1), the audible alarms shall be activated. A notification of high concentration shall be sent to City of Edmonton Corporate Security for response from Fire Rescue Services and notification to Facility Maintenance. The vehicle refuelling appliance shall be switched off automatically.

## **9. Refrigerants (i.e. Ammonia [NH<sub>3</sub>], R-22, R-422B, R-410A, R-134a)**

- 9.1. Application
  - 9.1.1. A gas detection system shall be installed in any location where the concentrations of the gas corresponding to this section is plausible in a concentration exceeding the low alarm point stated in Table 1.<sup>15</sup>
  - 9.1.2. A refrigerant vapour detection system shall be installed in any corresponding refrigeration machinery room.<sup>16</sup>
  - 9.1.3. A gas detection system shall be installed wherever one is required by CSA B52.
- 9.2. System performance criteria
  - 9.2.1. Follow all gas detection requirements in CSA B52 for machinery rooms and Class T machinery rooms (where applicable).
  - 9.2.2. For ammonia detection in small spaces with potential for ammonia leaks, the gas detection system shall employ a combination of low and high concentration sensors such that the gas detection system accurately detects both toxic concentrations (low) and explosive concentrations (high) of

<sup>15</sup> Occupational Health & Safety Code – Part 4: An employer must ensure that a worker’s exposure to any substance [...] does not exceed its occupational exposure limits [...]. The high alarm point is set to indicate that the gas concentration has reached a potentially harmful level.

<sup>16</sup> CSA B52 – 6.2.3

ammonia. This is so that the gas detection system will continue to measure and display concentrations if the concentration is approaching explosive levels. For all other ammonia detection applications, where the risk of an explosive concentration of ammonia are sufficiently low, a low concentration sensor shall be employed.

9.2.3. The gas detection system shall include a means of manual reset. The gas detection system shall require a manual reset following a detection of gas.<sup>17</sup> The controller shall not allow a manual reset to be completed whenever the alarm low or high status is active.

9.2.4. The ventilation exhaust system serving the room containing the refrigeration machinery shall be designed including the full requirements of CSA B52 and ASHRAE 15 and 34. For example, see section 6.3 in CSA B52 and section 8.11.3 in ASHRAE 15 and 34.

### 9.3. System configuration

#### 9.3.1. Gas detection zones

9.3.1.1. If the refrigeration machinery is located in a Class T machinery room: A minimum of two zones shall be established: one inside the refrigeration machinery room and one in any adjacent public area connected by an interior door.

- .1 A gas detection event in a zone shall only activate ventilation and visual and audible alarms for that zone, and not for any other zone.  
 E.g. If a leak is detected in the machinery room zone, then the visual and audible alarms associated with the machinery room zone shall be activated. The visual and audible alarms associated with the other zones shall not be activated.

9.3.1.2. If existing refrigeration machinery is not located in a Class T machinery room: The machinery room and all adjacent public spaces shall be considered part of the same zone. A single refrigerant gas detection zone shall encompass all areas at risk of exposure to a refrigeration system leak.

- .1 A gas detection event in the single zone shall activate ventilation and visual and audible alarms for that zone.  
 E.g. If a leak is detected in the machinery room, then the visual and audible alarms associated with the single zone shall be activated.

#### 9.3.2. Controller location

9.3.2.1. If the refrigeration machinery is located in a Class T machinery room:

- .1 If the refrigeration machinery room has a door to the interior of the building: the gas detection controller or controllers shall be located inside the building, inside the machinery room vestibule.
- .2 If the refrigeration machinery room does not have a door to the interior of the building: the gas detection controller shall be located inside the machinery room, near the door. There shall be a weather-proof, tamper-proof, heated enclosure located immediately outside the exterior door containing a secondary visual display, displaying the measured concentration and the alarm status (low or high).

9.3.2.2. If the refrigeration machinery is not located in a Class T machinery room:

---

<sup>17</sup> In accordance with ASHRAE 15 and 34 – 8.11.2.1



- .1 If the refrigeration machinery room has a door to the interior of the building: the gas detection controller shall be located inside the building, immediately outside the door to the machinery room.
- .2 If the refrigeration machinery room does not have a door to the interior of the building: the gas detection controller shall be located inside the machinery room, near the door. There shall be a weather-proof, tamper-proof, heated enclosure located immediately outside the exterior door containing a secondary visual display, displaying the measured concentration and the alarm status (low or high).

9.3.2.3. Ensure that gas detection controllers for the machinery room and public zones are located so that it is clear which space each controller serves. (i.e. not side by side).

9.3.3. Sensor location

9.3.3.1. Machinery room zone:

- .1 For refrigerants other than ammonia: In the machinery room, a minimum of one gas detection sensor shall be located where leaked refrigerant will concentrate.<sup>18</sup> If the gas is more dense than air, the sensor(s) shall be mounted at *low elevation*.
- .2 For ammonia: In the machinery room, a minimum of two gas detection sensors shall be installed in rooms of up to 370 m<sup>2</sup> of floor area and an additional sensor shall be installed for every 185 m<sup>2</sup> of additional floor area. Both sensors shall be located in a location where, under continuous low ventilation, a leak will concentrate. Normally, the location where a leak will concentrate shall be between the refrigeration equipment and the nearest exhaust intake, unless determined otherwise by the design professional.
  - A minimum of one sensor shall be installed at high elevation (for initial leaked ammonia vapour—lighter than air).<sup>19</sup>
  - A minimum of one sensor shall be installed at *low elevation* (for humidified leaked ammonia—potentially heavier than air).

9.3.3.2. Adjacent public area zone:

- .1 If the machinery room has an interior door, a minimum of one gas detection sensor shall be located inside the building, immediately outside the door to the machinery room door (and vestibule). Sensors shall be located for the purpose of protecting occupants. If the gas is more dense than air, the sensor(s) shall be mounted at *low elevation*. In the case of ammonia, the sensor shall be mounted at high elevation.

9.3.3.3. Please contact Facility Engineering to see if an ammonia sensor needs to be installed in the emergency discharge pipe. This is so that, if the refrigeration system's pressure-relief valves open and discharge ammonia to the outdoors, the gas detection system is alerted. This shall be on a third, separate zone.

9.3.4. The mechanical ventilation system (exhaust and make-up air) serving the machinery room shall be on a separate electrical circuit.<sup>20</sup>

9.3.5. A fan ON switch controlling the machinery room ventilation shall be installed immediately outside

<sup>18</sup> In accordance with ASHRAE 15 and 34

<sup>19</sup> In accordance with ASHRAE 15 and 34

<sup>20</sup> In accordance with ASHRAE 15 and 34

each machinery room door. This fan switch shall only allow the ventilation to be turned 'on.'<sup>21</sup> The fan switch shall comply with CSA B52 (2013) – 6.2.5.4. For exterior doors, the fan switch shall be mounted outdoors and shall be rated for the outdoors. For interior doors, the fan switch shall be mounted outside the vestibule.

- 9.3.6. One fan ON switch and one fan OFF switch controlling the machinery room ventilation shall be installed immediately inside the machinery room, beside the door. These fan switches shall allow the ventilation to be turned on and off. The gas detection system fan control shall override the fan switch 'off' position whenever the gas detection system commands the ventilation to be activated. The fan switch shall comply with CSA B52 (2013) – 6.2.5.4.<sup>22</sup>
- 9.3.7. The ventilation fan ON and OFF switches shall be separate push-button style (i.e. one push button for ON and one push button for OFF). The switches shall be mounted approximately at eye-level (i.e. 1,500 mm above the floor). Each switch shall have a label indicating whether it is 'ventilation ON' or 'ventilation OFF'.
- 9.3.8. Where the BAS is needed to control equipment under regular circumstances, the manual ON and OFF switches shall override the BAS control signal.
- 9.3.9. A display screen shall be installed immediately outside the main machinery room door, displaying the measured concentration in the machinery room zone. This shall allow a person to verify the concentration measured inside the machinery room before entering the vestibule.

#### 9.4. Alarm delay period

- 9.4.1. The alarm delay period, as specified in 2.6.1, shall be 10 seconds, unless otherwise determined by the design engineer.

#### 9.5. Visual and audible alarm specifications

- 9.5.1. A visual and audible alarm for each refrigerant gas detection zone shall be located inside the rink attendant office.
- 9.5.2. If the arena facility has a pool, a visual and audible alarm for each refrigerant gas detection zone shall be located at the guest services counter.
- 9.5.3. Visual and audible alarms serving machinery room and adjacent public area gas detection zones:
  - 9.5.3.1. If the refrigeration machinery is located inside a Class T machinery room:
    - .1 Alarms for the machinery room zone shall be located at each of the following locations:
      - Inside the machinery room
      - Outside any interior door to the machinery room, outside the vestibule, immediately above the door
      - Outside any exterior door to the machinery room, immediately above the door
    - .2 If there is a door (and vestibule) connecting the machinery room to the building's interior: alarms for the adjacent public area zone shall be located in a location that is clearly visible by occupants of the adjacent public area. Ensure that the alarms are located such that it is clear the alarms are for the public area and not the mechanical room.

- 9.5.3.2. If the refrigeration machinery is not located inside a Class T machinery room:

<sup>21</sup> In accordance with CSA B52 – 6.2.5.4

<sup>22</sup> In accordance with ASHRAE 15 and 34 and CSA B52 – 6.2

- .1 Alarms shall be located at each of the following locations:
  - Inside the machinery room
  - Outside any interior door to the machinery room, immediately above the door
  - Outside any exterior door to the machinery room, immediately above the door
  - In the adjacent public area, in a location that is clearly visible by occupants of the adjacent public area

9.5.4. Wherever the alarms for two (or more) zones are located in the same room (i.e. the rink attendant office or the front desk), the alarms for each zone shall be separated by a minimum of 600 mm.

E.g. Within the rink attendant office, the visual and audible alarms for the machinery room zone shall be mounted together, and the visual and audible alarms for the adjacent public area zone shall be mounted together, but these two alarm sets shall be separated by a minimum of 600 mm.

This is so that the alarms from different zones are not confused.

#### 9.6. Label and sign specifications

9.6.1. Visual alarms, audible alarms, controllers, and sensors, shall be labelled according to the following nomenclature:

9.6.1.1. If the refrigeration machinery is located inside a Class T machinery room:

- .1 Equipment related to the gas detection zone covering the machinery room: “Refrigerant Ice Plant Machinery Room” (for ammonia: “Ammonia Ice Plant Machinery Room”)
- .2 Equipment related to the gas detection zone covering the adjacent public areas: “Refrigerant Arena Space”

9.6.1.2. If the refrigeration machinery is not located inside a Class T machinery room:

- .1 Equipment related to the gas detection zone covering the machinery room and adjacent public areas: “Refrigerant Ice Plant Machinery Room and Arena Space” (for ammonia: “Ammonia Ice Plant Machinery Room and Arena Space”)

#### 9.7. Control sequence of operation requirements

9.7.1. If required under CSA B52,<sup>23</sup> in the event of a refrigerant leak at a level not exceeding the refrigerant threshold limit value or time-weighted average as measured by the gas detection system, any combustion equipment located in the space shall be shut down.

9.7.2. If any combustion equipment is located in the room containing refrigerant or refrigeration machinery, the gas detection system shall shut down the combustion process in the event of a refrigeration leak.<sup>24</sup>

9.7.3. Upon exceeding a concentration equal to the ventilation activation concentration (stated in Table 1), the mechanical ventilation system shall be activated, or increased to high flow, to exhaust air from the space and introduce outdoor air to the space.

9.7.4. Upon exceeding a concentration equal to the low alarm activation concentration (stated in Table 1), the visual alarms shall be activated. A notification of low concentration shall be sent to City of

<sup>23</sup> See CSA B52 – 6.2.4.3

<sup>24</sup> In accordance with ASHRAE 15 and 34

Edmonton Corporate Security for response from Facility Maintenance and the Facility Supervisor.

- 9.7.5. Upon exceeding a concentration equal to the high alarm activation concentration (stated in Table 1), the audible alarms shall be activated. A notification of high concentration shall be sent to City of Edmonton Corporate Security for response from Fire Rescue Services and notification to Facility Maintenance.

## 10. Ozone (O<sub>3</sub>)

### 10.1. Application

- 10.1.1. A gas detection system shall be installed in any location where the concentrations of the gas corresponding to this section is plausible in a concentration exceeding the low alarm point stated in Table 1.<sup>25</sup>
- 10.1.2. Gas detection is required in any ozone room, in accordance with WorkSafeBC's Ozone Safe Work Practices guidelines.

### 10.2. System performance criteria

- 10.2.1. The gas concentrations stated in Table 1 are contingent upon an air volume of 10 air changes per hour being provided to all spaces using ozone outside of the ozone room (i.e. the mechanical room) in accordance with WorkSafeBC's Ozone Safe Work Practices guidelines. The ventilation for any space using ozone must also be independent of the ventilation for any other portion of the facility.

### 10.3. System configuration

- 10.3.1. Sensor(s) shall be installed at low elevation.
- 10.3.2. The gas detection sensor shall be located inside the ozone generator room, near the ozone generator, between the generator and the destructor.<sup>26</sup>
- 10.3.3. If the ozone generator system has a reaction tank or destructor further than 5 m away from the gas detection sensor described in 9.4.1, that reaction tank or destructor shall have an additional gas detection sensor.<sup>27</sup>

### 10.4. Alarm delay period

- 10.4.1. The alarm delay period, as specified in 2.6.1, shall be 10 seconds, unless otherwise determined by the design engineer.

### 10.5. Visual and audible alarm specifications

- 10.5.1. Visual and audible alarms shall be located at each of the following locations:
- 10.5.1.1. Inside the space containing the gas
  - 10.5.1.2. Outside the space near each door accessing the space

### 10.6. Label and sign specifications

<sup>25</sup> Occupational Health & Safety Code – Part 4: An employer must ensure that a worker's exposure to any substance [...] does not exceed its occupational exposure limits [...]. The high alarm point is set to indicate that the gas concentration has reached a potentially harmful level.

<sup>26</sup> WorkSafeBC – Ozone Safe Work Practices

<sup>27</sup> WorkSafeBC – Ozone Safe Work Practices

10.6.1. No additional specific requirements.

10.7. Control sequence of operation requirements

- 10.7.1. The ventilation system, **operating at normal volume**, shall be turned on any time the ozone generator is active.
- 10.7.2. Upon exceeding a concentration equal to the ventilation activation concentration (stated in Table 1), the mechanical ventilation system shall be activated, **or increased to high flow**, to exhaust air from the space and introduce outdoor air to the space. The ozone generator shall be turned off.<sup>28</sup>
- 10.7.3. Upon exceeding a concentration equal to the low alarm activation concentration (stated in Table 1), the visual alarms shall be activated. A notification of low concentration shall be sent to City of Edmonton Corporate Security for response from Facility Maintenance.
- 10.7.4. Upon exceeding a concentration equal to the high alarm activation concentration (stated in Table 1), the audible alarms shall be activated. A notification of high concentration shall be sent to City of Edmonton Corporate Security for response from Fire Rescue Services and notification to Facility Maintenance.

## 11. Carbon dioxide (CO<sub>2</sub>)

11.1. Application

- 11.1.1. A gas detection system shall be installed in any location where the concentrations of the gas corresponding to this section is plausible in a concentration exceeding the low alarm point stated in Table 1.<sup>29</sup>
- 11.1.2. A gas detection system shall be installed in any enclosed space containing a carbon dioxide storage tank or piping. This includes indoor spaces housing carbon dioxide bulk storage and distribution piping for pool pH control.

11.2. System performance criteria

- 11.2.1. No additional specific requirements.

11.3. System configuration

- 11.3.1. In occupied spaces, sensor(s) shall be mounted at occupant breathing elevation.
- 11.3.2. In mechanical spaces, sensor(s) shall be installed at low elevation. If the mechanical space has occupant traffic as part of normal operations (i.e. pool mechanical room), and the mechanical space is large enough for two sensors to be needed, then 10.4.1 shall also apply.
- 11.3.3. The gas detection sensor(s) shall be located in the same space as the carbon dioxide injection point into the pool water circulation system, in a location where the gas will accumulate. Gas detection sensors shall also be located in any space that contains carbon dioxide piping or a carbon dioxide bulk storage tank.
- 11.3.4. **The gas detection controller shall be located immediately outside the space containing the carbon dioxide tank or piping. If this is not possible, then the controller shall be located a safe distance away from the carbon dioxide equipment and source, and be rated for the location in which it is**

<sup>28</sup> WorkSafeBC – Ozone Safe Work Practices

<sup>29</sup> Occupational Health & Safety Code – Part 4: An employer must ensure that a worker’s exposure to any substance [...] does not exceed its occupational exposure limits [...]. The high alarm point is set to indicate that the gas concentration has reached a potentially harmful level.

installed.

11.4. Alarm delay period

11.4.1. The alarm delay period, as specified in 2.6.1, shall be 10 seconds, unless otherwise determined by the design engineer.

11.5. Visual and audible alarm specifications

11.5.1. Visual and audible alarms shall be located at each of the following locations:

- 11.5.1.1. In the space where the carbon dioxide injection equipment is located, in a clearly visible location
- 11.5.1.2. On the pool deck in a clearly visible location
- 11.5.1.3. At the guest services counter

11.6. Label and sign specifications

11.6.1. Display ventilation and alarm activation concentrations in percent, and display converted values to PPM as reference.

11.7. Control sequence of operation requirements

- 11.7.1. Upon exceeding a concentration equal to the ventilation activation concentration (stated in Table 1), the mechanical ventilation system complying with 2.11.1 shall be activated to exhaust air from the space and introduce outdoor air to the space.
- 11.7.2. Upon exceeding a concentration equal to the low alarm activation concentration (stated in Table 1), the visual alarms shall be activated. A notification of low concentration shall be sent to City of Edmonton Corporate Security for response from Facility Maintenance.
- 11.7.3. Upon exceeding a concentration equal to the high alarm activation concentration (stated in Table 1), the audible alarms shall be activated. A notification of high concentration shall be sent to City of Edmonton Corporate Security for response from Fire Rescue Services and notification to Facility Maintenance.

## **12. Hydrogen (H<sub>2</sub>) - Generated via pool sanitization equipment**

12.1. Application

- 12.1.1. A gas detection system shall be installed in any location where the concentrations of the gas corresponding to this section is plausible in a concentration exceeding the low alarm point stated in Table 1.<sup>30</sup>
- 12.1.2. A gas detection system shall be installed in any enclosed space containing hydrogen generation equipment or exhaust piping.
- 12.1.3. The requirements in this section are for small sources of hydrogen being generated as a by-product of pool sanitization equipment.

12.2. System performance criteria

12.2.1. No specific requirements.

---

<sup>30</sup> Occupational Health & Safety Code – Part 4: An employer must ensure that a worker’s exposure to any substance [...] does not exceed its occupational exposure limits [...]. The high alarm point is set to indicate that the gas concentration has reached a potentially harmful level.



### 12.3. System configuration

- 12.3.1. Sensor(s) are to be installed at high elevation and the sensor(s) shall be capable of being calibrated from ground level without using a ladder. Sensor(s) are to be located a minimum of one foot below the ceiling.
- 12.3.2. Sensors are to be installed at Stagnation points near the ceiling, or below platform or equivalent structure / horizontal surfaces where hydrogen may accumulate as a result of a leak,
- 12.3.3. The gas detection sensor(s) shall be located in the same space as the source equipment. The specific location must be designed according to room configurations and manufacturer's recommendations. Gas detection sensors shall also be located in any space that contains hydrogen vent piping
- 12.3.4. The gas detection controller shall be located immediately outside the space containing the hydrogen source. If this is not possible, then the controller shall be located a safe distance away from the hydrogen source, and be rated for the location in which it is installed.

### 12.4. Alarm delay period

- 12.4.1. The alarm delay period, as specified in 2.6.1, shall be 10 seconds, unless otherwise determined by the design engineer.

### 12.5. Visual and audible alarm specifications

- 12.5.1. Visual and audible alarms shall be located at each of the following locations:
  - 12.5.1.1. In the space where the hydrogen generation equipment is located, in a clearly visible location
  - 12.5.1.2. On the pool deck in a clearly visible location
  - 12.5.1.3. At the guest services counter
  - 12.5.1.4. Outside the space near each door accessing the space

### 12.6. Label and sign specifications

- 12.6.1. If the hydrogen vent discharges in an accessible location (i.e. the roof) warning signage and no-smoking signage is required in that location

### 12.7. Control sequence of operation requirements

- 12.7.1. Upon exceeding a concentration equal to the ventilation activation concentration (stated in Table 1), the mechanical ventilation system complying with 2.11.1 shall be activated to exhaust air from the space and introduce outdoor air to the space.
- 12.7.2. Upon exceeding a concentration equal to the low alarm activation concentration (stated in Table 1), the visual alarms shall be activated. A notification of low concentration shall be sent to City of Edmonton Corporate Security for response from Facility Maintenance.
- 12.7.3. Upon exceeding a concentration equal to the high alarm activation concentration (stated in Table 1), the audible alarms shall be activated. A notification of high concentration shall be sent to City of Edmonton Corporate Security for response from Fire Rescue Services and notification to Facility Maintenance. A high alarm for hydrogen will "latch" until acknowledged at the controller.



## 13. Hydrogen (H<sub>2</sub>) - Vehicle Storage Garages / Maintenance Areas

### 13.1. Application

- 13.1.1. A gas detection system shall be installed in any location where the concentrations of the gas corresponding to this section is plausible in a concentration exceeding the low alarm point stated in Table 1.<sup>31</sup>
- 13.1.2. A hydrogen gas detection system is required in all parking and service spaces where hydrogen fueled vehicles are operated, stored, and maintained. The requirements listed below are for those spaces.

### 13.2. System performance criteria

- 13.2.1. Each sensor shall be able to be designated a user defined name for the purposes of determining and locating which sensor is in alarm or has failed.
- 13.2.2. The gas detection controller shall be capable of detecting a failed sensor(s) or fault in the gas detection controller and generating an alarm via relay or other method.
- 13.2.3. The power to the gas detection controller shall be monitored and be able to trigger a relay or some other form of alarm to indicate when power to the controller has been interrupted.
- 13.2.4. The gas detection controller will have a battery to provide a minimum of 4 hour runtime in standby mode upon loss of power.

### 13.3. System configuration

- 13.3.1. Sensor(s) are to be installed at high elevation and the sensor(s) shall be capable of being calibrated from ground level without using a ladder. Sensor(s) are to be located a minimum of one foot below the ceiling.
- 13.3.2. Sensors are to be installed at Stagnation points near the ceiling, or below platform or equivalent structure / horizontal surfaces where hydrogen may accumulate as a result of a leak, as well as any low velocity regions of the space's ventilation system.
- 13.3.3. Design of sensor arrays shall be based on a review of all vehicle modes of operations, including both normal and failure modes and their respective H<sub>2</sub> losses, emissions, and crossover, as applicable, as well as the hazardous classification study conducted for the space.
- 13.3.4. The gas detection controller shall be located immediately outside the space containing the hydrogen source. If this is not possible, then the controller shall be located a safe distance away from the hydrogen source, and be rated for the location in which it is installed.
- 13.3.5. Emergency shut down devices shall be installed at exit doors leaving the space where the hydrogen vehicles are stored. Emergency shutdown devices to be labelled with purpose, zone covered and specific equipment being shutdown and other actions that occur upon depression.

### 13.4. Alarm delay period

- 13.4.1. The alarm delay period, as specified in 2.6.1, shall be 10 seconds, unless otherwise determined by the design engineer.

---

<sup>31</sup> Occupational Health & Safety Code – Part 4: An employer must ensure that a worker's exposure to any substance [...] does not exceed its occupational exposure limits [...]. The high alarm point is set to indicate that the gas concentration has reached a potentially harmful level.

### 13.5. Visual and audible alarm specifications

13.5.1. A visual and audible alarm shall be located outside the building near the space containing the gas equipment and source, near the outside door.

13.5.2. Visual and audible alarms shall be located at each of the following locations:

13.5.2.1. Inside the building but outside the space containing the gas equipment and source, near the door to the space.

13.5.2.2. Inside the space containing the gas equipment and source

13.5.2.3. In the remainder of the facility, in a location that is clearly audible by staff and patrons throughout the facility and visible within all common areas of the facility. (Example: The office portion of a hydrogen bus storage garage would require audible alarms to be heard within the individual office spaces, but visuals can be only in common corridors, break-rooms, etc.)

### 13.6. Label and sign specifications

13.6.1. All HVAC equipment that will trigger an alarm upon failure must be identified with placards on the equipment

### 13.7. Control sequence of operation requirements

13.7.1. Upon exceeding a concentration equal to the ventilation activation concentration (stated in Table 1), the mechanical ventilation system complying with 2.11.1 shall be activated to exhaust air from the space and introduce outdoor air to the space.

13.7.2. Upon exceeding a concentration equal to the low alarm activation concentration (stated in Table 1), the visual alarms shall be activated. A notification of low concentration shall be sent to City of Edmonton Corporate Security for response from Facility Maintenance. All unclassified electrical equipment and circuits posing an explosion risk will also be interrupted. Overhead exterior doors may also need or be beneficial to open however this item is dependent on many factors such as building layout and should be discussed with Facility Engineering prior to implementation.

13.7.3. Upon exceeding a concentration equal to the high alarm activation concentration (stated in Table 1), the audible alarms shall be activated. A notification of high concentration shall be sent to City of Edmonton Corporate Security for response from Fire Rescue Services and notification to Facility Maintenance. A high alarm for hydrogen will “latch” until acknowledged at the controller.

13.7.4. Upon depression of the emergency shutdown device the visual alarms associated with low alarm shall be activated. The mechanical ventilation system complying with 2.11.1 shall be activated to exhaust air from the space and introduce outdoor air to the space. The audible alarms associated with a high alarm condition shall be activated. A notification of emergency shutdown device activated shall be sent to City of Edmonton Corporate Security for response from Fire Rescue Services and notification to Facility Maintenance. All unclassified electrical equipment and circuits posing an explosion risk will also be interrupted. Emergency shutdown devices will require manual reset.

13.7.5. Upon a failure of the ventilation system associated with the Hydrogen gas detection system, a visual alarm shall be activated. This visual alarm will be separate from the strobes that activate on low alarm and may encompass a board of lights, screen showing BAS status of the units or other options showing which systems have failed. An audible alarm, separate from the audible alarm listed above for high alarm shall also be engaged in the space served by the ventilation system.

This audible alarm will have a silence button. A notification of HVAC Equipment Fail shall be sent to City of Edmonton Corporate Security for a response from Facility Maintenance.

- 13.7.6. Upon a failure of the gas detection system a visual alarm shall be activated. This visual alarm will be separate from the strobes that activate on low alarm and may encompass a board of lights, screen showing BAS status of the units or other options showing which systems have failed. An audible alarm, separate from the audible alarm listed above for high alarm shall also be engaged in the space served by the ventilation system. This audible alarm will have a silence button. A notification of gas detection system fail shall be sent to City of Edmonton Corporate Security for a response from Facility Maintenance.

**Table 1 – Alarm and ventilation activation concentrations**

Section	Gas	Formula	Ventilation activation concentration	Low alarm activation concentration	High alarm activation concentration
Carbon monoxide - Bulk Storage, repair garages, specified mechanical rooms	Carbon monoxide	CO	2.5 ppm <sup>1</sup>	15 ppm	25 ppm
Carbon monoxide - Storage garages / parking garages	Carbon monoxide	CO	As required to meet Alberta Building Code	Not applicable	Not applicable
Nitrogen dioxide - Bulk Storage, repair garages, specified mechanical rooms	Nitrogen dioxide	NO <sub>2</sub>	0.75 ppm <sup>1</sup>	1.5 ppm	3.0 ppm
Nitrogen dioxide - Storage garages / parking garages	Nitrogen dioxide	NO <sub>2</sub>	As required to meet Alberta Building Code	Not applicable	Not applicable
Chlorine	Chlorine	Cl <sub>2</sub>	—	0.5 ppm	1.0 ppm
Hydrocarbons	Natural gas & methane	92% CH <sub>4</sub> & 100% CH <sub>4</sub>	0.50% <sup>2</sup>	0.50% <sup>3</sup>	1.00% <sup>4</sup>
	Propane	C <sub>3</sub> H <sub>8</sub>	0.05% <sup>2</sup>	0.05% <sup>3</sup>	0.42% <sup>4</sup>
	Acetylene	C <sub>2</sub> H <sub>2</sub>	0.25% <sup>2</sup>	0.25% <sup>3</sup>	0.50% <sup>4</sup>
Refrigerants	R-410A	CH <sub>2</sub> F <sub>2</sub> (50%) CHF <sub>2</sub> CF <sub>3</sub> (50%)	500 ppm <sup>2</sup>	500 ppm	1,000 ppm
	R-134a	CH <sub>2</sub> FCF <sub>3</sub>	500 ppm <sup>2</sup>	500 ppm	1,000 ppm
	R-22	CHClF <sub>2</sub>	500 ppm <sup>2</sup>	500 ppm	1,000 ppm
Ammonia (Class T machinery room zone)	Ammonia	NH <sub>3</sub>	15 ppm <sup>2</sup>	15 ppm	25 ppm
Ammonia (Public areas zone)	Ammonia	NH <sub>3</sub>	15 ppm <sup>2</sup>	15 ppm	15 ppm
Ozone	Ozone	O <sub>3</sub>	0.1 ppm <sup>2</sup>	0.1 ppm	0.3 ppm
Carbon dioxide	Carbon dioxide	CO <sub>2</sub>	0.25% (2,500 ppm) <sup>2</sup>	0.25% (2,500 ppm)	0.50% (5,000 ppm)
Hydrogen	Hydrogen	H <sub>2</sub>	1% (25 % LEL)	1% (25% LEL)	1.6% (40% LEL)

<sup>1</sup> Designed to mitigate undesirable gas concentrations as early as possible.

<sup>2</sup> Equal to the low alarm activation concentration; presence of gas is not expected, therefore must not be obscured by ventilation.

<sup>3</sup> Equal to 10% of the lower explosive limit. Based on industrial gas detection standard.

<sup>4</sup> Equal to 20% of the lower explosive limit. Based on industrial gas detection standard.

**Table 2 – Visual alarm, label, and sign colours**

Section	Gas	Formula	Visual alarm light colour	Label and sign colour
Carbon monoxide	Carbon monoxide	CO	Green	Green with white lettering
Nitrogen dioxide	Nitrogen dioxide	NO <sub>2</sub>	White	White with black lettering
Chlorine	Chlorine	Cl <sub>2</sub>	Amber	Amber with black lettering
Hydrocarbons	Natural gas & methane	92% CH <sub>4</sub> & 100% CH <sub>4</sub>	Red	Red with white lettering
	Propane	C <sub>3</sub> H <sub>8</sub>		
	Acetylene	C <sub>2</sub> H <sub>2</sub>		
Refrigerants	R-410A	CH <sub>2</sub> F <sub>2</sub> (50%) CHF <sub>2</sub> CF <sub>3</sub> (50%)	Blue	Blue with white lettering
	R-134a	CH <sub>2</sub> FCF <sub>3</sub>		
	R-22	CHClF <sub>2</sub>		
Ammonia	Ammonia	NH <sub>3</sub>	Blue	Blue with white lettering
Ozone	Ozone	O <sub>3</sub>	Amber	Amber with black lettering
Carbon dioxide	Carbon dioxide	CO <sub>2</sub>	Magenta	Magenta with white lettering
Hydrogen	Hydrogen	H <sub>2</sub>	Red	Red with white lettering

**Table 3 – Occupational exposure limits and lower explosive limits**

Section	Gas	Formula	Lower explosive limit <sup>2</sup>	8-hour exposure limit <sup>1</sup>	15-minute exposure limit <sup>1</sup>	Ceiling limit
Carbon monoxide	Carbon monoxide	CO	—	25 ppm	75 ppm <sup>3</sup>	125 ppm <sup>4</sup>
Nitrogen dioxide	Nitrogen dioxide	NO <sub>2</sub>	—	3 ppm	5	20 ppm
Chlorine	Chlorine	Cl <sub>2</sub>	—	0.5 ppm	1.0	10 ppm
Hydrocarbons	Natural gas & methane	92% CH <sub>4</sub> & 100% CH <sub>4</sub>	5%	—	—	—
	Propane	C <sub>3</sub> H <sub>8</sub>	2.1%	—	—	2,100 ppm
	Acetylene	C <sub>2</sub> H <sub>2</sub>	2.5%	—	—	—
Refrigerants	R-410A	CH <sub>2</sub> F <sub>2</sub> (50%) CHF <sub>2</sub> CF <sub>3</sub> (50%)	—	1,000 ppm	3,000 ppm <sup>3</sup>	5,000 ppm <sup>4</sup>
	R-134a	CH <sub>2</sub> FCF <sub>3</sub>	—	1,000 ppm	3,000 ppm <sup>3</sup>	5,000 ppm <sup>4</sup>
	R-22	CHClF <sub>2</sub>	—	1,000 ppm	3,000 ppm <sup>3</sup>	5,000 ppm <sup>4</sup>
Ammonia	Ammonia	NH <sub>3</sub>	—	25 ppm (LEL=15%)	35 ppm	300 ppm
Ozone	Ozone	O <sub>3</sub>	—	0.1 ppm	0.3 ppm	5.0 ppm
Carbon dioxide	Carbon dioxide	CO <sub>2</sub>	—	0.50% (5,000 ppm)	3.00% (30,000 ppm)	4.00% (40,000 ppm)
Hydrogen	Hydrogen	H <sub>2</sub>				

<sup>1</sup> Time-weighted average gas concentration

<sup>2</sup> Instantaneous gas concentration

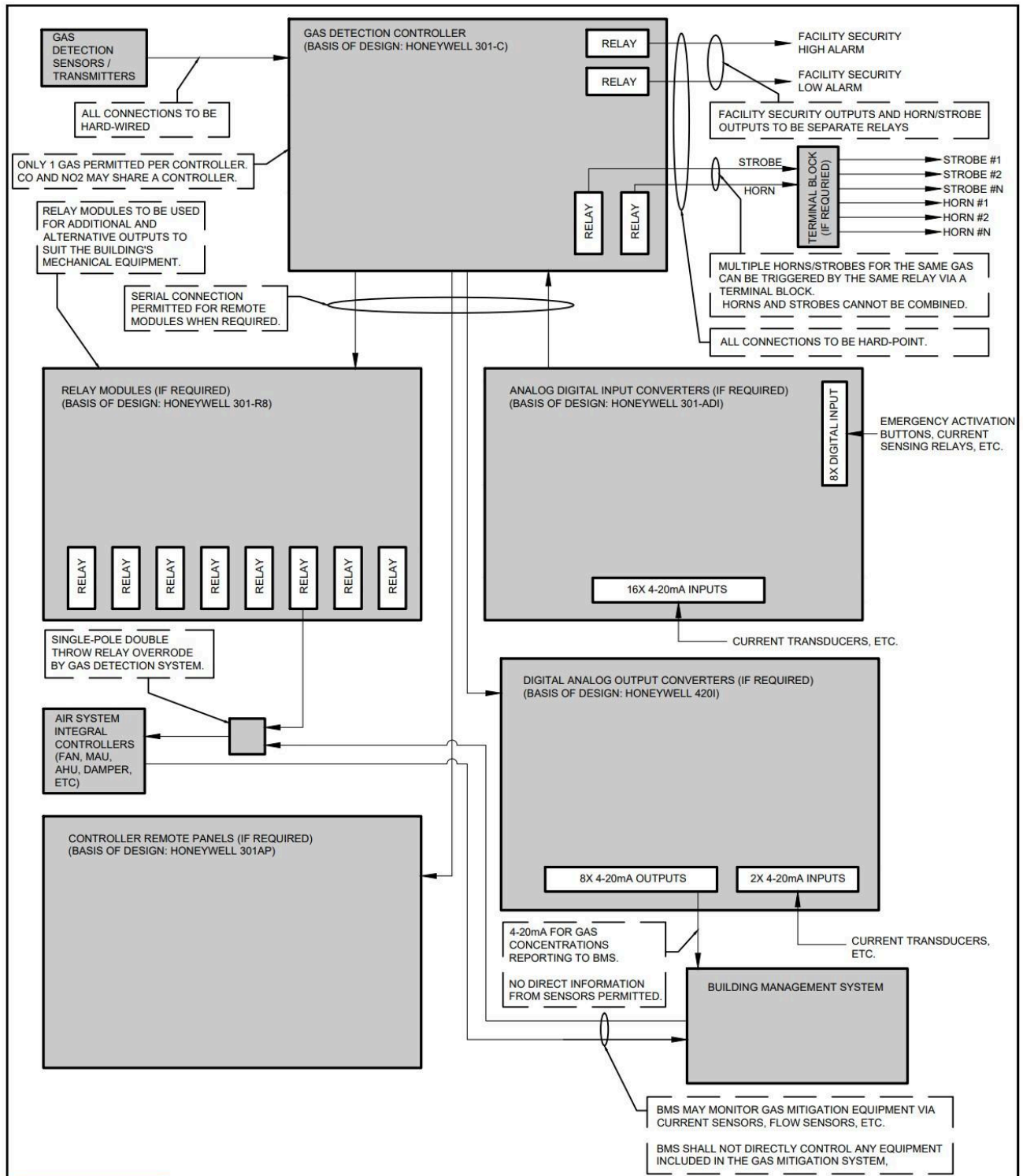
<sup>3</sup> 15-minute exposure limit is not defined, therefore 15-minute exposure limit is set to 3 x the 8-hour exposure limit, except if that value is higher than the IDLH concentration; as per the Occupational Health & Safety Code – Part 4

<sup>4</sup> 15-minute exposure limit is not defined, therefore ceiling limit set to 3 x the 8-hour exposure limit or the IDLH concentration, whichever is lower; as per the Occupational Health & Safety Code – Part 4



## **APPENDIX G1 - GAS DETECTION CONTROLLER AND SYSTEM SUPPORTING SKETCH**







## **APPENDIX H - WATER SPRAY PARK DESIGN GUIDELINES**

## 1. Technical Guidelines

### 1.1. Introduction

- 1.1.1. This document is the Water Spray Park Design Guideline. For design guidelines for buildings refer to the City of Edmonton Facility Design and Construction Consultant Manual Volume 1 and 2.
- 1.1.2. No content in this manual is designed for verbatim specification use and in general content should not be copied directly into a book spec for any project unless the consultant is explicitly so instructed.

### 1.2. Definitions

Spray Park or Water Spray Park	Per the Alberta Building Code a spray deck is a structure onto which water is sprayed or released without accumulating that is used for recreation or other similar purposes, and includes all buildings, equipment and facilities used in connection with it.
--------------------------------	--

### 1.3. General

- 1.3.1. This section contains technical guidelines to follow when designing new spray parks for the City of Edmonton. These guidelines are to be used in conjunction with professional judgment to ensure that they are followed only to the extent they are appropriate. Consultants remain ultimately responsible for design.
- 1.3.2. More specifically, the intent of this document is to:
  - 1.3.2.1. Describe the minimum requirements for spray park components, assemblies, and systems that have an impact on serviceability and anticipated life cycle of the spray park.
  - 1.3.2.2. Alert consultants to design aspects that historically have been problematic.
  - 1.3.2.3. Provide solutions or problem avoidance techniques that have been developed through experience and have proven to be practical and effective.
  - 1.3.2.4. Provide a vehicle for communicating departmental design standards to consultants in an effective and expedient manner.
  - 1.3.2.5. Indirectly, provide a basis for evaluating designs.
- 1.3.3. No attempt is made to address every conceivable condition. Rather, common sense and best industry practice solutions are provided where experience has indicated that problems commonly arise. This experience can be applied to new designs as a preventative measure, and to existing spray parks to address problems that are attributable to design and/or execution that does not conform to these technical design requirements.
- 1.3.4. Where these guidelines do not address a technical design issue that arises on a project, it is the Consultant's responsibility to address it. When a requirement, though normally applicable, may not be appropriate for a specific project, the consultant should propose an alternative for consideration by the project team.
- 1.3.5. Include Open Spaces Planning and Design (OSPD) and Facility Engineering Services (FES) in the

review process of all spray parks.

- 1.3.6. Innovative designs or products are encouraged after thorough consideration of potential benefits and risks, value analysis and life cycle cost. Consult project team members and persons with expertise in spray park design, operation, and maintenance.
- 1.3.7. Designs are required to comply with most current versions of all applicable codes and regulations. Where the technical design requirements contained herein differ from building codes and other applicable codes and standards, apply the more stringent requirements.
- 1.3.8. All design drawings shall be drafted 11x17 size or larger as appropriate for content and be legible when printed. All design drawing pdf submissions shall be provided in black and white.

## **1.4. Spray Deck Equipment**

### **1.4.1. References**

- 1.4.1.1. National Building Code(NBC) - Alberta Edition
- 1.4.1.2. Canadian Electrical Code(CEC) - Current Edition
- 1.4.1.3. Alberta Health Pool Standards

### **1.4.2. General**

- 1.4.2.1. Consultant to confirm with the City of Edmonton project manager if the consultant is managing the spray deck equipment selection or if this scope of work will be performed internally to the City.
- 1.4.2.2. The consultant is responsible for confirmation of the items below regardless of the party responsible for the spray toy selection.

### **1.4.3. Bonding**

- 1.4.3.1. The below grade component of the water spray deck equipment is to include two (2) redundant manufacturer provided bonding lugs.
- 1.4.3.2. The above grade component of the water spray deck equipment is to include provisions for proper bonding:
  - .1 Bond must be electrically continuous, as defined by CEC, between the above grade and below grade components.

### **1.4.4. Equipment Selection and Delivery**

- 1.4.4.1. Flow rate, water pressure, and power available for spray deck equipment must be determined prior to issuance of Request for Proposal and incorporated into the RFP documents.
- 1.4.4.2. The spray park equipment must include a programmable timer to allow the spray park operation to align with the operational hours of the park or plaza where it is installed.
- 1.4.4.3. The spray park equipment must include an activation device to allow users to activate the spray equipment for a defined period.

- 1.4.4.4. Consultant to review the spray deck equipment RFP prior to issuance.
- 1.4.4.5. Water Distribution Valve Vault
  - .1 Water distribution cabinet to be designed to fit over an accessible vault.
  - .2 Vault to be a minimum of 600mm back-to-front to allow access to water distribution drain valves.
  - .3 Ensure all drain valves are accessible (within arms reach down into vault)
- 1.4.4.6. Shop drawings of spray equipment must be approved by the consultant team prior to acceptance.
- 1.4.4.7. The water spray equipment supplier must sign off on equipment received by the contractor.

## **1.5. Site Services**

### **1.5.1. References**

- 1.5.1.1. Alberta Environmental Protection:
  - .1 Standards and Guidelines for Municipal Water Supply, Wastewater and Storm Drainage Facilities
  - .2 Stormwater Management Guidelines
- 1.5.1.2. Alberta Fire Code, by the Alberta Fire Prevention Council
- 1.5.1.3. City of Edmonton Design and Construction Standards. These documents can be found on the City of Edmonton website.
- 1.5.1.4. Standard Guideline for the Collection and Depiction of Existing Subsurface Utility Data, CI/ASCE 38-02.
- 1.5.1.5. Geometric Design Standards for Canadian Roads and Streets, by the Roads and Transportation Association of Canada

### **1.5.2. Site Selection**

- 1.5.2.1. Projects on City of Edmonton land or affecting City of Edmonton assets or maintenance requires coordination with Open Space Planning and Design (OSPD).

### **1.5.3. Site Survey Plan and Site Plan**

- 1.5.3.1. An authenticated site survey and plan shall be obtained by a licenced Alberta Land Surveyor.
- 1.5.3.2. Include the following items on the site plan in the contract documents (CI/ASCE 38-02 or similar – Level D and C):
  - .1 Legal description and address of the property, property lines and their legal dimensions, and legal pins.
  - .2 Adjacent vegetation/trees, hard surfaces, site features, grading, roadways, utilities, easements and how the new development will tie to them.
  - .3 Work of the contract and work by other forces and contracts.
  - .4 All utilities, including power, water, storm and sanitary sewer.

## 1.5.4. Geotechnical

- 1.5.4.1. A geotechnical investigation report shall be obtained prior to all spray deck installations.

## 1.5.5. Roads, Walks and Parking

- 1.5.5.1. Follow City of Edmonton Design and Construction Standards for design of roads, walks and parking.
- 1.5.5.2. Lay out walkways and locate benches, bike racks, flower beds, etc to facilitate snow clearing and removal and to avoid damage from snow moving equipment. Provide adequate width and turning radii for snow moving equipment. Provide allowances for snow storage on site from snow clearing of walks and pathways and ensure drainage of these areas during melting.
- 1.5.5.3. Ensure separation of vehicular traffic from main pedestrian traffic.
- 1.5.5.4. Design for snow dumping areas to reduce snow removal requirements.

## 1.5.6. Utilities

- 1.5.6.1. All utility service providers are to be contacted to obtain the following information:
  - .1 Existing active and abandoned utilities that may affect or be affected by the construction.
  - .2 Proposed utilities that may affect or be affected by the construction.
  - .3 Determination of the responsibility for relocation and notice timeline requirements (as per existing agreements with the City).
- 1.5.6.2. Where utilities are to be connected to municipal systems, confirm with the City of Edmonton and utility companies the adequacies of their systems to service the site.
- 1.5.6.3. Ensure the specification instructs the contractor to provide horizontal and vertical GPS location of all utilities and underground valves.
- 1.5.6.4. Early in the design, confirm with the City of Edmonton about any restrictions on stormwater discharge to the stormwater drainage system and confirm any impacts that the new development will have on the existing stormwater drainage system or stormwater management facilities. If applicable, provide on-site stormwater storage solutions in cases of limited stormwater drainage system capacity (e.g. storm water retention, bioswales, etc).
- 1.5.6.5. Contact the utility provider to confirm the municipal water pressure.
- 1.5.6.6. On large sites, locate utilities in utility corridors, keeping in mind any potential for future development.
- 1.5.6.7. Coordinate provisions for future utilities with the City.
- 1.5.6.8. Utilities within integrated sites and park areas with multiple features are typically managed and maintained by the City. Assistance from utility companies and cadastral information may not be available. In the absence of information, perform CI/ASCE 38-02 or similar – Level D to Level A collection and depiction of existing subsurface utility data.
- 1.5.6.9. Perform a complete review of all utilities(including Exterior Lighting) when developing a site within an Integrated Site or park area. Necessary upgrades to existing utility distribution or

service connections are to be included as part of the new development.

- 1.5.6.10. Where possible, provide single service connections to each property or integrated site. Size service connections for anticipated future needs.
- 1.5.6.11. Where water service metering cannot be located within a building, a metering chamber or vault shall be provided. Access to chambers and vaults shall meet or exceed the EPCOR access requirements and shall have sufficient space to facilitate maintenance activities. Chambers requiring confined space entry procedures or fall protection to access will not be accepted. Alternatives to the standard Epcor meter chamber detail must be coordinated with and approved by Epcor.

## **1.6. Landscape Development**

### **1.6.1. References**

- 1.6.1.1. City of Edmonton landscape requirements as per Zoning Bylaw 12800.
- 1.6.1.2. City of Edmonton, Design and Construction Standards, Volume 5 – Landscaping. This document is available on the City of Edmonton website.
- 1.6.1.3. City of Edmonton Access Design Guide

### **1.6.2. Exterior Landscape Development**

- 1.6.2.1. Refer to City of Edmonton Design and Construction Standards, Volume 5 – Landscaping.
- 1.6.2.2. Coordinate landscape development with Open Spaces Planning and Design (OSPD)

## **1.7. Civil**

### **1.7.1. References**

- 1.7.1.1. The City of Edmonton Playspace and Wheeled Sport Facility Design and Construction Standards
- 1.7.1.2. EPCOR Design and Construction Standards Volume 3 - Drainage
- 1.7.1.3. EPCOR Design and Construction Standards Volume 4 - Water

### **1.7.2. General**

- 1.7.2.1. Consultant to confirm with the City of Edmonton project manager if the consultant is responsible for the spray deck slab and grading design or if this scope of work will be performed internally.

### **1.7.3. Spray Deck**

- 1.7.3.1. Provide a 175mm depth concrete spray deck with a brushed finish
  - .1 Deck to include 15M single mat rebar at 250mm on center for both spray deck and apron area.
  - .2 Deck to have a minimum slope of 2% and maximum slope of 5%.
  - .3 Consult with OSPD for spray deck surface finish. Typical finish is a concrete brushed finish.



- .4 Provide a 1.5m wide 120mm depth concrete over spray apron around the deck. Consult OSPD for apron surface finish.
- 1.7.3.2. Dowel new concrete into existing concrete with chemical dowels and caulking. Chemical dowels to be Hilti Hit HY 200 or equivalent.
- 1.7.3.3. Fillcrete to be utilized to achieve compaction between closely spaced spray heads that can otherwise not achieve adequate compaction.
- 1.7.3.4. Survey points must be included with spray deck drawings to indicate the location of the spray deck equipment.
- 1.7.3.5. Spray deck location within the site to be reviewed with OSPD during design. Consideration must be given to adjacent infrastructure, vegetation, shade, etc.

## **1.8. Mechanical**

### **1.8.1. References**

- 1.8.1.1. Meet or exceed the following guidelines and standards:
  - .1 Canadian Standards Association (CSA) Standards
  - .2 National Building Code - Alberta Edition
  - .3 National Plumbing Code of Canada
  - .4 ASHRAE Handbooks
  - .5 ASHRAE Standards
  - .6 Alberta Health Pool Standards

### **1.8.2. General**

#### **1.8.2.1. Drawings**

- .1 Prepare project drawings with schematic diagrams indicating the following:
  - .1 Mechanical equipment, components, and piping arranged to accurately reflect the physical (on-site) configuration including equipment connections and valves.
  - .2 Design parameters for inlet and outlet water flow rates and pressure.
  - .3 survey points for the water supply and drainage tie in locations.
- .2 Equipment schedules shall be located on drawings and not in the specifications.

#### **1.8.2.2. Accessibility**

- .1 Provide sufficient access space for servicing, maintaining and removal of equipment and components or portions thereof (i.e. drain valves, solenoids, etc.). Service access requirements shall be shown on drawings.
- .2 Indicate on the drawings, access space provided.
- .3 Ensure that all vaults and cabinets are specified to include latches for locking.

### 1.8.2.3. Winterization

- .1 Incorporate winterization requirements into design:
  - .1 Clearly identify blow out points and drain connections on design drawings
  - .2 Include a requirement for this section in the O&M manuals
  - .3 Ensure systems are commissioned and identified to maintenance staff
  - .4 Self-draining curb stops on main water feed are recommended

### 1.8.3. Design Criteria

#### 1.8.3.1. General

- .1 Design water spray park mechanical systems according to the National Building Code - Alberta Edition and Alberta Health Pool Standards (current editions).
- .2 Recirculating water treatment systems are not to be designed unless discussed with Facility Engineering Services.

### 1.8.4. Water System

#### 1.8.4.1. General

- .1 Refer to Spray Deck Equipment section above for consultant responsibilities regarding spray deck equipment selection and procurement
- .2 Contact EPCOR ([wass.drainage@epcor.com](mailto:wass.drainage@epcor.com)) to determine the local system water pressure and for water meter queries.

#### 1.8.4.2. Fixtures and Equipment

- .1 Provide backflow prevention that conforms to either the National Plumbing Code of Canada or the requirements of the municipality, whichever is more stringent.
  - .1 When spray park water feeds must have a dedicated backflow preventer independent of other services that share the same line to the main (i.e If one line from connecting to the City main serves a spray park and a community hall, both the hall and the spray park must have backflow preventers).
  - .2 Reduced pressure principle backflow preventers (RP) are not to be installed below grade.
- .2 Specify ball valves for isolation service up to 100 mm. Gate valves 100 mm and smaller will not be accepted.
- .3 Cleanouts shall be specified as 50 mm or larger.
- .4 Hose bibb to be provided to facilitate flushing and disinfecting.
- .5 All spray devices must be designed, constructed and installed so that they do not create a safety hazard. Nozzles that spray from the ground level must be flush with the ground, with openings no greater than 15 mm. Spray features that extend above the ground must be high enough to be clearly seen and are not a trip hazard.

- .6 All vaults and chambers must be lockable.
- .7 Water meter chamber
  - .1 Water meter chambers must be installed to EPCOR standards and match previous water spray park meter chamber installations at the City. Any alternative must be coordinated and approved by EPCOR.
  - .2 Water meter chamber basis of design to be equal to Alberta Wilbert Sales pre-manufactured '1600 Gallon Square City Sump' measuring 2615mm x 2615mm x 1220mm.
- .8 Water Distribution Vault
  - .1 Vault to be a minimum of 600mm back-to-front to allow access to water distribution drain valves.
  - .2 Ensure all drain valves are accessible (within arms reach down into vault)

**1.8.4.3. Drainage**

- .1 Water meter chamber and water distribution vault to be drained via french drains and not tied into the sanitary system
  - .1 Confirm water table height prior to installation of french drain
- .2 Provide drainage sump as per standard City requirements to match previous water spray park installations at the City.
  - .1 Sump to be 900mm x 900mm with the depth determined by site conditions.
  - .2 Sump to include a backwater valve on the drainage pipe.
  - .3 Sump pipe to include a T-connection with a cleanout cover on the top of the fitting and a 300mm clearance between the bottom of the T-fitting and the bottom of the sump.
  - .4 Sump lid to be skid resistant stainless steel fastened down in all four corners with stainless steel screws fastened into nickel coated screw holes. Lid to include 19x125mm slots and 19mm holes. Drain slot/hole pattern to be approved by the City.
  - .5 Sump to be located at the lowest point of the spray park bowl with a secondary area drain located at a higher elevation
  - .6 Sump to drain the sanitary system.

## 1.9. Electrical

### 1.9.1. References

- 1.9.1.1. Meet or exceed guidelines and standards of the following organizations:
- .1 Canadian Standards Association
  - .2 Illuminating Engineering Society of North America
  - .3 Institute of Electrical and Electronics Engineers
  - .4 Insulated Cable Engineers Association
- 1.9.1.2. EPCOR, *Customer Connection Guide*

### 1.9.2. Service and Power Distribution

#### 1.9.2.1. Utility Service

- .1 Coordinate new and modified services with EPCOR. Refer to the latest EPCOR connection guide.

#### 1.9.2.2. Load Calculation

- .1 Provide load calculations for Utility and on-site generation services as part of the Contract Documents.
  - .1 New Service: Provide calculation as per CEC Section 8. Discuss future load allowances with City Engineering Services..
  - .2 Addition to existing service/feeder: Provide calculation as per CEC Section 8. City to provide maximum demand load for most recent 12-month period where available.

#### 1.9.2.3. Single Line Drawing

- .1 Provide electrical single line diagram as part of the Contract Documents, indicating the following:
  - .1 Configuration, type, voltage and amperage ratings of electrical equipment including panelboards, transformers, etc.
  - .2 Type, size and amperage ratings of services and feeders.
  - .3 Type, frame size and trip rating of overcurrent protective devices.
  - .4 kAIC rating of switchgear, panelboards, transformer secondaries and overcurrent devices.
  - .5 Anticipated demand load at panelboards
  - .6 Arc flash incident energy levels at all points where specified labels are required.
  - .7 Service and distribution grounding/bonding.
  - .8 Renovation/Rehab: Provide complete site wide single line diagram; partial single line diagrams will not be accepted. City to provide existing master single line diagrams

where available.

- .2 Provide copies of single line diagrams from Record Drawings, recording actual construction, to:
  - .1 Incorporate into Operating and Maintenance Manuals.
  - .2 Display in clear pocket mounted to the inside of the Outdoor Pedestal door. This requirement is to be included in the electrical construction specifications.

**1.9.2.4. Protection and Control**

- .1 Ensure adequate fault interrupt ratings of all panelboards and overcurrent devices. Provide calculation results when requested by the City of Edmonton.
- .2 Use fully-rated overcurrent protective devices throughout the distribution system. Series-rated combinations may only be used with permission by the City of Edmonton.
- .3 Where ground fault protection is provided on services and feeders, ensure protection is also provided for downstream feeders and loads that are susceptible to nuisance ground faults. Ensure ground fault equipment is coordinated to prevent upstream devices tripping before downstream devices.

**1.9.2.5. Panelboards Switching and Overcurrent Devices**

- .1 Ensure that the panel is properly rated for application and environment.
- .2 Provide panel schedules indicating breaker size and wattage all connected loads. Panels to be a maximum of 50% filled at completion of design.
- .3 Hinged, door-in-door construction.
- .4 Lockable.
- .5 Single pole breakers with handle ties are not permitted in place of multi pole breakers.
- .6 Use bolt on molded case circuit breakers with thermal, magnetic trip for all circuit protective
- .7 devices.
- .8 Obtain the approval of the City of Edmonton for the use of fused equipment. Consideration will only be given where fault duties of equipment require a limitation of the available fault current.
- .9 Bussing
  - .1 Use solid copper only.
  - .2 Provide min. 25% spare capacity for future growth.
- .10 Control
  - .1 Consultant FES Mechanical to ensure to BAS interconnection is not required.
- .11 Working Clearances
  - .1 Provide all electrical equipment with minimum 1.5 m front clearance, and all free standing equipment with minimum 1.0 m back and side clearance.

.12 Outdoor Pedestals

- .1 Shall contain Service Entrance Rated main breaker, 200A meter socket (or as required by EPCOR), meter viewing window, recessed photocell for lighting circuits, one (1) GFCI receptacle mounted within the cabinet, panel board, 35A 4P lighting contactor(s) and Hand off Auto (HOA) switch.
- .2 Cabinet shall be fabricated from 5052-H32 sheet, marine grade aluminum of at least 1/8-inch thick. All materials shall be corrosion resistant for extended life.
- .3 All screws, bolts, washers, nuts, etc. shall be stainless steel. All screws shall be stainless steel pan-head machine screw type. Any bolts that are 1/4-20 or larger shall be stainless steel hex head type. No sheet metal or self tapping screws shall be used.
- .4 All exterior seams shall be of continuously welded construction . All welds shall be free of slag and spatter. All exterior welds shall be ground smooth.
- .5 Doors shall be designed for maximum strength and snug fit. Doors shall be fabricated out of a single sheet of aluminum and have a wrap around return for strength and fit. Doors shall also have an inner skin for additional strength. The bottom of each door shall have ventilation holes. Doors shall be fully gasketed against the cabinet.
- .6 Door hinges shall be positioned so they are hidden behind the door and cannot be accessed with the door closed. A minimum of 2 hinges are required per door. Each door shall have a pneumatic return device to control the rate of door open and close and prevent opening beyond 90 degrees. Door handles shall be 3 point contact stainless steel construction. The handles shall latch to the cabinet with minimum 16 gauge stainless steel rails and rollers which shall be fabricated to provide a secure and well sealed attachment to the cabinet. Cabinet to include stainless steel padlockable clasps on side.
- .7 The cabinet shall be mounted onto a concrete foundation and attached via suitable anchors. The cabinet shall be placed in such a way where it is unlikely to come in contact with motor vehicles. It shall be at least 1.25m away from roadways where behind curb and gutter and at least 3m off the roadway where no curb or gutter is present. The cabinet shall face away from the road to avoid water splashing on the door.
- .8 Conduits shall be located to suit the cabinet and components. Conduits shall be located to run straight into panels or cabinets with minimal bends.
- .9 Seal cabinet to concrete with suitable silicone sealant.
- .10 Type all circuits and device identifications onto panel schedules and locate on the panels.
- .11 Ensure that a grounding bar on standoffs is provided within the cabinet and accessible for maintenance.
- .12 Provide minimum temper heating to 5°C to facilitate proper operation of equipment and prevent condensation.

**1.9.2.6. Transformers**

- .1 Location
  - .1 Utility Transformers: locate standard 600V, 208V or 240V outside with pads and rails

as per EPCOR guide. Provide screens where required by project. Location to be serviceable as required by EPCOR standards and as close as possible to service entrance to reduce capital and operating costs (line losses)..

#### 1.9.2.7. Feeders

- .1 Use copper conductors for feeders.
- .2 Provide a full capacity neutral and a bonding conductor with all feeders.
- .3 Other than main service feeder cables and/or raceway, feeders are not permitted to be located in slab or below slab-on-grade.

#### 1.9.2.8. Arc Flash and Shock Hazard Labelling

- .1 Refer to Consultant Manual Appendix E – “*Arc Flash Design Guideline*”.

### 1.9.3. Lighting

#### 1.9.3.1. General

- .1 Design to maximize the energy efficiency of lighting systems.

#### 1.9.3.2. Exterior Lighting

- .1 All projects to adhere to the City ‘Light Efficient Community Policy’, latest edition.
- .2 Use LED for parking, roadway, area lighting, and building exterior. Acceptable voltages are 120V, 208V, 240V. 347V not permitted for new installations. In retrofit situations where only 347V is available and no conversion feasible, true integrated 347V drivers preferred (no external autotransformers) and confirm acceptability with City Engineering Services prior to specification.
- .3 Approved luminaire head manufacturers include “Philips Lumec”, “Cooper/Eaton”, or “Acuity Brands”. Preferentially recognized families already approved by Transportation for roadway or MUT or those otherwise previously used by the City. Acceptable examples include “Philips Lumec” ‘Roadstar’, ‘Roadview’, ‘Streetview’, ‘Metroscape’, ‘Urbanscape’ & ‘Ancestra’; “Cooper/Eaton” ‘Ridgeview’. Explicitly confirm exceptions with City Engineering Services prior to specification.
- .4 Use cast in place or precast concrete piles with internal ducts and embedded bolts/rods. 280 mm (11”) BCD nominal standard. Top of pile shall be 150 mm above finished grade in soft landscaped areas, 150 mm if in sidewalk or other hard surfaced areas. Additionally, for parking lots and roadway areas where there is likely a risk of vehicular impact, top of pile shall be 1000 mm above finished grade.
- .5 Pile design & size to be coordinated with the structural consultant taking into account soil & grade conditions and final pole/head requirements. Acceptable examples for precast piles include Armtec ‘8-0082’, ‘8-0083-6’, & extended (3000 mm) ‘8-0079’ depending on application. Cast in place to be fully detailed.
- .6 Poles to be square or octagonal, galvanized steel and painted with 2 coats of enamel on primer or polyester powder coated. Approved manufacturers include Novapole & West Coast Engineering. Any aluminum and/or custom poles to be explicitly approved by City Engineering Services. Pole supplier to confirm design suitability for luminaire head EPA



and associated installation location parameters.

- .7 Ensure that lighting standards installed within the spray deck area meet current CEC standards, GFCI protection to be provided as required.
- .8 If cameras are to be pole mounted then please ensure that poles are specified with segregated raceways for different voltages and include manufacturer approved camera mounts. Custom poles to be explicitly approved by City Engineering Services.
- .9 Luminaires including emitter diode package & driver shall be explicitly rated to operate from -40°C to 40°C.
- .10 Exterior luminaires to have a minimum colour rendering index (CRI) of 60 and correlated colour temperature (CCT) of 3000 ( $\pm 200$ ) K with a  $D_{UV}$  of -0.006 to 0.006. Optionally a CCT of 4000 ( $\pm 200$ ) K with a  $D_{UV}$  of 0.005 to 0.007 will only be accepted with explicit approval from City Engineering Services.
- .11 A single head's emitter diode package/board should not exceed 12000 lumens for general purpose horizontal illumination. Consult with the City of Edmonton for project-specific details that may fall outside this limit.
- .12 Use UV resistant diffusers/lenses for exterior luminaires and consider vandal resistance.
- .13 Use full cutoff luminaires for all parking, roadway and area lighting. House side shielding to be specified on property perimeter luminaires unless there is otherwise lit road, or other adjacent city property, that could benefit from spill light. Wall mounted luminaires to be positioned or shielded to eliminate glare and light trespass to adjacent, non-city, properties.
- .14 Where multiple different architectural exterior luminaires are used (eg: pole mount, bollard, building mount), select luminaires to complement each other, possibly from the same manufacturer "family".
- .15 Bench and in ground lighting by explicit approval only, please contact City Engineer Services prior to specification.
- .16 Bollard, tube, saber style lighting by explicit exception approval only and used for decorative, architectural purposes only, not general area lighting. Follow above pile guidelines. Breakaway base design required except when not indicated due to security requirements.
- .17 Custom products are highly discouraged and not permitted without explicit approval from City Engineering Services. Eg. Architectural marquee luminaires, bollards, rail and rope light installations, etc.

**1.9.3.3. Drivers and Ballasts**

- .1 Use energy efficient electronic, solid state designs with built in inrush and surge suppression.
- .2 Total Harmonic Distortion of less than 12% and Power factor greater than 0.95.

**1.9.3.4. Control**

- .1 General

- .1 Provide single photocell, manual electro-mechanical time clock, or security device control or a combination thereof for exterior luminaires. Consider facility usage and security when determining the exterior lighting control scheme.
- .2 Maintenance
- .2 Commonly replaced components used in specified lighting products, such as LED arrays/lamps and ballasts/drivers, are to be available locally from wholesale supplies and/or distributors. Ensure the manufacturer guarantees compatible replacement parts for a minimum of 10 years.
- .3 All LED arrays, lamps, lens, ballasts, drivers, etc shall be readily accessible for service and replacement without any requirement for architectural remediation Luminaires located in high areas (above 3 m) are to be positioned to allow for maintenance and replacement of parts with standard City of Edmonton maintenance equipment.

#### **1.9.4. Branch Wiring**

##### **1.9.4.1. General**

- .1 Use copper conductors minimum #12 AWG conductor size.
- .2 Provide a separate bonding conductor in all branch circuit raceways. Conduit shall not serve as bond.
- .3 Branch circuit cable and/or raceway is not permitted to be located in slab or below slab-on-grade.
- .4 Minimum raceway size to be 21 mm.
- .5 Obtain approval of the City of Edmonton for the use of non-metallic sheathed cables.
- .6 All receptacles to be specification grade.
- .7 All branch circuits to be labelled with panel name & circuit designation.
  - .1 For circuits less than or equal to 20A and 240 volt, panel name and circuit designation to be indicated with a wrap around style label on faceplate and permanent marker inside the box.
  - .2 Otherwise, All higher voltage and ampacity circuits to have lamacoid style labels with panel name, circuit, and voltage/phase.
- .8 For high humidity applications, ensure surface raceways are galvanized and painted (coordinate with Architectural).

##### **1.9.4.2. Provisions for Mechanical**

- .1 Indicate location and circuiting of all mechanical control panels on drawings.
- .2 Coordinate electrical equipment required for mechanical equipment with mechanical designer.

#### **1.9.5. Miscellaneous**

##### **1.9.5.1. Maintenance & Sustainable Design of Electrical Equipment & Infrastructure**

- .1 Common replacement components used in electrical equipment, such as lamps, ballasts,

fuses and breakers, must be available through local distributors.

- .2 Where possible, specify electrical equipment and systems that have local service and support with 8 hr response time.

#### 1.9.5.2. Equipotential Bonding:

##### .1 Equipotential bonding for All type of facilities:

- .1 The below grade component of the water spray deck, and natatorium equipment is to include two (2) redundant manufacturer provided bonding lugs.
- .2 The above grade component of the water spray deck equipment is to include provisions for proper bonding: Bond must be electrically continuous, as defined by CEC, between the above grade and below grade components.
- .3 All exposed metallic features, structural steel, pool equipment, in slab/wall rebar, piping to be connected to a dedicated grounding and bonding loop installed around each basin, pool, fountain, water collection depression. Bonding and grounding loop to be made with at least a 4/0 cable

##### .2 System Performance Testing:

- .1 **For rehabilitations, renovations and/or addition of on deck pool equipment within 1.5 m of the pool edge:** Equipotential bonding testing to occur before implementation of any changes. In case of identification of unacceptable results, the scope of the proposed additions/changes/rehabilitations shall include the design and implementation of mitigation solutions as required to ensure proper bonding and grounding of both existing and new features.
- .2 **All projects:** Equipotential bonding testing to occur before and after basin concrete pour for all permanent metallic structures with 1.5m of the pool and whirlpools are bonded per CEC section 68.

#### 1.9.5.3. Bonding Study

- .1 List in specification that contractor is to:
  - .1 Perform visual inspection of existing bonding system, torque (and mark) all accessible hardware and inspect anchorage for tight connection
  - .2 Perform 4-Pole DC Resistance Test Bonding Study on all metal parts of the pool and of other non-electrical equipment located within 1.5 meters of the pool edge. Pool edge definition to follow applicable code. Bonding study is to be completed before and after concrete pour. Equipment to be tested shall include (but not be limited to):
    - Piping;
    - Pool Reinforcing Steel (including rebar or other steel structure exposed during work);
    - Grates (including non-metallic grates);
    - Fences;
    - Lighting;
    - Speakers;

- Conduits;
  - Junction Boxes;
  - Control Cabinets;
  - Electrical Cabinets.
- .3 Perform bonding study using method appropriate to site conditions and to the approval of the City of Edmonton and local authority having jurisdiction. Test back to the main ground connection point at the incoming electrical service. Coordinate main electrical service shutdown with the City of Edmonton and all associated parties.
    - Ensure test point locations are <20m apart.
    - Disconnect and test main ground to establish base point including test lead values.
    - Connect main ground and test each point bonding point.
    - Perform self-check prior to testing each point
  - .4 Where metallic equipment is covered with a coating (i.e. paint), expose base metal as required to perform test, using non-destructive methods. Patch and repair any removed coating to the satisfaction of the City of Edmonton.
  - .5 Submit tabular results to the Engineer of Record for review.
  - .6 Disconnect main power to any motors or electrical equipment (switches, outlets) prior to testing.
  - .7 Disconnect or bypass ground fault indicator during tests.

**1.9.5.4. Lightning Protection:**

- .1 Provide lightning arrestors on all services connected to overhead lines or elements/systems otherwise deemed to be exposed plant (eg. Roof mount antennas).
- .2 As a guideline, provide lightning protection for structures which are taller than adjacent structures within a 500 m radius.
- .3 Lightning protection requirements depend on a multitude of building design, construction, & location factors. On all projects the design professional of record shall positively confirm the requirement or exclusion of lightning protection.

**1.9.5.5. Colour Coding Requirements:**

- .1 Refer to *Appendix A – Colour Coding Requirements for Mechanical and Electrical Systems* for identification symbols and colours for electrical conduit and equipment.



## **APPENDIX I - ELECTRIC VEHICLE CHARGING**

## 1. Electric Vehicle Charging Infrastructure

### 1.1. General Requirements:

- 1.1.1. If more than one EV charger is planned to be installed, consider utilizing dual-port chargers in place of two single port chargers.
- 1.1.2. Charging stations to be located as close as possible to the electrical supply service while also assuring that they are conveniently located for drivers.
- 1.1.3. Provide curbs, bollards, wheel stops and/or equipment setbacks to prevent vehicle damage to equipment.
- 1.1.4. Provide adequate lighting in the area of the charger to facilitate nighttime use. Where solar canopies are present, coordinate canopies, BESS, EV charger and lighting system installation to integrate all systems and minimise the needs for supporting structures.
- 1.1.5. EV Chargers intended for public access shall have station information added to the Alternative Fuel Data Center ( <https://afdc.energy.gov/stations>), the Zero-emission vehicle charging stations ([link](#)) and Edmonton Mapping system ([link](#)). Include this responsibility to the electrical contractors scope of work.
- 1.1.6. Where feasible, provide each charger with a network connection using CAT 6 cable or using Wifi or Cellular Connections. Alternative connection methods to be discussed with Engineering Services prior to implementation.

## 2. Charging Technology and EV Battery Evolution Note

- 2.1. The city is fully aware that the Electric Vehicle (EV) market is changing at a rapid pace. The constant emergence of new EV models and the usage of larger onboard battery packs ranging up to more than 200kW.hr (cars) and 0.6MW.hr to 1MW (buses and large trucks) keeps redefining charger power output requirements every year.
- 2.2. The present section represents a minimum requirement which may or may not become obsolete 6 months from publication of the current document revision. As such, upon each project initiation, consultants and designers shall coordinate with the City to confirm the characteristics of the targeted EV application, then confirm the required performance of the charging infrastructure required to support said EVs.

## 3. Site Assessment:

- 3.1. The installation of large intermittent loads type EV Chargers shall be carefully evaluated for both existing and new sites. Refer power system study: Site's energy assessment study for details
- 3.2. The assessment shall factor the site BESS, if planned, and the PV solar array, if planned or already present. See also BESS and PV solar Sections for additional details.
- 3.3. Where generators shall be supplied to provide from a backup power source (e.g.: E-Bus Garage), a load demand profile shall be established to identify the chargers' power demand variations over a 24 hours period. Said profile shall be used to size the maximum capacity of the generator plant and to identify if said plant should be composed of several backup generators capable of sharing the load (paralleling operations). The study shall also consider if a BESS would be desirable. Said onsite power plant would have to integrate a control system capable of operating on a reduced number of generators as required to ensure each generator will not be operated below manufacturer's recommended loading

level

#### 4. Permissible Charger Types and Minimum Rated Pow

##### 4.1. Acceptable Manufacturers

- 4.1.1. ABB
- 4.1.2. Siemens
- 4.1.3. EATON
- 4.1.4. Leviton
- 4.1.5. ChargePoint,
- 4.1.6. Sun Country,
- 4.1.7. Flo,
- 4.1.8. Electric Avenue
- 4.1.9. Ecamion
- 4.1.10. Tesla
- 4.1.11. Approved equivalent meeting the requirements as listed herein

##### 4.2. Charger Rated Power Output (instantaneous)

###### 4.2.1. Level 1:

- 4.2.1.1. This type of chargers are not considered as practical and is not permitted (up to 1.5kW)
- 4.2.1.2. No exception.

###### 4.2.2. Level 2 Charger (Destination Charger):

- 4.2.2.1. Only the “higher tier” Level 2 chargers will be permitted.
- 4.2.2.2. Chargers shall be with a rated output of minimum 205kW (AC) to 30kW (DC)

###### 4.2.3. Level 3 Chargers for light duty vehicles:

- 4.2.3.1. Fast DC chargers shall be rated no less than 250kW and up to 5003600kW (DC) each

###### 4.2.4. Level 3 Charger for E-Bus:

###### 4.2.4.1. Garage / Destination Chargers:

- 4.2.4.1.1. Fast DC chargers shall be rated no less than 150kW
- 4.2.4.1.2. These chargers shall be capable of recharging a bus battery from 0% to 100% rated 660kW.hr in no more than 5.5 hours.

###### 4.2.4.2. En Route Charger:

- 4.2.4.2.1. Fast DC chargers shall be rated no less than 150kW and shall be compatible with applications where several chargers can be interconnected in parallel to reach higher power outputs (charger bank) to achieve a minimum power of 350kW, or
- 4.2.4.2.2. Fast DC chargers shall be rated no less than 350kW minimum and shall be able to provide



at least a 16% battery recovery for a 15 min charging time (based on a 660kW.hr pack).

#### 4.3. Level 3 & Industrial Chargers' Rated DC Output Voltage

4.3.1. Chargers shall be compatible with 400Vdc and 900 Vdc applications

4.3.2. Where achievable, dual voltage chargers are preferred.

#### 4.4. Power Supply:

##### 4.4.1. Common Requirements:

4.4.1.1. Level 2 chargers shall be 240V, single phase. Zig zag 240v phase to neutral 410V phase to phase

4.4.1.2. Level 3 chargers shall be type 3 phase / 3 wire (no neutral). No exception

4.4.1.3. All chargers located at a site shall be supplied from an "EV Charger AC Central Distribution Panel". This panel shall be:

4.4.1.3.1. Supplied directly from the site's electrical service entrance,

4.4.1.3.2. Equipped with a power quality meter compatible with a BACnet communication protocol and providing kW, kVA, kVAR, kW.hr, kVA.hr, THD (from fundamental to 50th order) instantaneous reading and log functions.

4.4.1.3.3. The panel shall have sufficient spare capacity to:

4.4.1.3.3.1. Accommodate the addition of active harmonic filters.

4.4.1.3.3.2. Provide a 25% growth capacity in circuit and ampacity.

4.4.1.4. EV charger Transformer and Harmonic mitigation:

4.4.1.4.1. Where required, the EV Charger AC Central Distribution Panel shall be supplied from a transformer sized to meet the charger power demand and adapt the site's power supply voltage to the required charger voltage input.

4.4.1.4.2. The transformer shall be:

4.4.1.4.2.1. The designer shall assess the charger performance for all modes of operation (idling, start of charge, charge at full output current, and end of charge) to fully identify the various variations in THD and harmonic spectrum of the charger bank.

4.4.1.4.2.2. Minimum type K13, or

4.4.1.4.2.3. Type Harmonic Mitigating Transformer (HMT). Where practical for sites with multiple EV chargers (>4 chargers and >250kW for combined power demand ), chargers shall be split into two charger banks, each supplied from a harmonic mitigating transformer with different phase shift. See above section "harmonic" for additional details on transformer's phase shifting choices.

4.4.1.5. In line reactors:

4.4.1.5.1. Designer shall evaluate in full coordination with EV charger manufacturers if inline "series" reactors similar to those used upstream of VFD drives could be used to limit a charger's harmonic distortion.

#### 4.5. **Chargers AC Power Supply Infrastructure, Notes:**

##### 4.5.1. EV Charger AC Central Distribution Panel (EV Source Panel)

4.5.1.1. Refer to [Appendix Ia - Electric Vehicle Charging Drawings](#) for typical installation details

##### 4.5.2. Bus Duct Distribution (Indoor fleet charging system)

4.5.2.1. Where practical, designers shall make use of rigid bus duct distribution systems to supply power to the chargers

4.5.2.2. Bus duct maybe used in lieu of, or in association with, the above described EV Source Panel:

4.5.2.2.1. When used in lieu of the source panel , the bus ducts shall be supplied directly from the service entrance board, with or without step down transformers (as required) and a dedicated meter shall be installed as described above to monitor the bus duct power demand and power quality.

4.5.2.2.2. All tap boxes shall be complete with a circuit breaker providing protection against faults and a point of isolation.

4.5.2.2.3. Bus duct to include a number of tap box ports exceeding the required number of planned tap box by at least 25% to provide flexibility for adding or relocating tap box / chargers within the area.

4.5.2.3. Where available from manufacturer:

4.5.2.3.1. Chargers shall be integral to the charging busway bus duct assembly, installed within bus duct tap boxes. If not available in the manufacturer offering, designers shall design a system where the chargers are located overhead or on walls or pedestal. per below figure.

4.5.2.3.2. Where chargers are located overhead the vehicles, DC charging cables shall be complete with retractable cords to prevent cable damages or obstruction on the vehicle's path.

#### 4.6. **EV Charger Circuits & Diversity Factors**

##### 4.6.1. **Level 2 and 3 chargers up to 30kW**

##### 4.6.1.1. **Chargers dedicated to fleet vehicles:**

4.6.1.1.1. These chargers will be solely operated by the city's services to recharge the city's light duty fleet vehicles.

4.6.1.1.2. Each charger shall be supplied from a dedicated branch circuit which shall not be shared with any other equipment

4.6.1.1.3. The site shall have sufficient capacity to simultaneously operate all chargers at full capacity.

4.6.1.1.4. Chargers to be single corded.

4.6.1.1.5. *To be confirmed on a project by project basis:* The city may be willing to make these chargers accessible to the public. Designers to confirm intent at project initiation. See below for additional conditions.

##### 4.6.1.2. **Chargers dedicated to emergency vehicles:**

4.6.1.2.1. These chargers ***SHALL NOT*** be accessible by the public. They will be solely operated by

the city's emergency (police, fire and ambulance services) services to recharge the city's light duty emergency fleet vehicles.

4.6.1.2.2. Each charger shall be supplied from a dedicated branch circuit which shall not be shared with any other equipment

4.6.1.2.3. The site shall have sufficient capacity to simultaneously operate all chargers at full capacity.

4.6.1.2.4. Chargers to be single corded.

**4.6.1.3. Chargers located within areas accessible by the public:**

4.6.1.3.1. These chargers will be accessible by the public and provide a pay per use EV charging service. Options to provide a free "courtesy" charging service shall also be available. Designers to confirm intent at project initiation.

4.6.1.3.2. These units may be also used by the city's services to recharge the city's light duty fleet vehicles and emergency vehicles.

4.6.1.3.3. Where achievable, each charger should have a dedicated circuit and the facility should have sufficient power to allow a simultaneous use of all its chargers, or

4.6.1.3.4. Where not achievable, each charger will share a branch circuit with several unit according the the following ratio:

4.6.1.3.4.1. Nomenclature: x/y with x representing the number of charger, and y the number of branch circuit servicing said chargers

4.6.1.3.4.2. Multi Unit Residential Building (MURB):

- Average parking duration: 12 hour average park window,
- Average charging time to replenish a battery depleted due to commuting: 2 hour average charge time
- Maximum permissible ratio of chargers per circuit: 6:1 for single corded charger or 3/1 for dual corded chargers

4.6.1.3.4.3. Office and other work areas:

- Average parking duration: 8 hour average park window,
- Average charging time to replenish a battery depleted due to commuting: 2 hour average charge time
- Maximum permissible ratio of chargers per circuit: 4:1 for single corded charger or 2/1 for dual corded chargers

4.6.1.3.4.4. Retail / public spaces / parks:

- Average parking duration: 2 hour average park window,
- Average charging time to replenish a battery depleted due to trip to access the place: 2 hour average charge time
- Maximum permissible ratio of chargers per circuit: 1:1. Dual corded chargers are not desirable for these applications.

4.6.1.3.5. Accessories:

4.6.1.3.5.1. Chargers shall be networked and exchange loading data. The system will ensure that

the total charger’s bank power demand does not exceed the capacity of the branch circuits supplying power to said chargers.

4.6.1.3.5.2. The system shall include a “VIP” option which can be used by the city to prioritize the recharge of its emergency vehicles either on demand or during specific periods. **See below for additional details regarding the charger control system and VIP functions.**

**4.6.1.4. Power Supply Type:**

4.6.1.4.1. Charger supplying power to the public and to the city’s light duty vehicle fleet shall be supplied from utility power sources.

4.6.1.4.2. Chargers supporting the operation of emergency vehicles shall be supplied from both normal and backup power sources. The site’s utility source and backup generator shall have sufficient capacity to accommodate the simultaneous operation of all chargers without any form of restriction.

**4.6.2. Level 3 chargers rated above 30kW and no more than 500kW**

**4.6.2.1. Intended use:**

4.6.2.1.1. These chargers will be supporting the operation of the city’s light duty fleet (supercharging applications) and possibly some heavy duty vehicles.

4.6.2.1.2. Some location may be made available to the public

**4.6.2.2. Minimum size:**

4.6.2.2.1. The city is willing to use chargers rated no less than 250kW.

4.6.2.2.2. Chargers rated above 30kW and below 250kW are not considered as desirable due to the rapid evolution of fast charging technologies and battery sizes.

**4.6.2.3. Charger units rated no more than 250kW**

4.6.2.3.1. These chargers shall be specified to supply a single vehicle at the time (single corded output).

**4.6.2.4. Charger units rated more than 250kW up to 500kW**

4.6.2.4.1. These chargers shall be specified to supply no more than two vehicles simultaneously (dual cord output).

4.6.2.4.2. When in “dual vehicle” charging mode, the charger shall be capable of regulating the power allocated to each vehicle based on their respective battery state of charge and related current demand.

**4.6.2.5. Power Supply Type:**

4.6.2.5.1. These chargers shall be supplied from dedicated branch circuit wiring. They will be operated on normal power only.

4.6.2.5.2. For locations where the chargers are dedicated to the support of the city’s fleet, and where said fleet is utilised to deliver critical services (garbage collection, snow removal, etc...) the charger panel shall be paired with an electrically operated manual transfer switch and cam-lock system allowing site personnel to use a portable generator set to supply power

to the EV charging system.

4.6.2.5.3. The site normal power supply shall have sufficient capacity to allow the simultaneous operation of all chargers without any form of limitations.

**4.6.3. Level 3 Charger for EV-Bus**

4.6.3.1. General requirements:

4.6.3.1.1. All chargers shall be supplied from dedicated circuits.

4.6.3.2. Garage overnight charging:

4.6.3.2.1. Chargers shall be rated 150kW minimum, and each charger shall supply a single bus at the time.

4.6.3.2.2. Each charger module shall be supplied from a dedicated circuit and the charge point's service entrance shall have sufficient capacity

4.6.3.2.3. The charger shall be supplied by both a utility source and a backup generator of same capacity. The capacity shall be determined to operate a minimum number of chargers based on bus utilization schedule. Seasonal scheduling changes shall be factored in the sizing.

4.6.3.3. En Route charging:

4.6.3.3.1. These chargers shall be installed in banks with options to operate several units in parallel to meet the power demand of the bus.

4.6.3.3.2. A charge point can be made of several units rated from 150kW to 300kW each to supply up to 500kW to 600kW.

4.6.3.3.3. Each charger module shall be supplied from a dedicated circuit and the charge point's service entrance shall have sufficient capacity to operate all units simultaneously. Utility power will be used for this application.

**5. Charger to EV Connections**

**5.1. Light Duty Vehicles Connectors:**

5.1.1. Common requirements:

5.1.1.1. Connectors and charging cables shall be rated for indoor and outdoor applications.

5.1.1.2. The temperature range shall be: -40 °C to +50 °C.

5.1.1.3. Rated cUL or CSA for both connectors and cables.

5.1.1.4. Connectors and cables shall be maintainable and field replaceable.

5.1.1.5. Connectors shall be rated for a minimum of 10,000(10k) plug/unplug operations.

5.1.2. Level 2: Charger to be SAE J1772 (Type 1) and Tesla's NACS.

5.1.2.1. Notes:

5.1.2.1.1. Connectors shall have a current rating of at least 80Amps/240V AC (19.2kW), or better,

95A/240V (22kW).

5.1.2.1.2. Chargers shall support the use of universal adapter type J1772 to NACS

5.1.3. Level 3: CCS 1 and NACS.

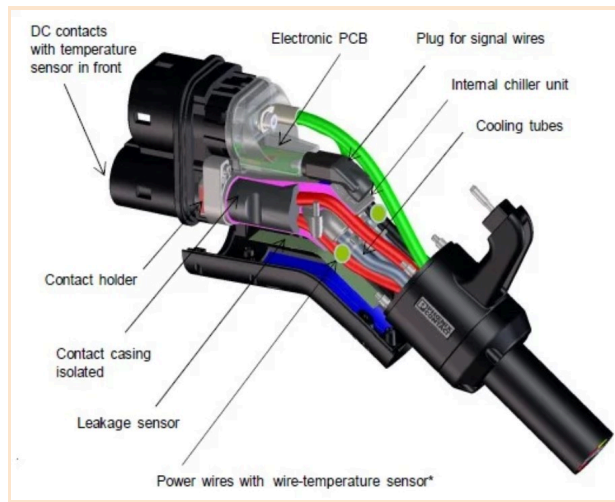
5.1.3.1.1.1. Notes:

5.1.3.1.1.1.1. Chargers shall be either with dual cable/connector output (1 CCS-1 and 1 x Tesla) or shall support the use of special universal adapters.

5.1.3.1.1.1.2. Connectors shall have a current rating of 80A/240Vac (19.2kW) AC (min) and 200A/1000Vdc (200kW) DC (min)

5.1.3.1.2. Level 3 Cooled (High Power Connectors):

5.1.3.1.2.1. Acceptable connectors:



**Water or Mineral Oil Cooled SAE J1772 CCS (IEC Type 1)  
 (North America - Example Provided for Illustration Only)**

**Figure I1: Acceptable Level 3 water cooled charging connectors**

5.1.3.1.2.2. Notes:

5.1.3.1.2.2.1. Connectors shall have a current rating of 80A/240Vac (min) and 500A/1000Vdc (500kW) DC (min).

5.1.3.1.2.2.2. External cooling solutions are not acceptable. Charging cable and liquid cooling connectors shall be a built-in feature within the charger package. **Cooling solutions using non conductive mineral oil based fluids are preferred.**

5.1.3.1.2.2.3. The special CCS-1 connector shall be complete with additional heat sinks, water piping, leak sensors, temperature sensors and associated control wiring. As of Q4 2022, there are no final current industry consensus standards for this type of system and their use may not be accepted by the city and their use may



not be approved by the city unless it can be demonstrated that cross compatibility between chargers is possible or if the application is justified due to vehicle specific requirement (e.g.: Emergency response vehicle such as fire engines)

5.1.3.1.2.3. Docking station

5.1.3.1.2.3.1. Chargers shall be equipped with an integrated or side mounted docking station for the connector.

5.1.3.1.2.3.2. The docking station shall have the ability to lock the connector in place and prevent the connector contamination with water, dirt, dust, and animal/insect ingress

5.1.3.1.2.4. Cables Management:

5.1.3.1.2.4.1. All chargers shall be equipped with cable management system inclusive of charger to vehicle cable retractor. All installations shall have a cable suspension mechanism designed to prevent the cable from touching the ground.

5.1.3.1.2.4.2. The cables shall be rated for applications where the ambient temperature is -50 degree Celsius.

5.1.3.1.2.4.3. The cable shall be reinforced (e.g. cable flex armor) to ensure the cables cannot be easily damaged due to vandalism or accidental mishaps.

**5.2. E-Bus Automated Charging System (ACS): Inverted Pantograph Connectors:**

5.2.1. Inverted Pantograph Application for Busses

5.2.1.1. The City of Edmonton operates a lithium battery powered bus fleet (E-Buss).

5.2.1.2. The bus are built by Protera and use a reversed pantograph connection for recharging their batteries

5.2.2. Indoor Pantograph

5.2.2.1. Bus depots schedule for the deployment of E-busses shall use the same type of pantographs as those already deployed by the city at the Centennial and Kathleen Garages

5.2.2.2. System Currently in Use:

5.2.2.2.1. The city is currently using an inverted pantograph. This system use the principle of a hanging pantograph used to connect with a roof installed DC rail system located on top of the EV bus.

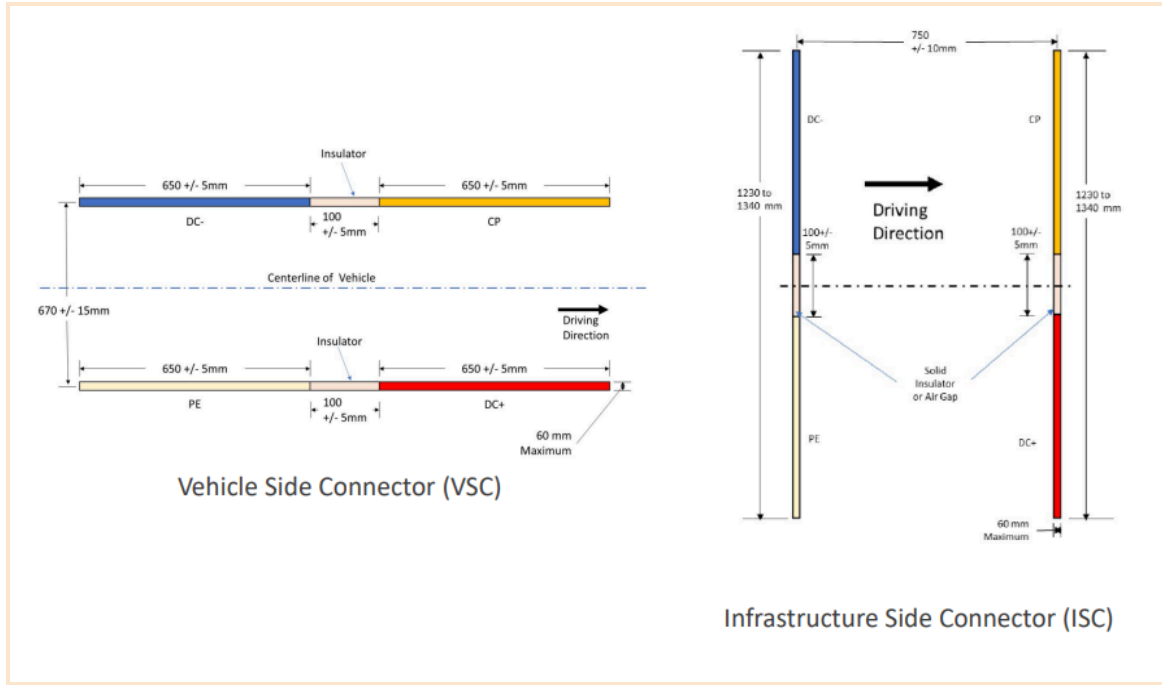
5.2.2.2.2. This pantograph deployment and retracting mechanism is completely motorised and automated:

5.2.2.2.2.1. The system is based on the **SAE J3105 ``Electric Vehicle Power Transfer System Using Conductive Automated Connection Devices Recommended Practice``**.

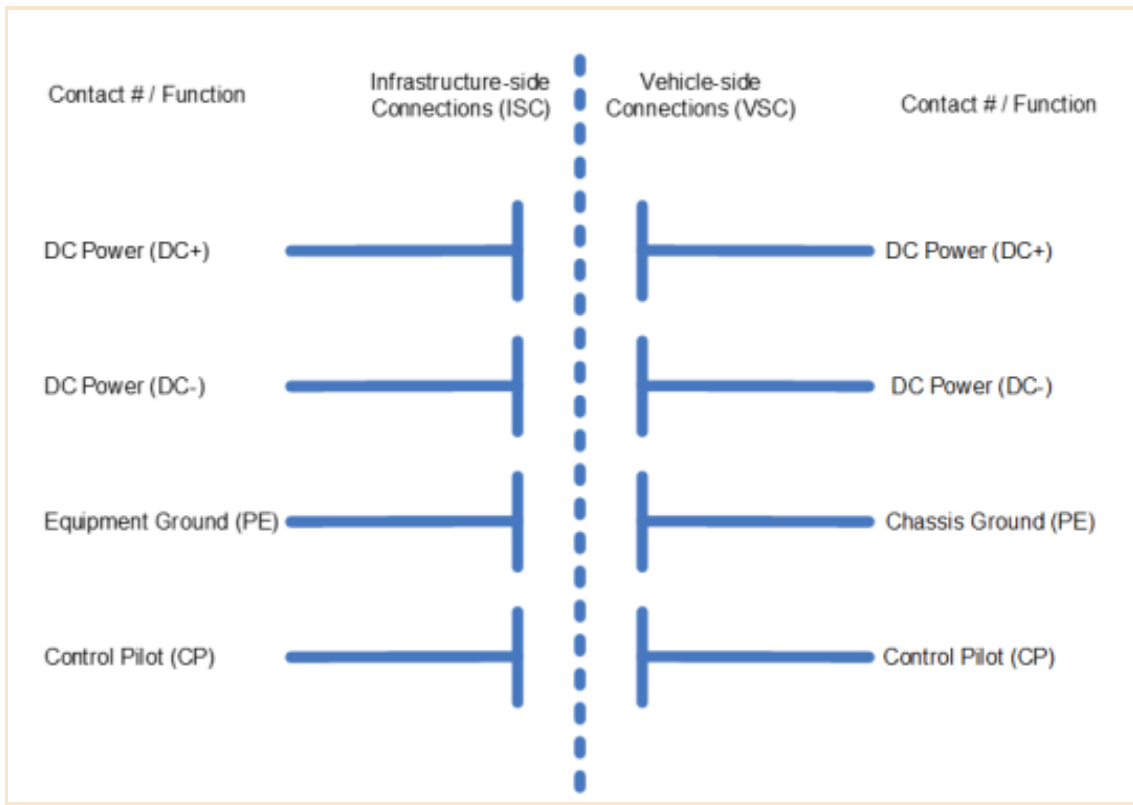
5.2.2.2.2.2. The standard compiles a series of recommended practices for **Automated Connection Devices (ACD)** that mate chargers with battery powered electric buses. The system is based on the **sub standard J3105-1 defining the use of crossrail**



**systems** as outlined below:



**Figure I2: SAE J3105-1 “cross rail” connection topology**



**Figure I3: SAE J3105-1 "cross rail" connection wiring**

This system is currently installed indoor in the city's bus depots per example below:



**Figure I4: Katleen Andrew Garage Example (Stemmann Technik “Charging Panto”)**

5.2.3. Inverted Pantograph Characteristics :

5.2.3.1. Any new installation shall be compatible with the existing ones as presented above

5.2.3.2. Rated Power:

5.2.3.2.1. The pantograph shall be compatible with a wide range of application including indoor charging in bus depot charging and outdoor “en route” charging applications

5.2.3.2.2. The power transfer rating shall be as follows:

- Charging power range of 150 kW to 450 kW.
- Rated current (dc) up to: 250A, 500A and 600A.
- Rated dc voltage: 900Vdc minimum, 1000Vdc rating preferred.

5.2.3.3. Construction:

5.2.3.3.1. The inverted pantograph shall be type single-arm raising by spindle drive

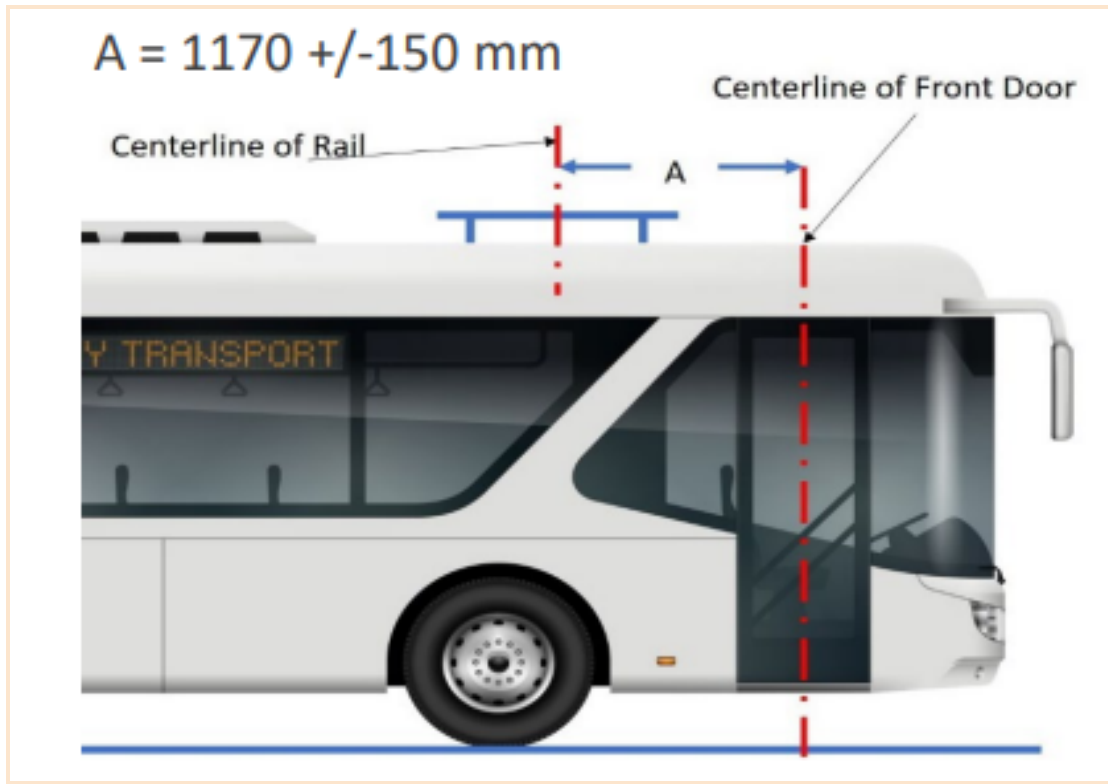
5.2.3.3.2. The system shall be:

- Equipped with tension spring raising / holding into a housed position as a redundant system.

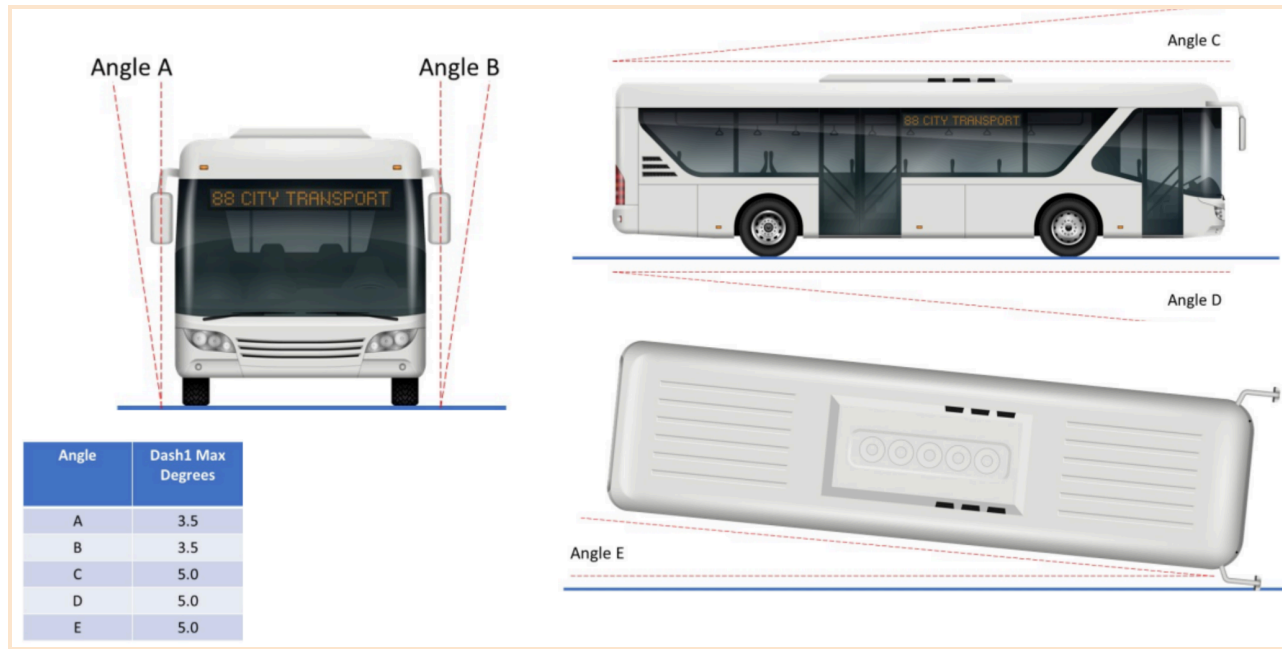
- Designed for high working ranges and inclined positions and capable of maintaining a constant kneeling contact.
- Complete with integrated DC wiring and redundant busbars capable of connecting to a bus mounted DC rail system . The connection shall be type Inverted crossrail pantograph
- The system shall be rated for:
  - Indoor applications: -10 °C to +50 °C
  - Outdoor Applications: -40 °C to +50 °C
- Rated cUL or CSA.

5.2.3.4. Alignment requirements:

- System to be J3105-1 compatible (Infrastructure-Mounted Cross Rail Connection" (or "Crossrail").
- J3105-1 Connection Tolerances Summary:



**Figure I5: J3105-1 Vehicle rail installation**



**Figure 16: J3105-1 Inverted Pantograph Alignment Requirements**

**5.2.4. Wiring Installation and Safety Features:**

**5.2.4.1. Common Requirements:**

- 5.2.4.1.1. The pantograph shall be wired to the charger bank via non fused disconnect switch installed in the line of sight of the pantograph, and located beside the ACS controller see below for details).
- 5.2.4.1.2. The switch’s line (charger) side and load (pantograph) side shall be equipped with voltage presence indicators type LED cluster.
- 5.2.4.1.3. DC cables linking the chargers to the inverted pantograph shall be rated 1000V for application based on a maximum voltage of 500V, and 2000V (2kV) for applications using a nominal voltage rating of 900V
- 5.2.4.1.4. Clearance from driving surface to underside of pantograph connector when retracted: 4600mm maximum

**5.2.4.2. Indoor installation:**

- 5.2.4.2.1. The wiring shall be installed in conduit or in cable tray.
- 5.2.4.2.2. When installed in conduits, the cable can be type RW-90 XLPE.
- 5.2.4.2.3. When installed in trays, cables to be type Teck-90 XLPE.
- 5.2.4.2.4. Note regarding DLO cables:
  - Diesel Locomotive (DLO) Cables can be acceptable if it can be demonstrated that their use is justified due to complex site specific conditions including but not limited to tight bending radiuses, limited space to add cables, and if the required ampacity is relatively high (>500A)

- When used, the installation shall provide:
  - A free air rating.
  - A full mechanical protection since this type of cable has only a soft insulating material and no jacket or armor.

**5.2.4.3. Outdoor installation:**

- 5.2.4.3.1. Switch, wiring and conduits shall be installed in a manner which is neither visible nor accessible to the public.
- 5.2.4.3.2. Self supporting combination of pantograph stand with built in wiring disconnecting devices and wiring are preferred.

**5.2.5. Chargers Control & Monitoring**

**5.2.5.1. Light Duty Vehicle Chargers**

**5.2.5.1.1. Definition**

- 5.2.5.1.1.1. In the present context, the word “transaction” means a charging session.
- 5.2.5.1.1.2. Said sessions can be either free and activated using the charger’s HMI, or type “pay per use” activated either by a user’s credit card or cell phone app, or activated by a city employee’s RFID card.

**5.2.5.1.2. Anti Power Theft: All Chargers**

- 5.2.5.1.2.1. All chargers shall be equipped with a monitoring system capable of identifying when the charger’s connector is disconnected from the EV charging port.
- 5.2.5.1.2.2. Upon disconnection:
  - 5.2.5.1.2.2.1. The ongoing transaction shall be immediately cancelled and the charger shall not resume the charging session if the connector is engaged into the charging port of any vehicle.
  - 5.2.5.1.2.2.2. The user who initiated the pay per use session shall receive a warning message indicating that the charging session was interrupted and not completed.
- 5.2.5.1.2.3. Should a user be willing to charge another vehicle, the new user shall initiate a new transaction per the rules as listed below.

**5.2.5.1.3. Charge Initiation and Monitoring:**

- 5.2.5.1.3.1. All chargers shall have a built in feature capable of sending a message to the cell phone of the user who initiated the charging session.
- 5.2.5.1.3.2. Courtesy Transaction:
  - 5.2.5.1.3.2.1. The charger shall prompt the user for a cell phone number and shall not initiate the charging session until the user comply with the request
  - 5.2.5.1.3.2.2. Upon completion of the transaction, the charger shall issue a message every 5 minutes to the user’s cell phone indicating that the charging session is complete. The issuance of the message shall stop upon disconnection of the charger’s connector.

**5.2.5.1.3.3. Pay Per Use Transactions:**



- 5.2.5.1.3.3.1. *Option 1:* The charger shall prompt the user for a cell phone number and shall not initiate the charging session until the user complies with the request and uses a credit card's contactless payment.
- 5.2.5.1.3.3.2. *Option 2:* The charger shall initiate the charging session once the user completes the required payment using a cell phone based app.
- 5.2.5.1.3.3.3. Upon completion of the transaction, the user shall be provided with a 15min window to remove the vehicle from the charging stall:
  - 5.2.5.1.3.3.3.1. For option 1, the charger shall issue a message to the user's cell phone
  - 5.2.5.1.3.3.3.2. For option 2, the charger shall issue the message directly to the cell phone or via the app used to activate the charging session.
  - 5.2.5.1.3.3.3.3. In case of user non compliance, the system shall charge the user \$15 dollars (canadian) per hour after the expiration of the 15 minutes grace period.
- 5.2.5.1.3.4. **RFID Initiated Transaction:**
  - 5.2.5.1.3.4.1. The charger shall initiate the charging session once the user uses his city issued RFID card.
  - 5.2.5.1.3.4.2. Upon completion of the transaction, the charger shall issue a message every 15 minutes to the user's cell phone indicating that the charging session is complete. The issuance of the message shall stop upon disconnection of the charger's connector:
    - 5.2.5.1.3.4.2.1. The RFID card based system shall ideally automatically program the charger with the user's cell phone
    - 5.2.5.1.3.4.2.2. if not achievable, the user's shall be prompted to enter his cell phone number using the charger's HMI
- 5.2.5.1.3.5. All types of sessions: The charger shall issue a message indicating that the charging session will be completed soon (15 min before completion).
- 5.2.5.1.4. **Light Duty EV Charger Communication Capabilities:**
  - 5.2.5.1.4.1. **General requirements:**
    - 5.2.5.1.4.1.1. All EV chargers shall have either a BACnet communication capability or a set of dry contacts which can be wired to the facility's BAS to indicate a common alarm or trouble condition, or
    - 5.2.5.1.4.1.2. Chargers shall be equipped with radio transceivers for sites where the installation of a hard wiring communication system is neither practical nor achievable. A "sister station" shall be installed within the facility supplying power to the charger. Said sister station shall provide a common alarm/trouble signal to the building's BAS. Alternate designs based on cellular connections are also acceptable.
  - 5.2.5.1.4.2. **Access Control and Revenue Generating Applications:**
    - 5.2.5.1.4.2.1. With few exceptions (\*) the city intends to make most of its EV charger infrastructure accessible to the public.
    - 5.2.5.1.4.2.2. (\*) **Exceptions:** Chargers installed in areas which are not accessible to the public shall be only equipped with RFID card readers. These chargers will be used solely



for the city's vehicle fleets.

5.2.5.1.4.2.3. Charger accessible by the public will be type "pay per use". Each charger shall be equipped with either built-in or side mounted RFID card reader and a built in credit card reader.

5.2.5.1.4.2.4. Chargers shall be equipped with a cell phone transceiver connected to a central billing system. Said system can be operated by a third party which will act on behalf of the city. The type of contract shall be negotiated as applicable during the procurement phase of the chargers.

5.2.5.1.4.2.5. The Cell phone transceiver shall be 4G/LTE or 5G compatible. **3G based systems are not acceptable.**

**5.2.5.1.4.3. VIP Bypass:**

5.2.5.1.4.3.1. General requirements:

5.2.5.1.4.3.1.1. All chargers located in public spaces shall be equipped with a "VIP bypass" feature allowing select users to cancel an ongoing transaction and initiate an emergency transaction.

5.2.5.1.4.3.1.2. Emergency transactions shall be made possible with the utilisation of a special RFID card which will be issued to city employees assigned to emergency response vehicles (police, fire fighters, ambulance).

5.2.5.1.4.3.1.3. For systems where chargers have dual outputs, or for systems where chargers share a site's available circuit, the charger used in VIP mode shall issue an inhibiting signal to all other chargers sharing the same circuit. Said chargers shall cancel their ongoing transaction and go in idle mode immediately.

5.2.5.1.4.3.2. Site where VIP features must be programmed:

5.2.5.1.4.3.2.1. Any police stations, fire hall, ambulance facilities where chargers can be accessed by the public.

5.2.5.1.4.3.2.2. Based on project specific requirements - Confirm requirements with project manager upon initiation of detailed design activities.

5.2.5.1.4.3.3. Chargers programmed with a VIP features shall comprise a blue light located on top or above of the charger.

**5.2.5.1.4.4. Standardised Operating Software for Vehicle Monitoring and Communication:**

5.2.5.1.4.4.1. The RFID card reader shall allow city employees to charge the city's vehicles. A management software shall be built-in to recognise this type of transaction and automatically bill the relevant city department. The RFID shall comprise an identification of the employee using the card. The identification can be build in the RFID chip, or it can be achieved by the use of a smartphone app, or by a keypad where the employee would dial an employee specific code and ID number

5.2.5.1.4.4.2. Chargers shall have option for compatibility with the following protocols:

5.2.5.1.4.4.2.1. This system shall be used for standardised EV fleet and charger control, management and vehicle **communication compatibility. The system shall**

provide options allowing smart phone based transactions.

5.2.5.1.4.4.2.2. Minimum requirement for telecommunication compatibility version:

- ISO 15118-20:2022 “Vehicle to grid communication interface”
- Open Charge Point Protocol (OCPP) version 2.0.1
- Backward compatibility with vehicles using the previous version of these protocols shall be provided.

5.2.5.2. E-Bus Chargers:

5.2.5.2.1.1. Control Infrastructure Requirements:

5.2.5.2.1.1.1. The charging management system shall be compatible with the use of inverted pantographs and telecommunication type “contactless vehicle status and identification”.

5.2.5.2.1.1.2. Principle:

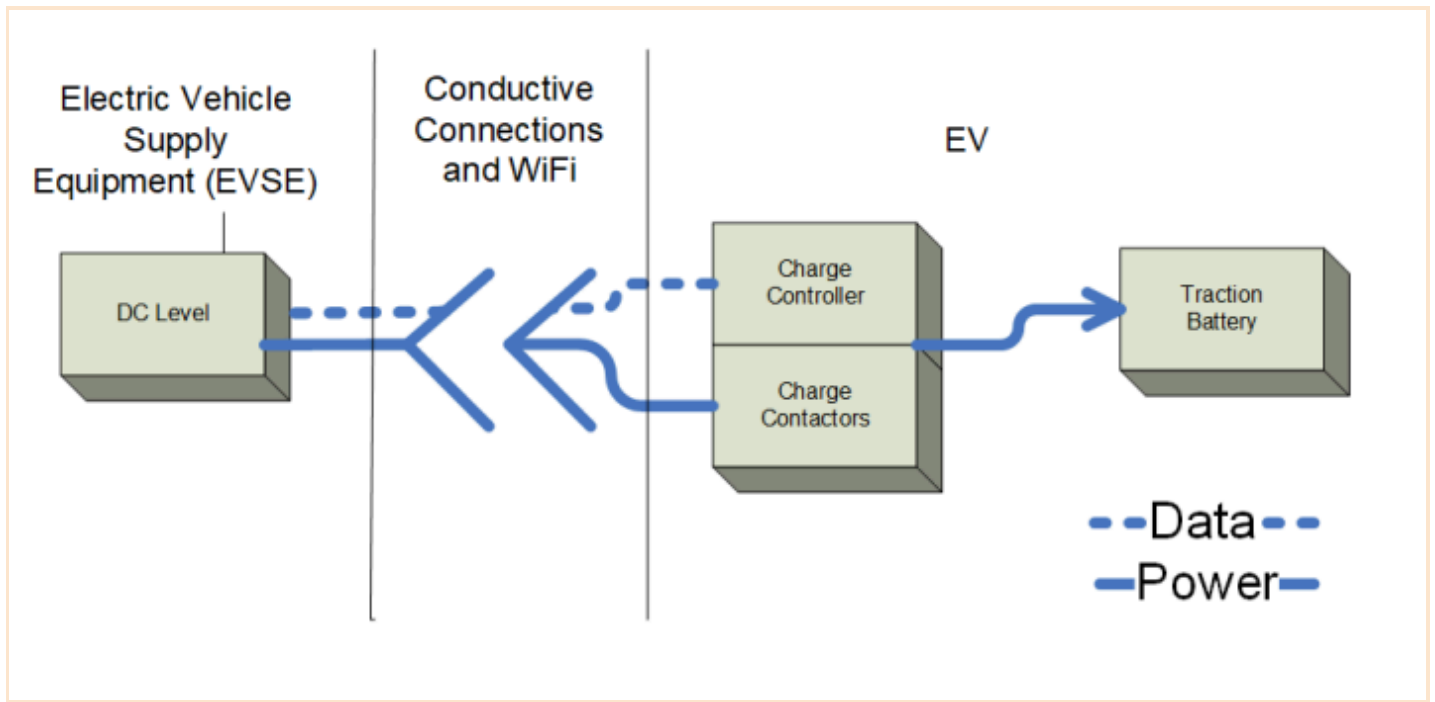


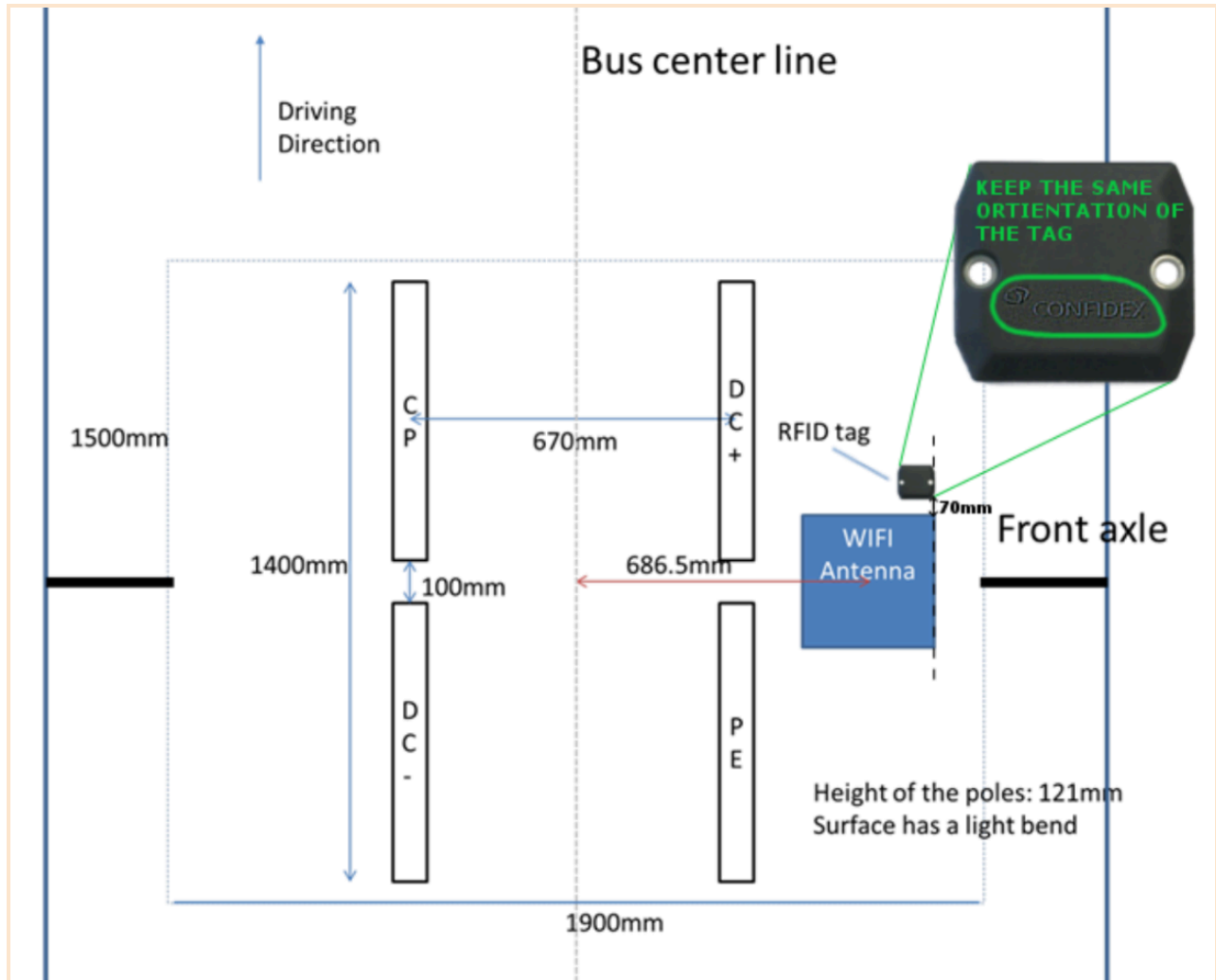
Figure I7: EVSE Principle

5.2.5.2.1.1.3. Vehicle Side:

5.2.5.2.1.1.3.1. The EVCC-P (electric vehicle communication controller for pantograph charging) shall be suited for 24-VDC in-vehicle electrical systems.

5.2.5.2.1.1.3.2. The charger application shall support inverted pantographs application with wireless connection per the principle outlined below.

5.2.5.2.1.1.3.3. Antenna and RFID tag position on roof:

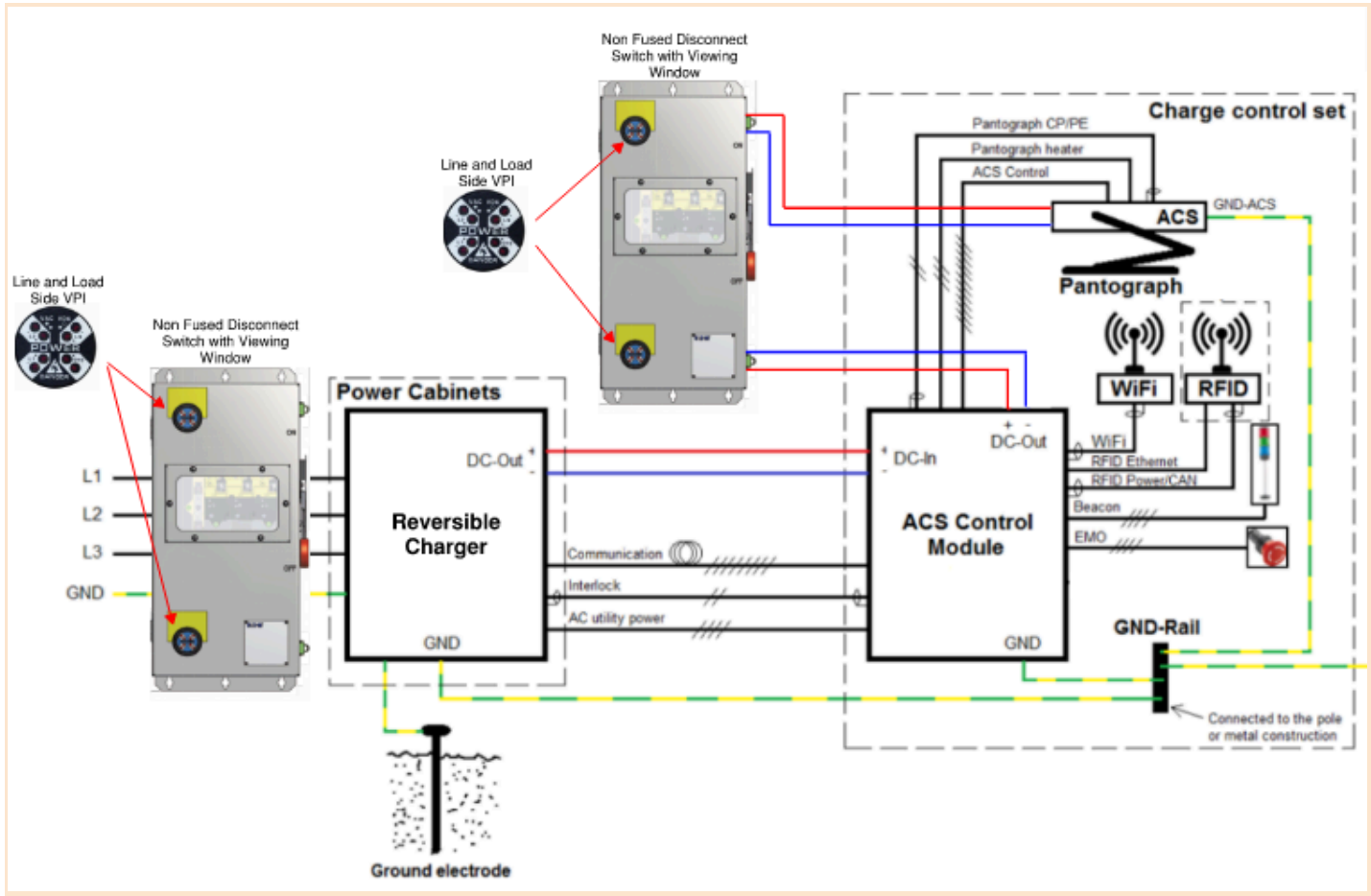


**Figure I8: Wifi and RFID tag Antenna Placement on Vehicle**

5.2.5.2.1.1.4. Inverted Pantograph Side: Control & Communication Gateways

5.2.5.2.1.1.4.1. The transceiver equipment shall be installed next to the pantograph installation and shall have the same indoor and outdoor rating as those stipulated above for the pantograph:

5.2.5.2.1.1.4.2. Charging locations shall be equipped with a reversed/inverted pantograph associated with a Automated Charging System (ACS) and complete with a wireless connection per following principle :



**Figure 19: Contactless Vehicle to Charger Wiring (Principle)**

5.2.5.2.1.1.4.3. The system shall be equipped with:

- Located near the pantograph:
  - o A “red/green/blue” beacon (ceiling mounted) providing a system status indication (charging, ready, trouble). The beacon shall be placed in a position which can be seen from the bus driver’s seat.
  - o RFID and Wifi Base stations/antennas:
    - The WIFI wireless communication (based on IEEE 802.11a/n) with the charging infrastructure is carried out by a CAN (vehicle)-to-Wifi (charging point) gateway.
    - An additional RFID module is also installed for additional vehicles to control system communication (Vehicle ID tag based identification system).
- Located near the bus front access door per below diagram:
  - o Two (2) voltage presence indicators (VPI) wired to the

pantograph DC disconnect switch on both its line and load side.

- An emergency stop push button .

5.2.5.2.1.1.4.4. Typical installation diagrams:

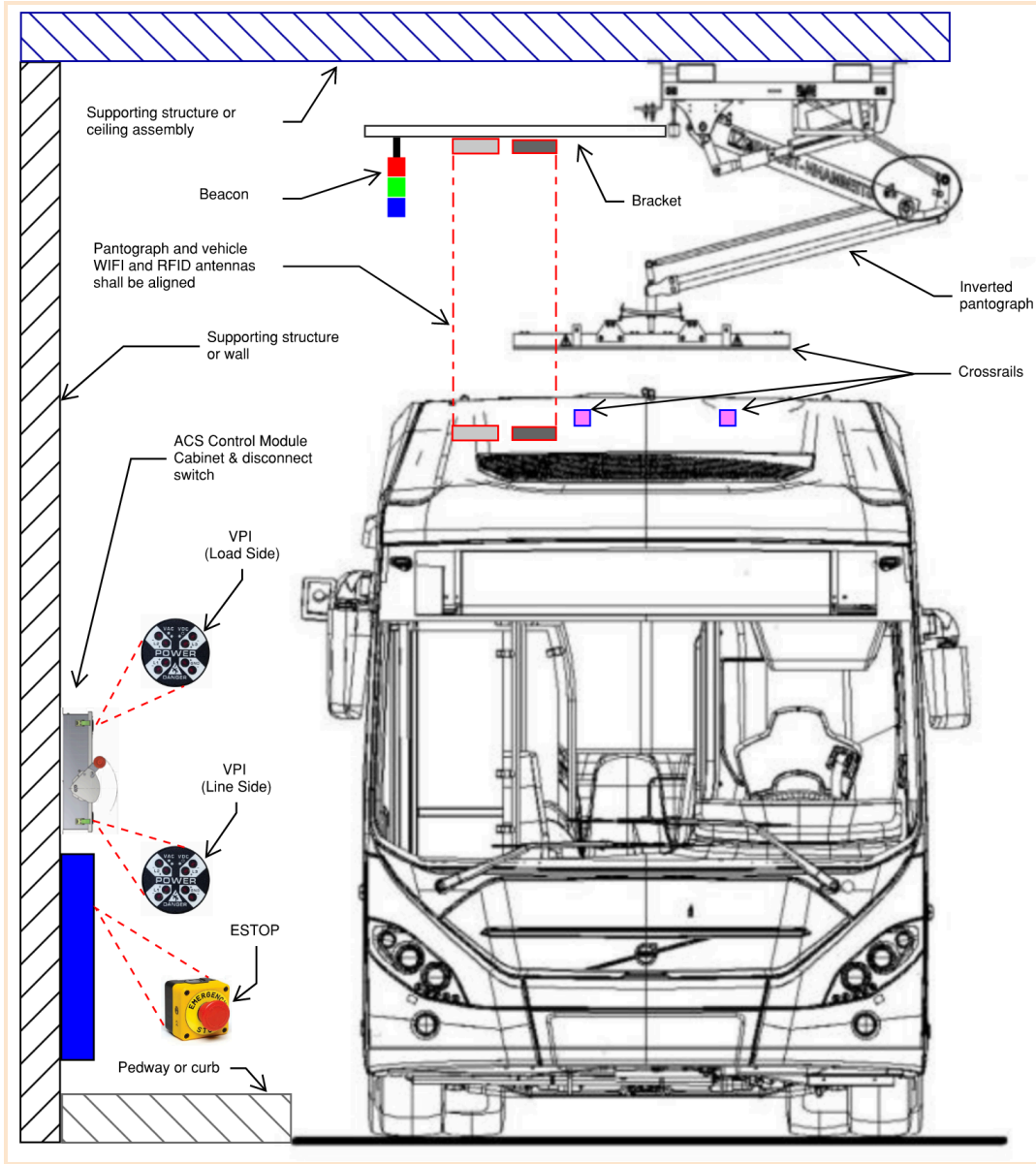


Figure I10: Bus Garage Typical System Setup (NTS) / Charger Not Shown

### 5.2.6. Coordination with distributed generators (Solar Arrays, Solar Canopies, CHP, and BESS)

5.2.6.1. Additional considerations shall be factored in the design of EV charger applications for sites equipped with solar arrays and Battery Energy Storage Systems (BESS).

5.2.6.2. Where achievable:

5.2.6.2.1. The EV chargers should be tied to distribution centers where solar inverters are connected.

5.2.6.2.2. BESS shall also be investigated to determine if such a storage unit could maximise a site's service entrance energy delivery capacity and/or solar array energy delivery capacity.



## **APPENDIX Ia - ELECTRIC VEHICLE CHARGING DRAWINGS**



SINGLE LINE SYMBOL LEGEND	
	WITHDRAWABLE LV CIRCUIT BKR LVPCB CLASS (IEEE STD.C37.13)
	MOLDED CASE CIRCUIT BREAKER MCCB CLASS (UL 489)
	DISCONNECT SWITCH
	FUSE
	POWER TRANSFORMER ( XFMR SIZE / RATING )
	CURRENT TRANSFORMER
	POTENTIAL TRANSFORMER
	METER
	WIRE INFO TAG ( WIRE SIZE / CONDUIT SIZE )
	ELECTRIC VEHICLE CHARGING STATION

**DRAWING NOTES (TYP.)**

- UTILIZE EXISTING SPARE 3P BREAKER FOR NEW EV CHARGING SYSTEM / PROVIDE NEW.
- INSTALL PRIMARY FEEDER FOR NEW EV TRANSFORMER FROM EXISTING MDP TO NEW TRANSFORMER TX-EV-A. SEE E001-1 FOR ROUTING DETAILS.
- INSTALL NEW TRANSFORMER TX-EV-A FLOOR MOUNTED, LOCATION AS SHOWN ON LAYOUT DRAWING(S).
- INSTALL NEW PANEL EV-A FEEDER FROM TX-EV-A TO PANEL EV-A. SEE E001-1 FOR ROUTING DETAILS.
- INSTALL NEW 480V 3PH, 4W PANEL EV-A WHERE SHOWN ON THE LAYOUT DRAWING(S) AND PER (INDOOR/OUTDOOR) PANEL INSTALLATION DETAILS.
- INSTALL 4#6AWG + GND IN 27mm CONDUIT FROM PANEL EV-A TO EACH CHARGING STATION.
- INSTALL EV CHARGING STATIONS AS PER DETAIL 1/E006

THIS STANDARD DRAWING/DETAIL AND/OR SPECIFICATION IS PROVIDED TO CONVEY THE CITY'S TYPICAL GENERAL ARRANGEMENT AND REQUIREMENTS. REPRESENTATIONS MAY NOT BE TO SCALE. THEY ARE SUBSTITUTED IN NATURE AND/OR REQUIRE FURTHER ELABORATION AND DEVELOPMENT AS SUCH THIS DOCUMENT IS NOT SUITABLE FOR INTEGRATION INTO A SPECIFIC IMPLEMENTATION WITHOUT REVIEW AND MODIFICATION AND IS ONLY INTENDED FOR USE BY A COMPETENT DESIGNER ENGINEERING PROFESSIONAL JUDGMENT. THE DESIGNER SHALL VERIFY AND SUPPLEMENT AS NECESSARY TO PROVIDE A COMPLETE, PROPERLY FUNCTIONING DESIGN THAT CONFORMS IN ALL RESPECTS TO THE CITY'S FUNCTIONAL REQUIREMENTS. WHEN ACTUALIZED IN A PARTICULAR IMPLEMENTATION IT IS THE DESIGNER'S RESPONSIBILITY TO ENSURE THE SIZE, LOCATION AND SPACING OF ALL ELEMENTS AND ALL COMPONENTS/SPECIFICATIONS, ARE SUITABLE AND SAFE FOR THE USE AND LOCATION INTENDED, AND ANY APPLICABLE CODES, LEGISLATIVE AND AUTHORITY REQUIREMENTS ARE ADHERED TO. IN ADDITION ANY ACCESSIBILITY, OPERATIONAL AND MAINTENANCE REQUIREMENTS MUST BE MET. DEVIATIONS FROM THE REPRESENTED NOMINAL DESIGN PARAMETERS, QUESTIONS OF INTENT OR ACCURACY, OR ANY OTHER APPARENT CONFLICTS, SHALL BE RECORDED WITH AN APPROPRIATE CITY REPRESENTATIVE. FINALLY, WHEN EMPLOYING ANY ASPECT OF THIS DOCUMENT, THE ULTIMATELY RESPONSIBLE PROFESSIONAL DESIGNER SHALL REMOVE ANY AUTHENTICATION OF THE ORIGINAL AUTHORITY, NOTE ANY PROVENANCE AS APPROPRIATE, AND APPLY THEIR OWN AUTHENTICATION AS REQUIRED.

Seal	Permit
------	--------

**Edmonton** ELECTRIC VEHICLE CHARGING STATION TYPICAL INSTALLATION  
 CP-000000

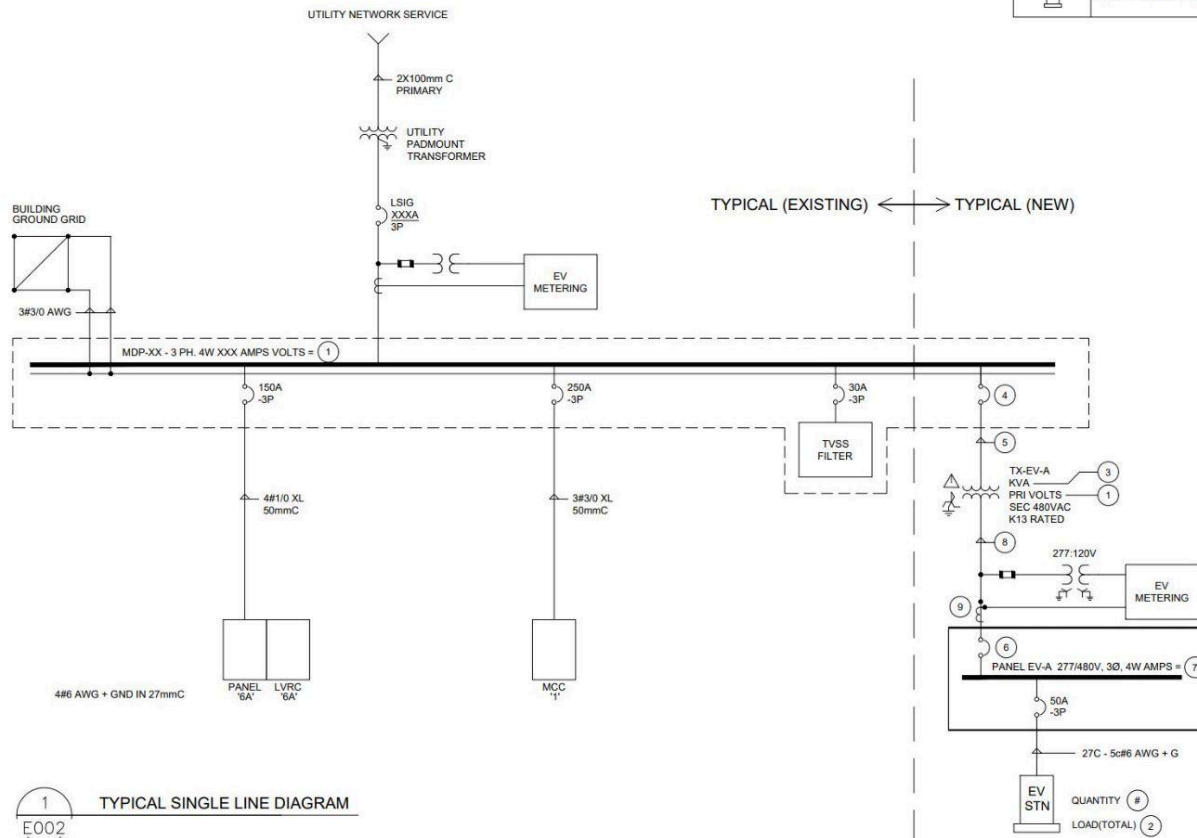
Department INTEGRATED INFRASTRUCTURE SERVICES

Issues / Revisions					
Ln.#	Date	Author	Review	Check	Description
A	2023-10-23	PS	TK	DL	ISSUED FOR REVIEW
B	2023-12-03	TK	PS	DL	ISSUED FOR REVIEW

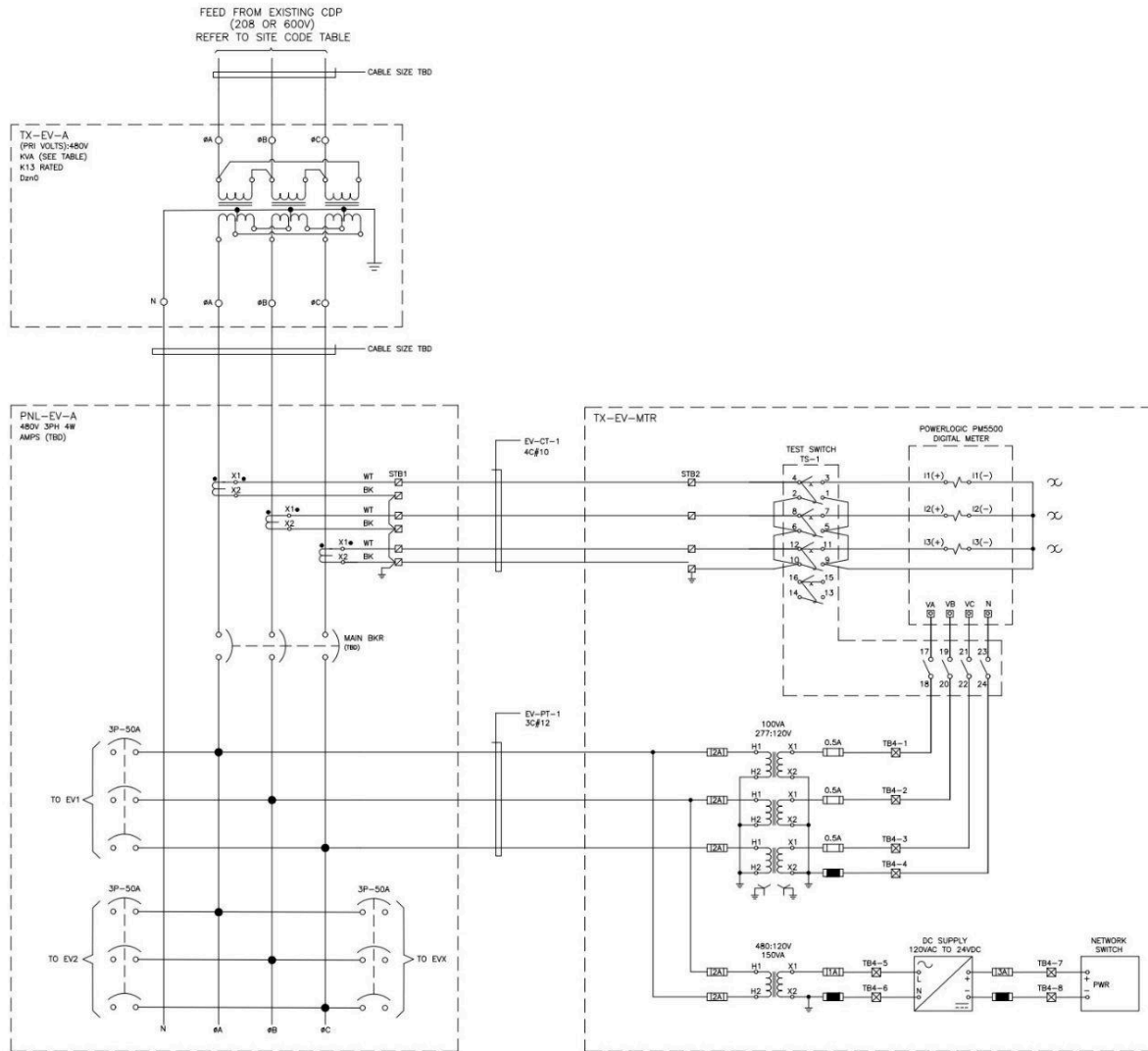
Location ID: CITXXX  
 Description: TYPICAL EV CHARGER SYSTEM CONSTRUCTION WORK PACKAGE

Drawing Title: TYPICAL SINGLE LINE DIAGRAM

Discipline: ELECTRICAL	E001
Volume: 01	
Sheet: 1 OF 10	
File: EV_STD_date_E001_V1.0.dwg	



1 TYPICAL SINGLE LINE DIAGRAM  
 E002



1  
E003  
TYPICAL THREE LINE DIAGRAM

SINGLE LINE SYMBOL LEGEND	
	MOLDED CASE CIRCUIT BREAKER MCCB CLASS (UL 489)
	FUSE
	SWITCH
	POWER TRANSFORMER (XFMR SIZE / RATING)
	CURRENT TRANSFORMER
	POTENTIAL TRANSFORMER
	METER
	WIRE INFO TAG ( WIRE SIZE / CONDUIT SIZE )
	RELAY / METER CURRENT ELEMENT

THIS STANDARD DRAWING/DETAIL AND/OR SPECIFICATION IS PROVIDED TO CONVEY THE CITY'S TYPICALLY EQUAL GENERAL ARRANGEMENT AND REQUIREMENTS. REPRESENTATIONS MAY NOT BE TO SCALE. THEY MAY BE SUBSTANTIALLY DIFFERENT IN NATURE AND/OR REQUIRE FURTHER ELABORATION AND DEVELOPMENT AS SUCH THIS DOCUMENT IS NOT SUITABLE FOR INTEGRATION INTO A SPECIFIC IMPLEMENTATION WITHOUT REVIEW AND MODIFICATION AND IS ONLY INTENDED FOR USE BY A COMPETENT DESIGNER EXERCISING PROFESSIONAL JUDGMENT. THE DESIGNER SHALL MODIFY AND SUPPLEMENT AS NECESSARY TO PROVIDE A COMPLETE, PROPERLY FUNCTIONING DESIGN THAT CONFORMS IN ALL RESPECTS TO THE CITY'S FUNCTIONAL REQUIREMENTS. WHEN ACTUALIZED IN A PARTICULAR IMPLEMENTATION IT IS THE DESIGNER'S RESPONSIBILITY TO ENSURE THE SIZE, LOCATION, AND SPACING OF ALL ELEMENTS AND ALL COMPONENTS/SPECIFICATIONS ARE SUITABLE AND SAFE FOR THE USE AND LOCATION INTENDED, AND ANY APPLICABLE CODE, LEGISLATIVE, AND AUTHORITY REQUIREMENTS ARE ADHERED TO. IN ADDITION, ANY ACCESSIBILITY, OPERATIONAL, AND MAINTENANCE REQUIREMENTS MUST BE MET. DEVIATIONS FROM THE REPRESENTED NORMAL DESIGN PARAMETERS, QUESTIONS OF INTENT OR ACCURACY, OR ANY OTHER APPARENT CONFLICTS, SHALL BE RECONCILED WITH AN APPROPRIATE CITY REPRESENTATIVE. FINALLY, WHEN EMPLOYING ANY ASPECT OF THIS DOCUMENT THE ULTIMATELY RESPONSIBLE PROFESSIONAL DESIGNER SHALL REMOVE ANY AUTHENTICATION OF THE ORIGINAL AUTHOR(S), NOTE ANY PROVENANCE AS APPROPRIATE, AND APPLY THEIR OWN AUTHENTICATION AS REQUIRED.

Seal	Permit
------	--------

Edmonton  
**ELECTRIC VEHICLE CHARGING STATION TYPICAL INSTALLATION**  
 CP-00XXXX

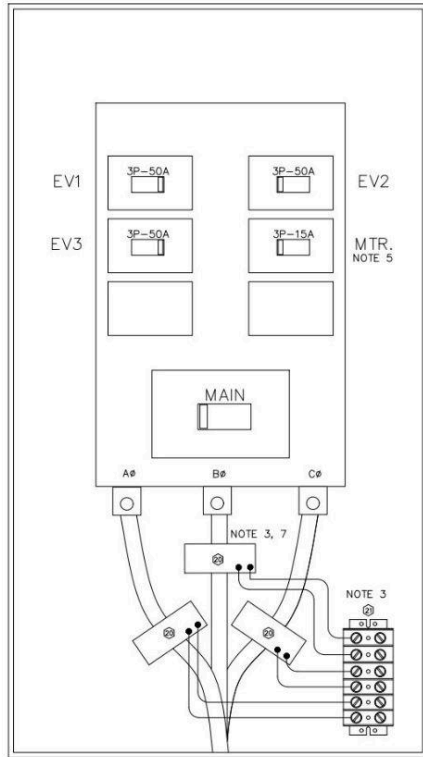
Department INTEGRATED INFRASTRUCTURE SERVICES

Issues / Revisions					
Ln#	Date	Author	Review	Check	Description
A	2022-02-23	PS	TK	DL	ISSUED FOR REVIEW
B	2023-02-03	TK	PS	DL	ISSUED FOR REVIEW

Location ID CITXXX  
 Description TYPICAL EV CHARGER SYSTEM CONSTRUCTION WORK PACKAGE

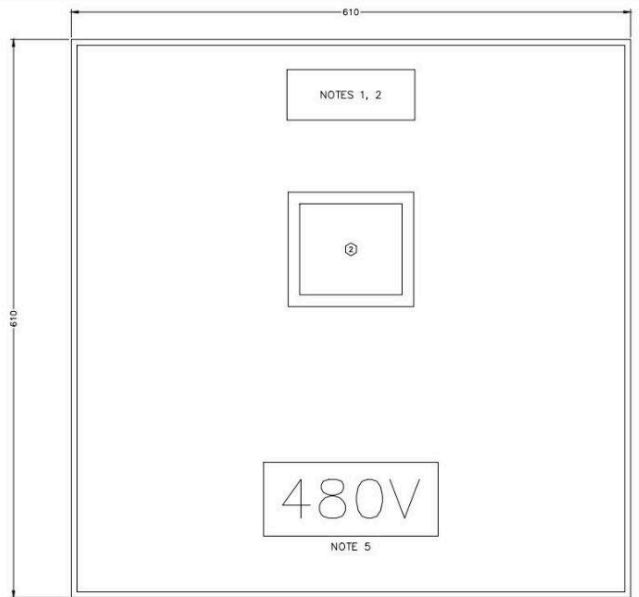
Drawing Title TYPICAL THREE LINE DIAGRAM

Discipline ELECTRICAL	Volume 01	Sheet 2 OF 10	Drawing Number E002
File EV_STD_date_E002_V1.0.dwg			

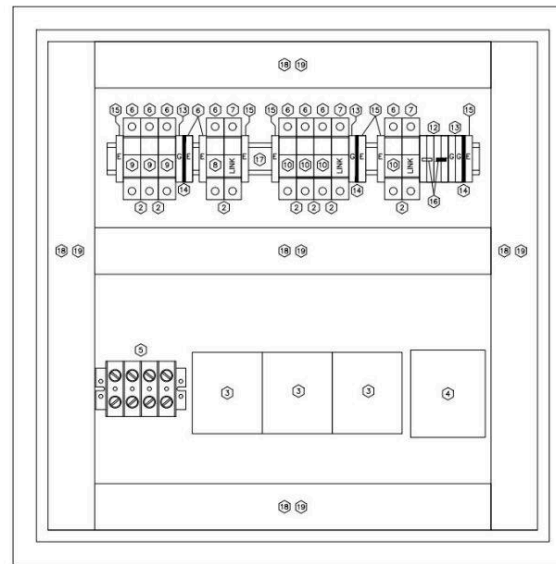


1 EV CHARGER DISTRIBUTION PANEL (DETAIL)  
 E007 N.T.S.

LEGEND:					
NO.	QTY	SUPPLIED BY	DEVICE	MANUFACTURER	MODEL/PART NUMBER
1	1	PANEL SHOP	NEMA 12 600x600x200mm ENCLOSURE	HAMMOND	1418J8
2	1	PANEL SHOP	PANEL MOUNT POWER QUALITY METER	SCHNEIDER	POWERLOGIC PM5500
3	3	PANEL SHOP	480:120V VOLTAGE TRANSFORMER, 40VA	GE-ITI	MODEL 467
4	1	PANEL SHOP	480:120V 150VA CPT	SQUARE D	9070T150032
5	1	PANEL SHOP	CT SHORTING BLOCK, 4--POLE	GE	EB27B04SC
6	8	PANEL SHOP	DEAD-FRONT FUSE HOLDERS	MERSEN	USM1
7	3	PANEL SHOP	DEAD-FRONT CAPTIVE NEUTRAL LINK	MERSEN	USN
8	1	PANEL SHOP	CONTROL FUSE, TYPE ATO, 2A	MERSEN	AT02
9	3	PANEL SHOP	CONTROL FUSE, TYPE ATM, 2A	MERSEN	ATM2
10	4	PANEL SHOP	CONTROL FUSE, TYPE ATM, 1A	MERSEN	ATM1
11	2	PANEL SHOP	FUSE HOLDER PIN-TIE ACCESSORY KIT	MERSEN	USPTH
12	4	PANEL SHOP	WDU 4N	WEIDMULLER	1020100000
13	4	PANEL SHOP	WPE 4 GROUNDING TERMINAL	WEIDMULLER	1010100000
14	3	PANEL SHOP	WAP WDU2.5N/4N (END COVER)	WEIDMULLER	1060000000
15	8	PANEL SHOP	END BRACKET	WEIDMULLER	1059000000
16	2	PANEL SHOP	2-POLE PLUG-IN JUMPER FOR WDU SERIES	WEIDMULLER	1758250000
17	(LOT)	PANEL SHOP	TS-35 DIN RAIL	ENTRELEC	017430017
18	2	PANEL SHOP	50mmW X 75mmD SLOTTED WIREWAY	PANDUIT	F2X3LG6
19	2	PANEL SHOP	50mmW WIREWAY COVER	PANDUIT	C2LG6
20	3	PANEL SHOP	METERING CT, DONUT TYPE	GE-ITI	MODEL 58
21	1	PANEL SHOP	CT SHORTING BLOCK, 6--POLE	GE	EB27B06SC



2 EV CHARGER DISTRIBUTION PANEL (DETAIL)  
 E007 N.T.S.



3 EV CHARGER METERING CABINET - BACKPLANE LAYOUT  
 E007 N.T.S.

- NOTES:
- LAMACOID IS 6" X 2" WHITE BACKGROUND, 0.5" BLACK TEXT (2 LINES)  
 LINE 1 = "EV CHARGER"  
 LINE 2 = "METERING CABINET"
  - LAMACOID TO BE SCREWED OR RIVETED TO PANEL.
  - CONTRACTOR TO SUPPLY AND INSTALL (3) DONUT-TYPE CURRENT TRANSFORMERS GE-ITI MODEL 58RL INTO EV CHARGER DISTRIBUTION PANEL AND WIRE TO 6-POLE SHORTING BLOCK USING CRIMP-ON RING-TYPE TERMINALS.
  - 480V WARNING STICKER, ORANGE
  - 3P-15A BREAKER FOR 3 PHASE PT SIGNAL TO METERING CABINET.
  - PANELBOARD REQUIRED TO BE FULLY TAMPER-PROOF.
  - CURRENT TRANSFORMERS ARE REQUIRED TO BE MOUNTED WITHIN PANEL (TAPING IS NOT ACCEPTABLE).
  - METER MUST INCLUDE BACNET PROTOCOL AND IS REQUIRED TO BE COMPATIBLE WITH CITY NETWORKING AND BMS SYSTEMS.

THIS STANDARD DRAWING/DETAIL AND/OR SPECIFICATION IS PROVIDED TO CONVEY THE CITY'S TYPICAL GENERAL ARRANGEMENT AND REQUIREMENTS. REPRESENTATIONS MAY NOT BE TO SCALE. THEY MAY BE SUBSTANTIALLY SCHEMATIC IN NATURE AND/OR REQUIRE FURTHER ELABORATION AND DEVELOPMENT AS SUCH THIS DOCUMENT IS NOT SUITABLE FOR INTEGRATION INTO A SPECIFIC IMPLEMENTATION WITHOUT REVIEW AND MODIFICATION AND IS ONLY INTENDED FOR USE BY A COMPETENT DESIGNER EXERCISING PROFESSIONAL JUDGMENT. THE DESIGNER SHALL MODIFY AND SUPPLEMENT AS NECESSARY TO PROVIDE A COMPLETE, PROPERLY FUNCTIONING DESIGN THAT CONFORMS IN ALL RESPECTS TO THE CITY'S FUNCTIONAL REQUIREMENTS. WHEN ACTUALIZED IN A PARTICULAR IMPLEMENTATION IT IS THE DESIGNER'S RESPONSIBILITY TO ENSURE THE SIZE, LOCATION AND SPACING OF ALL ELEMENTS AND ALL COMPONENTS/SPECIFICATIONS ARE SUITABLE AND SAFE FOR THE USE AND LOCATION INTENDED, AND ANY APPLICABLE CODE, LEGISLATIVE, AND AUTHORITY REQUIREMENTS ARE ADHERED TO IN ADDITION, ANY ACCESSIBILITY, OPERATIONAL, AND MAINTENANCE REQUIREMENTS MUST BE NOTED. DEVIATIONS FROM THIS REPRESENTED NORMAL DESIGN PARAMETERS, QUESTIONS OF INTENT OR ACCURACY, OR ANY OTHER APPARENT CONFLICTS, SHALL BE RECONCILED WITH AN APPROPRIATE CITY REPRESENTATIVE. FRANKLY, WHEN EMPLOYING ANY ASPECT OF THIS DOCUMENT, THE ULTIMATELY RESPONSIBLE PROFESSIONAL, DESIGNER, SHALL REMOVE ANY AUTHENTICATION OF THE ORIGINAL AUTHOR(S), NOTE ANY PROVENANCE AS APPROPRIATE, AND APPLY THEIR OWN AUTHENTICATION AS REQUIRED.

Seal	Permit

Edmonton  
**ELECTRIC VEHICLE CHARGING STATION TYPICAL INSTALLATION**  
 CP-00XXXX

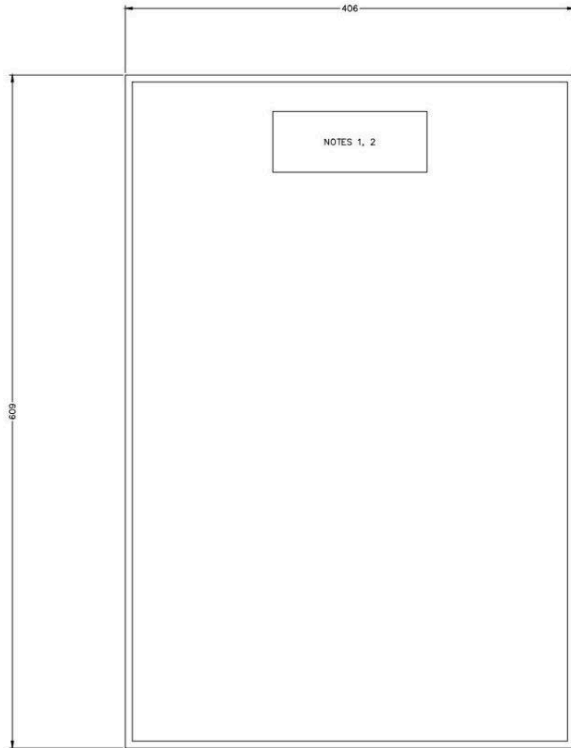
Department INTEGRATED INFRASTRUCTURE SERVICES

Issues / Revisions					
Id.#	Date	Author	Review	Check	Description
A	2022-02-03	PS	TK	DL	ISSUED FOR REVIEW
B	2023-03-03	TK	PS	DL	ISSUED FOR REVIEW

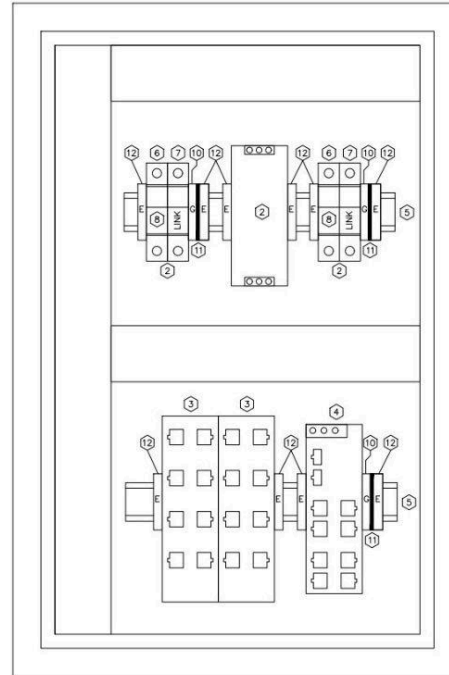
Location ID CITXXX  
 Description TYPICAL EV CHARGER SYSTEM CONSTRUCTION WORK PACKAGE

Drawing Title TYPICAL EV BREAKER PANEL & METERING CABINET DETAILS

Discipline ELECTRICAL	Volume 01	Sheet 3 TO 10	Drawing Number E003
File EV_STD_date_E003_V1.0.dwg			



1 EV CHARGER NETWORK CABINET – FRONT ELEVATION  
 COE N.T.S.



2 EV CHARGER NETWORK CABINET – BACKPLANE LAYOUT  
 COE N.T.S.

LEGEND:					
NO.	QTY	SUPPLIED BY	DEVICE	MANUFACTURER	MODEL/PART NUMBER
1	1	PANEL SHOP	NEMA 12 600x400x200mm ENCLOSURE	HAMMOND	1418H8
2	1	PANEL SHOP	24VDC DC SUPPLY, 120VAC INPUT, 2.5A	PHOENIX CONTACT	2904614
3	2	PANEL SHOP	8 PORT RJ45 PATCH BAY, DIN RAIL MOUNT	PANDUIT	CDPPBRG
4	1	PANEL SHOP	UNMANAGED 8-PORT NETWORK SWITCH	MOXA	EDR-810-VPN-2GSFP
5	LOT	PANEL SHOP	TS-35 DIN RAIL	ENTRELEC	017430017
6	2	PANEL SHOP	DEAD-FRONT FUSE HOLDERS	MERSEN	USM1
7	2	PANEL SHOP	DEAD-FRONT CAPTIVE NEUTRAL LINK	MERSEN	USN
8	2	PANEL SHOP	CONTROL FUSE, TYPE ATM, 2A	MERSEN	ATM2
9	1	PANEL SHOP	FUSE HOLDER PIN-TIE ACCESSORY KIT	MERSEN	USPTH
10	3	PANEL SHOP	WPE 4 GROUNDING TERMINAL	WEIDMULLER	1010100000
11	3	PANEL SHOP	WAP WDU2.5N/4N (END COVER)	WEIDMULLER	1060000000
12	10	PANEL SHOP	END BRACKET	WEIDMULLER	1059000000

NOTES:

- LAMACOID IS 6" X 2" WHITE BACKGROUND, 0.5" BLACK TEXT (2 LINES)  
 LINE 1 = "EV CHARGER"  
 LINE 2 = "NETWORK CABINET"
- LAMACOID TO BE SCREWED OR RIVETED TO PANEL.

THIS STANDARD DRAWING/DETAIL AND/OR SPECIFICATION IS PROVIDED TO CONVEY THE CITY'S TYPICALLY IDEAL GENERAL ARRANGEMENT AND REQUIREMENTS. REPRESENTATIONS MAY NOT BE TO SCALE. THEY MAY BE SUBSTANTIALLY SCHEMATIC IN NATURE AND/OR REQUIRE FURTHER ELABORATION AND DEVELOPMENT AS SUCH THIS DOCUMENT IS NOT SUITABLE FOR INTEGRATION INTO A SPECIFIC IMPLEMENTATION WITHOUT REVIEW AND MODIFICATION AND IS ONLY INTENDED FOR USE BY A COMPETENT DESIGNER EXERCISING PROFESSIONAL JUDGMENT. THE DESIGNER SHALL MODIFY AND SUPPLEMENT AS NECESSARY TO PROVIDE A COMPLETE, PROPERLY FUNCTIONING DESIGN THAT CONFORMS IN ALL RESPECTS TO THE CITY'S FUNCTIONAL REQUIREMENTS. WHEN ACTUALIZED IN A PARTICULAR IMPLEMENTATION IT IS THE DESIGNER'S RESPONSIBILITY TO ENSURE THE SIZE, LOCATION, AND SPACING OF ALL ELEMENTS, AND ALL COMPONENTS/SPECIFICATIONS, ARE SUITABLE AND SAFE FOR THE USE AND LOCATION INTENDED, AND ANY APPLICABLE CODE, LEGISLATIVE, AND AUTHORITY REQUIREMENTS ARE ADHERED TO IN ADDITION ANY ACCESSIBILITY, OPERATIONAL, AND MAINTENANCE REQUIREMENTS MUST BE MET. DEVIATIONS FROM THE REPRESENTED NOMINAL DESIGN PARAMETERS, QUESTIONS OF INTENT OR ACCURACY, OR ANY OTHER APPARENT CONFLICTS, SHALL BE RECONCILED WITH AN APPROPRIATE CITY REPRESENTATIVE. FINALLY, WHEN EMPLOYING ANY ASPECT OF THIS DOCUMENT, THE USUALLY RESPONSIBLE PROFESSIONAL DESIGNER SHALL REMOVE ANY AUTHENTICATION OF THE ORIGINAL AUTHOR(S). NOTE ANY PROVENANCE AS APPROPRIATE, AND APPLY THEIR OWN AUTHENTICATION AS REQUIRED.

Seal	Permit
------	--------

Edmonton  
**ELECTRIC VEHICLE CHARGING STATION TYPICAL INSTALLATION**  
 CP-00XXXX

Department INTEGRATED INFRASTRUCTURE SERVICES

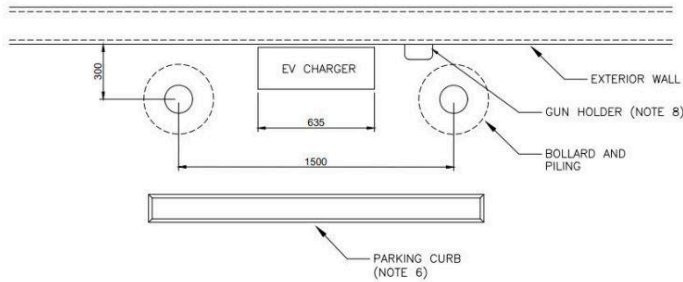
Issue / Revisions					
Iss#	Date	Author	Review	Check	Description
A	2022-12-23	PS	TK	DL	ISSUED FOR REVIEW
B	2023-02-03	TK	PS	DL	ISSUED FOR REVIEW

Location ID CITXXX  
 Description TYPICAL EV CHARGER SYSTEM CONSTRUCTION WORK PACKAGE

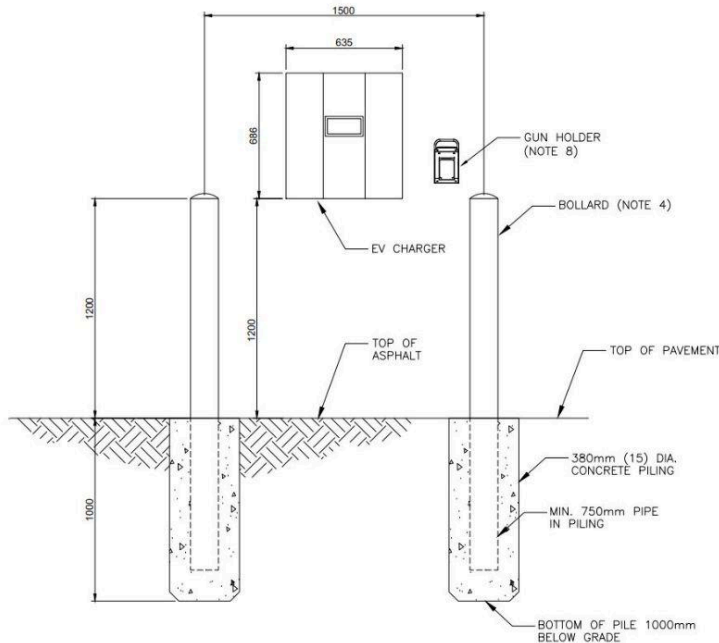
Drawing Title TYPICAL NETWORK CABINET DETAIL

Discipline ELECTRICAL	Volume 01	Sheet 4 OF 10	Drawing Number	<b>E004</b>
File EV_STD_date_E004_V1.0.dwg				





1 EV CHARGER INSTALLATION DETAIL (PLAN VIEW)  
 E011 N.T.S.



2 EV CHARGER INSTALLATION DETAIL (FRONT VIEW)  
 E011 N.T.S.

NOTES:

- SAW-CUT AND REMOVE MATERIAL TO INSET CONCRETE BASE 300mm INTO EXISTING SIDEWALK. TOP OF BASE TO MATCH ELEVATION OF EXISTING SIDEWALK.
- SAW-CUT EXISTING SIDEWALK AS REQUIRED TO INSTALL (2) 3/4" CONDUITS FOR DATA AND CHARGER POWER. REPAIR SIDEWALK AFTER INSTALLATION.
- WALL PENETRATION TO BE MADE INTO WALL AT DESIGNATED LOCATION AND SEALED WITH FIRE-RATED WEATHER AND UV RESISTANT EXPANDING FOAM.
- BOLLARDS TO CONSIST OF 150mm (6") STEEL PIPE FILLED WITH CONCRETE AND ENCASED WITH CONCRETE BELOW GRADE IN 380mm (15") PILING, DIMENSIONS AS SHOWN. STEEL TO BE FINISHED IN WEATHER RESISTANT FINISH AND COVERED WITH HDPE HIGH-VISIBILITY UV RESISTANT BOLLARD SLEEVE.
- CONTRACTOR TO CORE HOLES IN BASE AS REQUIRED FOR CONDUIT ENTRY/EXIT.
- RELOCATE EXISTING PARKING CURBS SO THAT CURBS ARE 900mm FROM FRONT EDGE OF SIDEWALK.
- CHARGER STAND TO BE AFFIXED TO CONCRETE BASE USING 3/4" x 2" CONCRETE INSERT AND 3/4" STAINLESS STEEL HARDWARE (4 PLACES).
- CCS1 STYLE GUN HOLDER AND CABLE MANAGEMENT BLOCK.

THIS STANDARD DRAWING/DETAIL AND/OR SPECIFICATION IS PROVIDED TO CONVEY THE CITY'S TYPICAL IDEAL GENERAL ARRANGEMENT AND REQUIREMENTS. REPRESENTATIONS MAY NOT BE TO SCALE. THEY MAY BE SUBSTANTIALLY SCHEMATIC IN NATURE AND/OR REQUIRE FURTHER ELABORATION AND DEVELOPMENT AS SUCH THIS DOCUMENT IS NOT SUITABLE FOR INTEGRATION INTO A SPECIFIC IMPLEMENTATION WITHOUT REVIEW AND MODIFICATION AND IS ONLY INTENDED FOR USE BY A COMPETENT DESIGNER EXERCISING PROFESSIONAL JUDGMENT. THE DESIGNER SHALL VERIFY AND SUPPLEMENT AS NECESSARY TO PROVIDE A COMPLETE, PROPERLY FUNCTIONING DESIGN THAT CONFORMS IN ALL RESPECTS TO THE CITY'S FUNCTIONAL REQUIREMENTS. WHEN ACTUALIZED IN A PARTICULAR IMPLEMENTATION IT IS THE DESIGNER'S RESPONSIBILITY TO ENSURE THE SIZE, LOCATION AND SPACING OF ALL ELEMENTS AND ALL COMPONENTS/SPECIFICATIONS ARE SUITABLE AND SAFE FOR THE USE AND LOCATION INTENDED, AND ANY APPLICABLE CODE, LEGISLATIVE AND AUTHORITY REQUIREMENTS ARE ADHERED TO. IN ADDITION, ANY ACCESSIBILITY, OPERATIONAL AND MAINTENANCE REQUIREMENTS MUST BE MET. DEVIATIONS FROM THE REPRESENTED NORMAL DESIGN PARAMETERS, QUESTIONS OF INTENT OR ACCURACY, OR ANY OTHER MOVEMENT CONFLICTS SHALL BE RECONCILED WITH AN APPROPRIATE CITY REPRESENTATIVE. FINALLY, WHEN EMPLOYING ANY ASPECT OF THIS DOCUMENT, THE ULTIMATELY RESPONSIBLE PROFESSIONAL DESIGNER SHALL REMOVE ANY AUTHENTICATION OF THE ORIGINAL AUTHOR(S), NOTE ANY PROVENANCE AS APPROPRIATE, AND APPLY THEIR OWN AUTHENTICATION AS REQUIRED.

Seal	Permit

Edmonton  
**ELECTRIC VEHICLE CHARGING STATION TYPICAL INSTALLATION**  
 CP-00XXXX

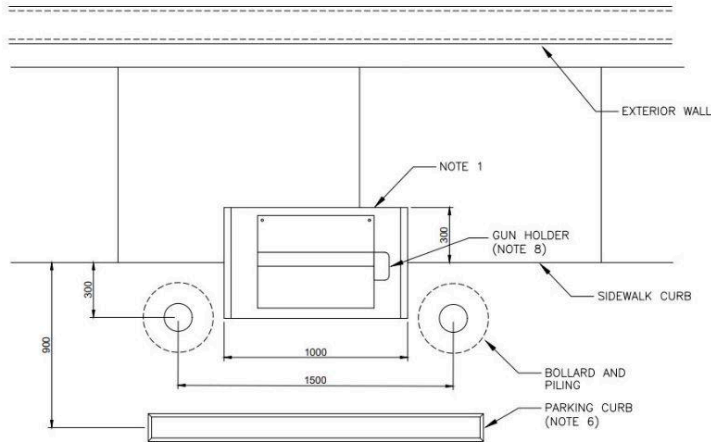
Department INTEGRATED INFRASTRUCTURE SERVICES

Issue / Revisions	Date	Author	Review	Check	Description
A	2023-02-23	PS	TK	DL	ISSUED FOR REVIEW
B	2023-02-03	TK	PS	DL	ISSUED FOR REVIEW

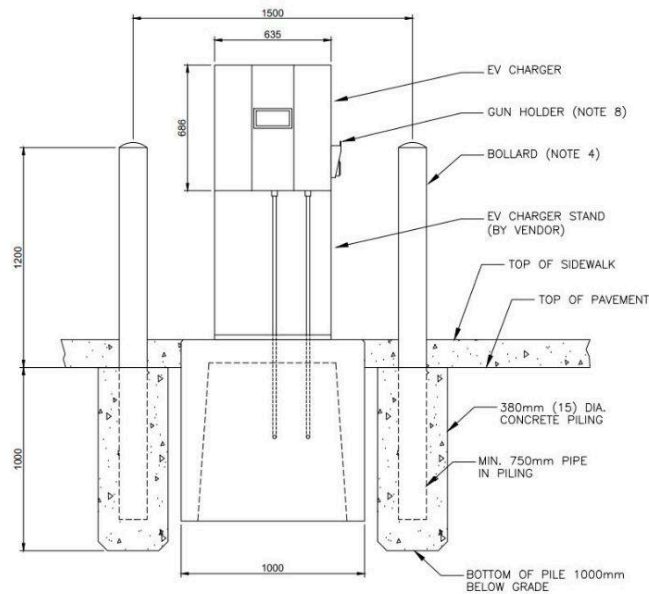
Location ID CITXXX  
 Description TYPICAL EV CHARGER SYSTEM CONSTRUCTION WORK PACKAGE

Drawing Title WALL MOUNTED EV CHARGER TYPICAL INSTALLATION DETAIL

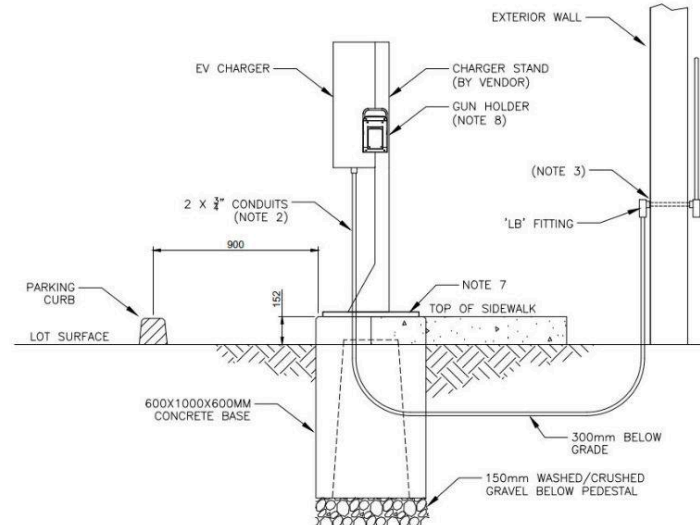
Discipline ELECTRICAL	Volume 01	Drawing Number	E005
Sheet 5 OF 10	File EV_STD_date_E005_V1.0.dwg		



1 EV CHARGER INSTALLATION DETAIL (FRONT VIEW)  
 E012 N.T.S.



2 EV CHARGER INSTALLATION DETAIL (FRONT VIEW)  
 E012 N.T.S.



3 EV CHARGER INSTALLATION DETAIL (FRONT VIEW)  
 E012 N.T.S.

NOTES:

1. SAW-CUT AND REMOVE MATERIAL TO INSET CONCRETE BASE 300mm INTO EXISTING SIDEWALK. TOP OF BASE TO MATCH ELEVATION OF EXISTING SIDEWALK.
2. SAW-CUT EXISTING SIDEWALK AS REQUIRED TO INSTALL (2) 3/4" RIGID STEEL CONDUITS FOR DATA AND CHARGER POWER. REPAIR SIDEWALK AFTER INSTALLATION.
3. WALL PENETRATION TO BE MADE INTO WALL AT DESIGNATED LOCATION AND SEALED WITH FIRE-RATED WEATHER AND UV RESISTANT EXPANDING FOAM.
4. BOLLARDS TO CONSIST OF 150mm (6") STEEL PIPE FILLED WITH CONCRETE AND ENCASED WITH CONCRETE BELOW GRADE IN 380mm (15") PILING, DIMENSIONS AS SHOWN. STEEL TO BE FINISHED IN WEATHER RESISTANT FINISH AND COVERED WITH HDPE HIGH-VISIBILITY UV RESISTANT BOLLARD SLEEVE.
5. CONTRACTOR TO CORE HOLES IN BASE AS REQUIRED FOR CONDUIT ENTRY/EXIT.
6. RELOCATE EXISTING PARKING CURBS SO THAT CURBS ARE 900mm FROM FRONT EDGE OF SIDEWALK.
7. CHARGER STAND TO BE AFFIXED TO CONCRETE BASE USING 3/4" X 2" CONCRETE INSERT AND 1/2" STAINLESS STEEL HARDWARE (4 PLACES).
8. CCS1 STYLE GUN HOLDER AND CABLE MANAGEMENT BLOCK.

THIS STANDARD DRAWING/TYPICAL AND/OR SPECIFICATION IS PROVIDED TO CONVEY THE CITY'S TYPICAL IDEAL GENERAL ARRANGEMENT AND REQUIREMENTS. REPRESENTATIONS MAY NOT BE TO SCALE. THEY MAY BE SUBSTITUTED, SCHEMATIC IN NATURE AND/OR REQUIRE FURTHER ELABORATION AND DEVELOPMENT AS SUCH THIS DOCUMENT IS NOT SUITABLE FOR NEGOTIATION INTO A SPECIFIC IMPLEMENTATION WITHOUT REVIEW AND MODIFICATION AND IS ONLY INTENDED FOR USE BY A COMPETENT DESIGNER EXERCISING PROFESSIONAL JUDGMENT. THE DESIGNER SHALL MODIFY AND SUPPLEMENT AS NECESSARY TO PROVIDE A COMPLETE, PROPERLY FUNCTIONING DESIGN THAT CONFORMS IN ALL RESPECTS TO THE CITY'S FUNCTIONAL REQUIREMENTS. WHEN ACTUALIZED IN A PARTICULAR IMPLEMENTATION IT IS THE DESIGNER'S RESPONSIBILITY TO ENSURE THE SIZE, LOCATION, AND SPACING OF ALL ELEMENTS AND ALL COMPONENTS/SPECIFICATIONS ARE SUITABLE AND SAFE FOR THE USE AND LOCATION INTENDED, AND ANY APPLICABLE CODE, LEGISLATIVE, AND AUTHORITY REQUIREMENTS ARE ADHERED TO. IN ADDITION, ANY ACCESSIBILITY, OPERATIONAL AND MAINTENANCE REQUIREMENTS MUST BE MET. DEVIATIONS FROM THE REPRESENTED NOMINAL DESIGN PARAMETERS, QUESTIONS OF INTENT OR ACCURACY, OR ANY OTHER APPARENT CONFLICTS SHALL BE RECOGNIZED WITH AN APPROPRIATE CITY REPRESENTATIVE. FINALLY, WHEN EMPLOYING ANY ASPECT OF THIS DOCUMENT THE ULTIMATELY RESPONSIBLE PROFESSIONAL DESIGNER SHALL REMOVE ANY AUTHENTICATION OF THE ORIGINAL AUTHOR(S), NOTE ANY PROVENANCE AS APPROPRIATE, AND APPLY THEIR OWN AUTHENTICATION AS REQUIRED.

Seal	Permit
------	--------

**Edmonton** ELECTRIC VEHICLE CHARGING STATION TYPICAL INSTALLATION  
 CP-00XXXX

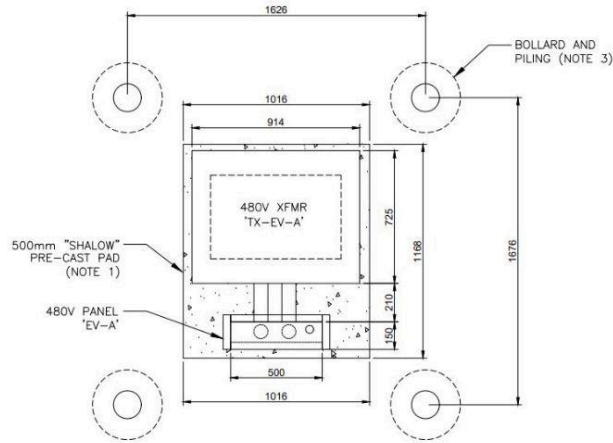
Department INTEGRATED INFRASTRUCTURE SERVICES

Issue #	Date	Author	Review	Check	Description
A	2023-12-29	FW	TR	DL	ISSUED FOR REVIEW
B	2024-01-03	FW	TR	DL	ISSUED FOR REVIEW

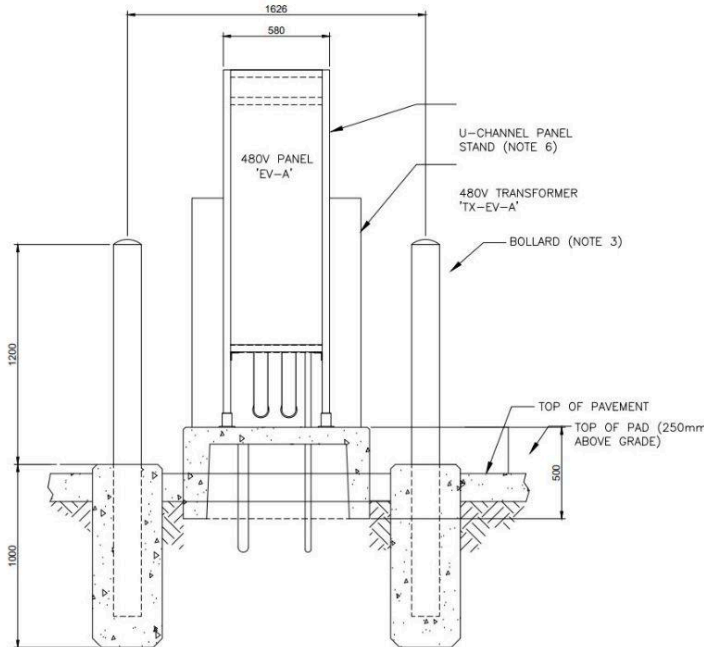
Location ID CITXXX  
 Description TYPICAL EV CHARGER SYSTEM CONSTRUCTION WORK PACKAGE

Drawing Title PEDESTAL MOUNTED EV CHARGER TYPICAL INSTALLATION DETAIL

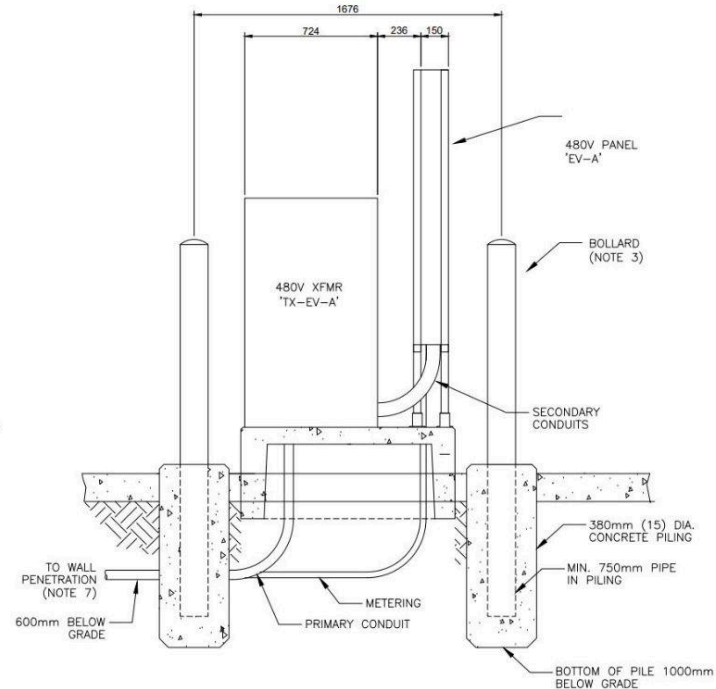
Discipline	ELECTRICAL	Volume	01	Drawing Number	E006
Sheet	6 OF 10	File	EV_STD_date_E006_V1.0.dwg		



1 EV PANEL & XFMR OUTDOOR INSTALLATION (PLAN)  
 E01.3 N.T.S.



2 EV PANEL & XFMR OUTDOOR INSTALLATION (FRONT ELEV.)  
 E01.3 N.T.S.



3 EV PANEL & XFMR OUTDOOR INSTALLATION (SIDE ELEV.)  
 E01.3 N.T.S.

- NOTES:
- SAW-CUT AND REMOVE MATERIAL TO INSET CONCRETE BASE INTO EXISTING SIDEWALK SUCH THAT TOP OF BASE IN 100mm ABOVE PARKING LOT SURFACE, PAD TO BE WESTCON PRECAST INC. MODEL W2-00 OR EQUAL.
  - WALL PENETRATIONS TO BE MADE INTO WALL AT DESIGNATED LOCATION AND SEALED WITH FIRE-RATED WEATHER AND UV RESISTANT EXPANDING FOAM.
  - BOLLARDS TO CONSIST OF 150mm (6") STEEL PIPE FILLED WITH CONCRETE AND ENCASED WITH CONCRETE BELOW GRADE IN 380mm (15") PILING, DIMENSIONS AS SHOWN. STEEL TO BE FINISHED IN WEATHER RESISTANT FINISH AND COVERED WITH HDPE HIGH-VISIBILITY UV RESISTANT BOLLARD SLEEVE. LOCATION AND REQUIREMENT FOR REINFORCEMENT TO BE EVALUATED ON A SITE-BY-SITE BASIS.
  - CONTRACTOR TO CORE HOLES IN BASE AS REQUIRED FOR CONDUIT ENTRY/EXIT.
  - U-CHANNEL PANEL STAND TO CONSIST OF FOUR VERTICAL POSTS AND FIVE CROSS-BRACES USING THE FOLLOWING COMPONENTS:
    - POSTS & BRACES UNISTRUT P1000 OR EQUAL
    - CORNER BRACKETS UNISTRUT 1026 OR EQUAL
    - ANGULAR BRACKET UNISTRUT 135 OR EQUAL
    - POST BASES UNISTRUT 2942 OR EQUAL
    - CONCRETE INSERTS UNISTRUT 6308SD OR EQUAL
    - SPRING NUTS UNISTRUT P1010 OR EQUAL.
  - EV DISTRIBUTION PANEL TO BE BOLTER TO U-CHANNEL STAND USING 1/2" GRADE V STAINLESS STEEL HARDWARE.
  - REFER TO WALL PENETRATION AND CONDUIT STUB-UP DETAILS.

THIS STANDARD DRAWING/DETAIL AND/OR SPECIFICATION IS PROVIDED TO CONVEY THE CITY'S TYPICAL IDEAL GENERAL ARRANGEMENT AND REQUIREMENTS. REPRESENTATIONS MAY NOT BE TO SCALE. THEY MAY BE SUBSTANTIALLY SCHEMATIC IN NATURE AND/OR REQUIRE FURTHER ELABORATION AND DEVELOPMENT. AS SUCH THIS DOCUMENT IS NOT SUITABLE FOR INTEGRATION INTO A SPECIFIC IMPLEMENTATION WITHOUT REVIEW AND MODIFICATION AND IS ONLY INTENDED FOR USE BY A COMPETENT DESIGNER EXERCISING PROFESSIONAL JUDGMENT. THE DESIGNER SHALL MODIFY AND SUPPLEMENT AS NECESSARY TO PROVIDE A COMPLETE, PROPERLY FUNCTIONING DESIGN THAT CONFORMS IN ALL RESPECTS TO THE CITY'S FUNCTIONAL REQUIREMENTS. WHEN ACTUALIZED IN A PARTICULAR IMPLEMENTATION IT IS THE DESIGNER'S RESPONSIBILITY TO DETERMINE THE SIZE, LOCATION AND SPACING OF ALL ELEMENTS AND ALL COMPONENTS/SPECIFICATIONS ARE SUITABLE AND SAFE FOR THE USE AND LOCATION INTENDED; AND ANY APPLICABLE CODE, LEGISLATIVE AND AUTHORITY REQUIREMENTS ARE ADHERED TO. IN ADDITION ANY ACCESSIBILITY, OPERATIONAL AND MAINTENANCE REQUIREMENTS MUST BE MET. DEVIATIONS FROM THE REPRESENTED NOMINAL DESIGN PARAMETERS, QUESTIONS OF INTENT OR ACCURACY, OR ANY OTHER APPARENT CONFLICTS, SHALL BE RECORDED WITH AN APPROPRIATE CITY REPRESENTATIVE. FINALLY, WHEN EMPLOYING ANY ASPECT OF THIS DOCUMENT, THE ULTIMATELY RESPONSIBLE PROFESSIONAL DESIGNER SHALL REMOVE ANY AUTHENTICATION OF THE ORIGINAL AUTHORED, NOTE ANY PROVENANCE AS APPROPRIATE, AND APPLY THEIR OWN AUTHENTICATION AS REQUIRED.

Seal	Permit
------	--------

**Edmonton** ELECTRIC VEHICLE CHARGING STATION TYPICAL INSTALLATION  
 CP-00XXXX

Department INTEGRATED INFRASTRUCTURE SERVICES

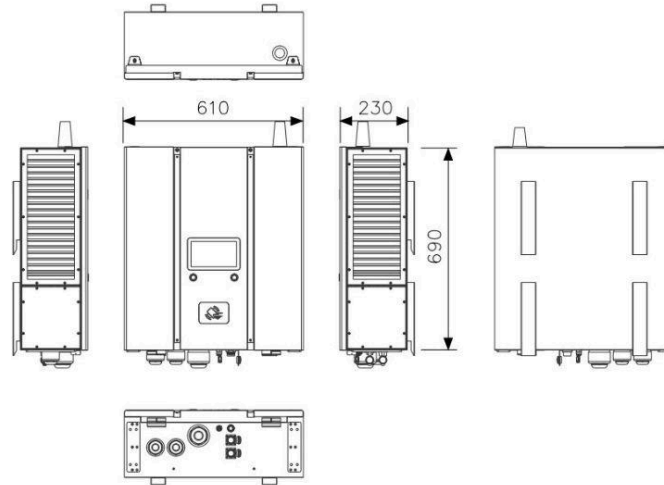
Lib.#	Date	Author	Review	Check	Description
A	2022-12-28	JPS	TK	DL	ISSUED FOR REVIEW
B	2023-03-03	TK	JPS	DL	ISSUED FOR REVIEW

Location ID CITXXX  
 Description TYPICAL EV CHARGER SYSTEM CONSTRUCTION WORK PACKAGE

Drawing Title PAD-MOUNTED PANEL & XFMR TYPICAL INSTALLATION DETAIL

Discipline	ELECTRICAL	Volume	01	Sheet	7 OF 10	Drawing Number	E007
File	EV_STD_date_E007_V1.0.dwg						





2 30kW ELECTRIC VEHICLE CHARGER  
 E006 N.T.S.

THIS STANDARD DRAWING/DETAIL AND/OR SPECIFICATION IS PROVIDED TO CONVEY THE CITY'S TYPICALLY IDEAL GENERAL ARRANGEMENT AND REQUIREMENTS. REPRESENTATIONS MAY NOT BE TO SCALE. THEY MAY BE SUBSTANTIALLY SCHEMATIC IN NATURE AND/OR REQUIRE FURTHER ELABORATION AND DEVELOPMENT. AS SUCH THIS DOCUMENT IS NOT SUITABLE FOR INTEGRATION INTO A SPECIFIC IMPLEMENTATION WITHOUT REVIEW AND MODIFICATION AND IS ONLY INTENDED FOR USE BY A COMPETENT DESIGNER EXERCISING PROFESSIONAL JUDGMENT. THE DESIGNER SHALL MODIFY AND SUPPLEMENT AS NECESSARY TO PROVIDE A COMPLETE, PROPERLY FUNCTIONING DESIGN THAT CONFORMS IN ALL RESPECTS TO THE CITY'S FUNCTIONAL REQUIREMENTS. WHEN ACTUALIZED IN A PARTICULAR IMPLEMENTATION IT IS THE DESIGNER'S RESPONSIBILITY TO ENSURE THE SIZE, LOCATION AND SPACING OF ALL ELEMENTS AND ALL COMPONENTS/SPECIFICATIONS ARE SUITABLE AND SAFE FOR THE USE AND LOCATION INTENDED, AND ANY APPLICABLE CODE, LEGISLATIVE AND AUTHORITY REQUIREMENTS ARE ADHERED TO. IN ADDITION, ANY ACCESSIBILITY, OPERATIONAL AND MAINTENANCE REQUIREMENTS MUST BE MET. DEVIATIONS FROM THE REPRESENTED NOMINAL DESIGN PARAMETERS, QUESTIONS OF INTENT OR ACCURACY, OR ANY OTHER APPARENT CONFLICTS SHALL BE RESOLVED WITH AN APPROPRIATE CITY REPRESENTATIVE. FINALLY, WHEN EMPLOYING ANY ASPECT OF THIS DOCUMENT, THE ULTIMATELY RESPONSIBLE PROFESSIONAL DESIGNER SHALL REMOVE ANY AUTHENTICATION OF THE ORIGINAL AUTHOR(S), NOTE ANY PROVENANCE AS APPROPRIATE, AND APPLY THEIR OWN AUTHENTICATION AS REQUIRED.

Seal	Permit

**Edmonton** ELECTRIC VEHICLE CHARGING STATION TYPICAL INSTALLATION  
 CP-00XXXX

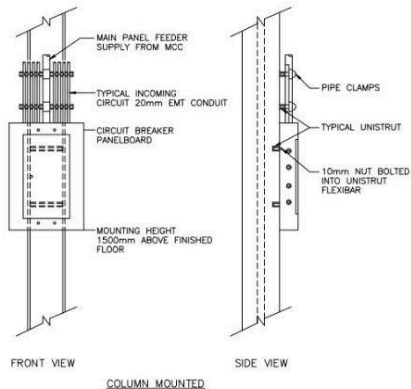
Department INTEGRATED INFRASTRUCTURE SERVICES

Rev	Date	Author	Review	Check	Description
A	2022-12-29	PS	TR	DL	SUBMITTED FOR REVIEW
B	2023-02-03	TR	PS	DL	SUBMITTED FOR REVIEW

Location ID CITXXX  
 Description TYPICAL EV CHARGER SYSTEM CONSTRUCTION WORK PACKAGE

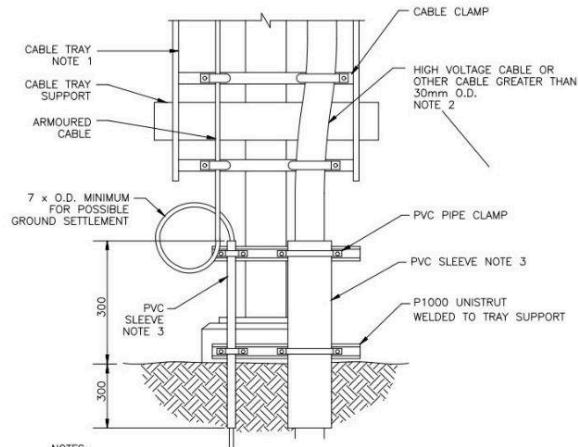
Drawing Title CHARGER DIMENSIONS & DETAILS

Discipline	ELECTRICAL	Volume	01	Sheet	8 OF 10	Drawing Number	E008
File	EV_STD_date_E008_V1.0.dwg						



COLUMN MOUNTED

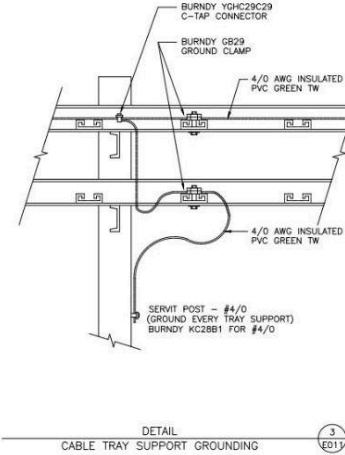
DETAIL DISTRIBUTION PANEL E011



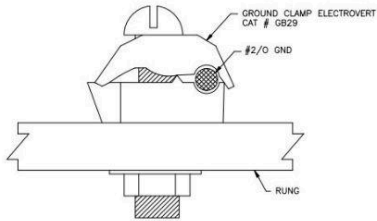
NOTES:

1. INSTALL SOLID COVER ON TRAY TO 2.5m ABOVE GRADE.
2. ENSURE CABLE HAS ENOUGH SLACK TO ALLOW FOR GROUND MOVEMENT.
3. AFTER CABLES ARE INSTALLED, SEAL THE PVC SLEEVE TOP WITH 3M TYPE CAULKING, CAT.No.3M800 (3M800 IS NOT COMPATIBLE WITH HDPE).

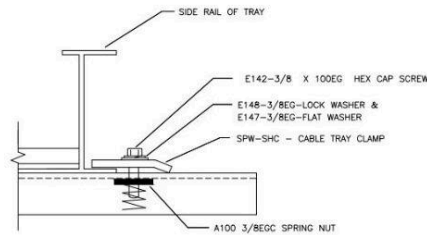
DETAIL TYPICAL CABLE ENTERING UNDERGROUND E011



DETAIL CABLE TRAY SUPPORT GROUNDING E011



DETAIL TYPICAL CABLE TRAY GROUNDING E011



DETAIL CABLE TRAY CLAMPING DETAIL E011

THIS STANDARD DRAWING/DETAIL AND/OR SPECIFICATION IS PROVIDED TO CONVEY THE CITY'S TYPICAL DESIGN ARRANGEMENT AND REQUIREMENTS. REPRESENTATIONS MAY NOT BE TO SCALE. THEY MAY BE SUBSTANTIALLY SCHEMATIC IN NATURE AND/OR REQUIRE FURTHER ELABORATION AND DEVELOPMENT AS SUCH THIS DOCUMENT IS NOT SUITABLE FOR INTEGRATION INTO A SPECIFIC IMPLEMENTATION WITHOUT REVIEW AND MODIFICATION AND IS ONLY INTENDED FOR USE BY A COMPETENT DESIGNER EXERCISING PROFESSIONAL JUDGMENT. THE DESIGNER SHALL ACCEPT AND SUPPLEMENT AS NECESSARY TO PROVIDE A COMPLETE, PROPERLY FUNCTIONING DESIGN THAT CONFORMS IN ALL RESPECTS TO THE CITY'S FUNCTIONAL REQUIREMENTS. WHEN ACTUATED IN A PARTICULAR IMPLEMENTATION IT IS THE DESIGNER'S RESPONSIBILITY TO ENSURE THE SIZE, LOCATION AND SPACING OF ALL ELEMENTS AND ALL COMPONENTS/SPECIFICATIONS ARE SUITABLE AND SAFE FOR THE USE AND LOCATION INTENDED AND ANY APPLICABLE CODE, LEGISLATIVE AND AUTHORITY REQUIREMENTS ARE ADHERED TO. IN ADDITION, ANY ACCESSIBILITY, OPERATIONAL, AND MAINTENANCE REQUIREMENTS MUST BE MET. DEVIATIONS FROM THE REPRESENTED NOMINAL DESIGN PARAMETERS, QUESTIONS OF INTENT OR ACCURACY, OR ANY OTHER REPRESENTATIVE FINALLY, WHEN EMPLOYING ANY ASPECT OF THIS DOCUMENT THE ULTIMATELY RESPONSIBLE PROFESSIONAL DESIGNER SHALL REMOVE ANY AUTHENTICATION OF THE ORIGINAL AUTHOR(S). NOTE ANY PROVENANCE AS APPROPRIATE AND APPLY THEIR OWN AUTHENTICATION AS REQUIRED.

Seal	Panel
------	-------

Edmonton  
**ELECTRIC VEHICLE CHARGING STATION TYPICAL INSTALLATION**  
 CP-00XXXX

Department INTEGRATED INFRASTRUCTURE SERVICES

Issues / Revisions					
Id #	Date	Author	Review	Check	Description
A	2023-12-29	PS	TK	DL	SELED FOR REVIEW
B	2023-02-01	TK	PS	DL	SELED FOR REVIEW

Location ID CITXXX  
 Description TYPICAL EV CHARGER SYSTEM CONSTRUCTION WORK PACKAGE

Drawing Title CONSTRUCTION DETAILS

Discipline ELECTRICAL	Volume 01	Sheet 9 OF 10	Drawing Number E009
File EV_STD_date_E009_V1.0.dwg			



## **APPENDIX J - UNINTERRUPTIBLE POWER SUPPLY (UPS)**

# 1. Uninterruptible Power Supply

## 1.1. Uninterruptible Power Supply (AC)

### 1.1.1.1. Requirements: Uninterruptible Power Supply (UPS) systems are required for

- .1 Maintaining the City Fiber network for facilities' VOIP and communications function during generator tests.
- .2 All Emergency Services facilities or facilities that provide City Fiber connectivity to said facilities. OCT Network Analyst to provide a list of associated City Fiber switch sites.
- .3 The telecommunication apparatus installed in Mission Critical Facilities including but not limited to 911 call centers, emergency response centers, police, fire, and ambulance facilities
- .4 All LRT facilities to follow the latest "[LRT High Floor Design Guidelines](#)"

### 1.1.1.2. UPS Topology: Location

- .1 Provide a centralized 3 phase + neutral UPS system for groups of loads unless otherwise directed. The use of load specific UPS and single phase UPS will be discouraged
- .2 Centralized UPS assemblies to be installed with a 100 mm (4") housekeeping pad
- .3 Location:
  - .1 Small applications (less than 20kW): Locate UPS in NAR room, adjust room size to accommodate centralized UPS systems. Installing UPS in IT rack is permissible.
  - .2 Large Application (20kW and above): Located UPS in dedicated rooms. UPS assembly shall not share racks / cabinets / room with any IT loads unless site specific constraints apply (brown field redesign only)

### 1.1.1.3. UPS Protection: Coordination with Mechanical Discipline

- .1 Coordination: Coordinate requirements for cooling, ventilation and fire suppression with Mechanical Consultant
- .2 Cooling:
  - .1 Rooms to include sufficient cooling to accommodate full equipment and UPS loss.
  - .2 Sizing to be based on equipment and UPS manufacturer's published maximum heat losses.
- .3 Fire Suppression:
  - .1 For lead acid technologies, an unsprinklered spare is preferred if permitted by code. Otherwise, mission critical applications to rely on either dry type clean release agent and/or backup pre-action dry type sprinkler system.
  - .2 When lithium technologies are used, additional requirements for room cooling and fire suppression may either apply or supersede the above listed acceptable methods and per the applicable requirements of the NFPA 853 and 855. Designers to consult with battery and UPS manufacturers and applicable code and industry consensus standards.

#### .4 Hydrogen control:

- .1 With one exception(\*) , the use of stationary batteries is NOT permitted.
- .2 LRT only: (\*) When nickel cadmium stationary batteries are used (refer to LRT guidelines), an intrinsically safe / explosion proof environment may be required. Refer to the applicable sections of the Alberta Building Code, Canadian Electrical Code, and LRT guidelines for guidance.

#### 1.1.1.4. UPS Topology: UPS system to include the following features:

##### .1 UPS Type:

- .1 Dual online double conversion, True Sine Wave output with active power factor and harmonic filtering built in for both input and output
- .2 Other UPS types (e.g.: Line interactive or Offline/Standby /Battery Backup) are not acceptable, no exceptions

##### .2 UPS voltage:

###### .1 UPS voltage and transformers: General Requirements

- .1 Where technologically achievable and practical, UPS input and outputs to match available facility voltage
- .2 When not achievable, UPS uses a step up and step down transformer to adapt its input/outputs to the facility's voltage level. Transformers to preferably form an integral part of the UPS lineup and to present to following characteristics:
  - o 0 degree phase shift,
  - o To be type isolation transformer or auto transformer if isolation transformer are not practical due to site specific weight or footprint limitations,
  - o Rated K13 or to be type harmonic mitigator (Zig Zag),
  - o Complete with electromagnetic shielding.

###### .2 Inputs:

- .1 UPS to use isolation K13 transformers if an input transformer is required.
- .2 Where space is an issue, the use of autotransformers is acceptable.

###### .3 Outputs:

###### .1 AC:

- o UPS to be preferably with an output voltage matching those of the critical loads.
- o When not achievable, output transformer or power distribution units (PDU) with built-in transformer type delta zig zag to be used. Stand alone transformers are also acceptable.

###### .2 DC output (LRT project only):

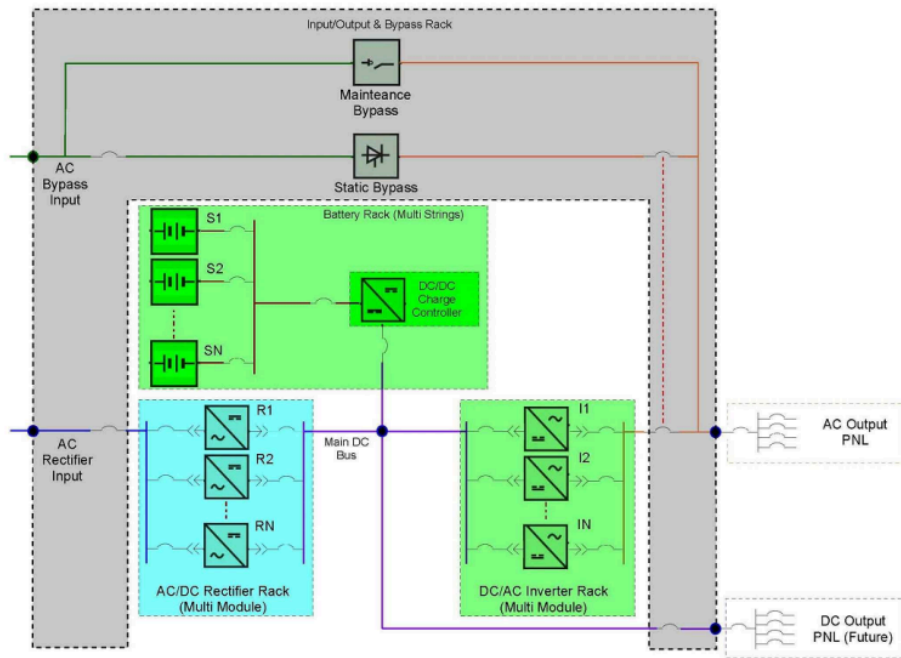
- o All UPS installed for LRT related projects shall include an available DC output for DC loads.

- Refer to the LRT guidelines for desired voltage levels.

#### **.4 UPS Assembly:**

- .1 UPS to be based on a multi-module assembly housed either in a rack or in a cabinet system. Multi module assembly can be achieved using internal or external assembly per UPS drawing E-001 below.
- .2 Rack or cabinet assembly shall prevent direct access to energised and exposed parts when the system is in operation.
- .3 Inputs and outputs shall be located in a common assembly or cabinet.
- .4 Rectifiers, battery strings, charge regulators and inverters shall be located in a common or separated assembly. When separated assemblies are specified, the wiring between each rack or cabinet shall form an integral part of the UPS system and shall be supplied by the UPS manufacturer as part of the manufacturer's engineered product offering.
- .5 All inputs and outputs shall be equipped with sufficient protective / disconnecting devices to ensure any part of the modular assembly can be taken offline while the remaining part of the system remains in operation.

THIS STANDARD DRAWING/DETAIL AND/OR SPECIFICATION IS PROVIDED TO CONVEY THE CITY'S TYPICALLY IDEAL GENERAL ARRANGEMENT AND REQUIREMENTS. REPRESENTATIONS MAY NOT BE TO SCALE. THEY MAY BE SUBSTANTIALLY SCHEMATIC IN NATURE AND/OR REQUIRE FURTHER ELABORATION AND DEVELOPMENT. AS SUCH THIS DOCUMENT IS NOT SUITABLE FOR INTEGRATION INTO A SPECIFIC IMPLEMENTATION WITHOUT REVIEW AND MODIFICATION AND IS ONLY INTENDED FOR USE BY A COMPETENT DESIGNER EXERCISING PROFESSIONAL JUDGMENT. THE DESIGNER SHALL MODIFY AND SUPPLEMENT AS NECESSARY TO PROVIDE A COMPLETE, PROPERLY FUNCTIONING, DESIGN THAT CONFORMS IN ALL RESPECTS TO THE CITY'S FUNCTIONAL REQUIREMENTS. WHEN ACTUALIZED IN A PARTICULAR IMPLEMENTATION IT IS THE DESIGNER'S RESPONSIBILITY TO ENSURE THE SIZE, LOCATION, AND SPACING OF ALL ELEMENTS, AND ALL COMPONENTS/SPECIFICATIONS, ARE SUITABLE AND SAFE FOR THE USE AND LOCATION INTENDED, AND ANY APPLICABLE CODE, LEGISLATIVE, AND AUTHORITY REQUIREMENTS ARE ADHERED TO. IN ADDITION, ANY ACCESSIBILITY, OPERATIONAL, AND MAINTENANCE REQUIREMENTS MUST BE MET. DEVIATIONS FROM THE REPRESENTED NOMINAL DESIGN PARAMETERS, QUESTIONS OF INTENT OR ACCURACY, OR ANY OTHER APPARENT CONFLICTS, SHALL BE RECONCILED WITH AN APPROPRIATE CITY REPRESENTATIVE. FINALLY, WHEN EMPLOYING ANY ASPECT OF THIS DOCUMENT, THE ULTIMATELY RESPONSIBLE PROFESSIONAL DESIGNER SHALL REMOVE ANY AUTHENTICATION OF THE ORIGINAL AUTHOR(S), NOTE ANY PROVENANCE AS APPROPRIATE, AND APPLY THEIR OWN AUTHENTICATION AS REQUIRED.

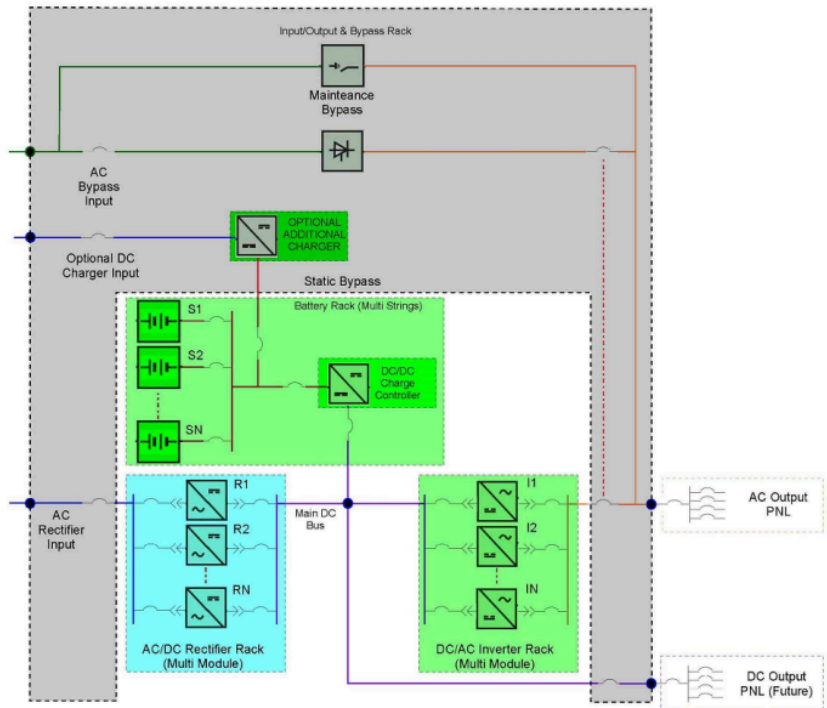


N+1 Dual On-line Conversion UPS Multi-Module Architecture with DC and AC outputs and fault resilient/independent bypasses (With possible N+1 internal redundancy)

Description		CONSULTANT MANUAL STANDARD DETAIL		
Location ID	N/A	Project #	N/A	
Discipline	ELECTRICAL	Author	RC	Review JM Check JM
Volume	01	Drawing Number	<b>E-001</b>	
Sheet	1 of 7			
File	UPS_STD_date_V1.0.dwg			



THIS STANDARD DRAWING/DETAIL AND/OR SPECIFICATION IS PROVIDED TO CONVEY THE CITY'S TYPICALLY IDEAL GENERAL ARRANGEMENT AND REQUIREMENTS. REPRESENTATIONS MAY NOT BE TO SCALE, THEY MAY BE SUBSTANTIALLY SCHEMATIC IN NATURE AND/OR REQUIRE FURTHER ELABORATION AND DEVELOPMENT. AS SUCH THIS DOCUMENT IS NOT SUITABLE FOR INTEGRATION INTO A SPECIFIC IMPLEMENTATION WITHOUT REVIEW AND MODIFICATION AND IS ONLY INTENDED FOR USE BY A COMPETENT DESIGNER EXERCISING PROFESSIONAL JUDGMENT. THE DESIGNER SHALL MODIFY AND SUPPLEMENT AS NECESSARY TO PROVIDE A COMPLETE, PROPERLY FUNCTIONING, DESIGN THAT CONFORMS IN ALL RESPECTS TO THE CITY'S FUNCTIONAL REQUIREMENTS. WHEN ACTUALIZED IN A PARTICULAR IMPLEMENTATION IT IS THE DESIGNER'S RESPONSIBILITY TO ENSURE THE SIZE, LOCATION, AND SPACING OF ALL ELEMENTS, AND ALL COMPONENTS/SPECIFICATIONS, ARE SUITABLE AND SAFE FOR THE USE AND LOCATION INTENDED, AND ANY APPLICABLE CODE, LEGISLATIVE, AND AUTHORITY REQUIREMENTS ARE ADHERED TO. IN ADDITION, ANY ACCESSIBILITY, OPERATIONAL, AND MAINTENANCE REQUIREMENTS MUST BE MET. DEVIATIONS FROM THE REPRESENTED NOMINAL DESIGN PARAMETERS, QUESTIONS OF INTENT OR ACCURACY, OR ANY OTHER APPARENT CONFLICTS, SHALL BE RECONCILED WITH AN APPROPRIATE CITY REPRESENTATIVE. FINALLY, WHEN EMPLOYING ANY ASPECT OF THIS DOCUMENT, THE ULTIMATELY RESPONSIBLE PROFESSIONAL DESIGNER SHALL REMOVE ANY AUTHENTICATION OF THE ORIGINAL AUTHOR(S), NOTE ANY PROVENANCE AS APPROPRIATE, AND APPLY THEIR OWN AUTHENTICATION AS REQUIRED.



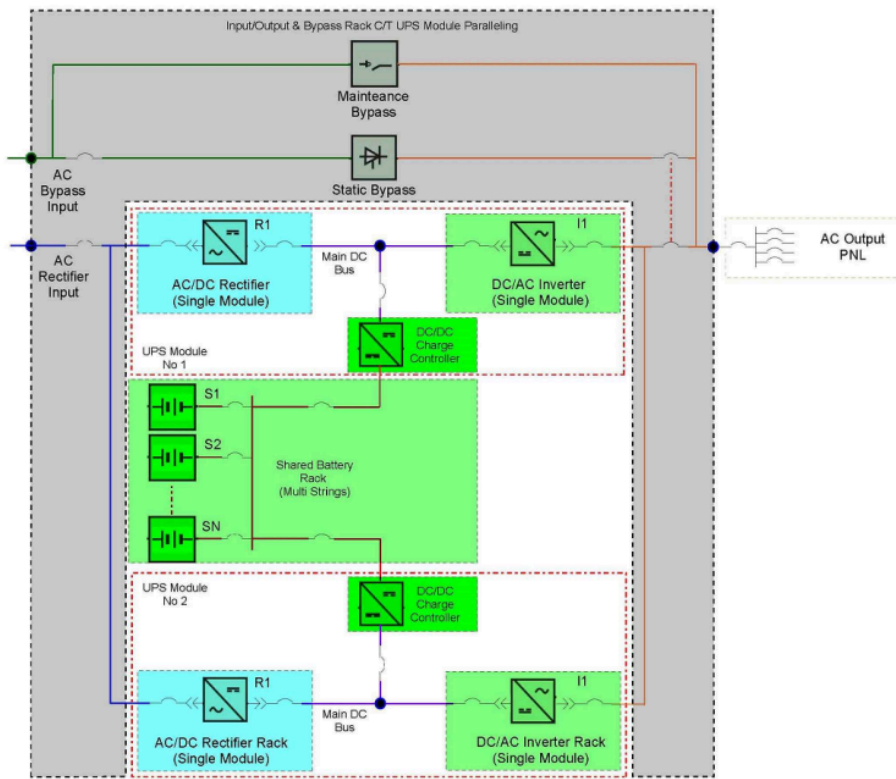
N+1 Dual On-line Conversion UPS Multi-Module Architecture with DC and AC outputs and fault resilient/independent bypasses (With possible N+1 internal redundancy)

UNINTERRUPTIBLE POWER SUPPLY DESIGN GUIDELINES

MULTI INTERNAL MODULES UPS TOPOLOGY WITH OPTIONAL DC CHARGER INPUT

Description		CONSULTANT MANUAL STANDARD DETAIL		
Location ID	N/A	Project #	N/A	
Discipline	ELECTRICAL	Author	RC	Review JM Check JM
Volume	01	Drawing Number	<b>E-001A</b>	
Sheet	2 of 7			
File	UPS_STD_date_V1.0.dwg			

THIS STANDARD DRAWING/DETAIL AND/OR SPECIFICATION IS PROVIDED TO CONVEY THE CITY'S TYPICALLY IDEAL GENERAL ARRANGEMENT AND REQUIREMENTS. REPRESENTATIONS MAY NOT BE TO SCALE, THEY MAY BE SUBSTANTIALLY SCHEMATIC IN NATURE AND/OR REQUIRE FURTHER ELABORATION AND DEVELOPMENT AS SUCH THIS DOCUMENT IS NOT SUITABLE FOR INTEGRATION INTO A SPECIFIC IMPLEMENTATION WITHOUT REVIEW AND MODIFICATION AND IS ONLY INTENDED FOR USE BY A COMPETENT DESIGNER EXERCISING PROFESSIONAL JUDGMENT. THE DESIGNER SHALL MODIFY AND SUPPLEMENT AS NECESSARY TO PROVIDE A COMPLETE, PROPERLY FUNCTIONING, DESIGN THAT CONFORMS IN ALL RESPECTS TO THE CITY'S FUNCTIONAL REQUIREMENTS. WHEN ACTUALIZED IN A PARTICULAR IMPLEMENTATION IT IS THE DESIGNER'S RESPONSIBILITY TO ENSURE THE SIZE, LOCATION, AND SPACING OF ALL ELEMENTS, AND ALL COMPONENTS/SPECIFICATIONS, ARE SUITABLE AND SAFE FOR THE USE AND LOCATION INTENDED, AND ANY APPLICABLE CODE, LEGISLATIVE, AND AUTHORITY REQUIREMENTS ARE ADHERED TO. IN ADDITION, ANY ACCESSIBILITY, OPERATIONAL, AND MAINTENANCE REQUIREMENTS MUST BE MET. DEVIATIONS FROM THE REPRESENTED NOMINAL DESIGN PARAMETERS, QUESTIONS OF INTENT OR ACCURACY, OR ANY OTHER APPARENT CONFLICTS, SHALL BE RECONCILED WITH AN APPROPRIATE CITY REPRESENTATIVE. FINALLY, WHEN EMPLOYING ANY ASPECT OF THIS DOCUMENT, THE ULTIMATELY RESPONSIBLE PROFESSIONAL DESIGNER SHALL REMOVE ANY AUTHENTICATION OF THE ORIGINAL AUTHOR(S), NOTE ANY PROVENANCE AS APPROPRIATE, AND APPLY THEIR OWN AUTHENTICATION AS REQUIRED.



N+1 Dual On-line Conversion UPS  
 Multi-Module Architecture with DC and AC  
 outputs and fault resilient/independent  
 bypasses (Single Module Assembly)

Description		CONSULTANT MANUAL STANDARD DETAIL	
Location ID	N/A	Project #	N/A
Discipline	ELECTRICAL	Author	RC
		Review	JM
		Check	JM
Volume	01	Drawing Number	<b>E-002</b>
Sheet	3 of 7		
File	UPS_STD_date_V1.0.dwg		

### 1.1.1.5. UPS Design Considerations: Redundancy

#### .1 Redundancy:

.1 With the following exceptions, all sites equipped with centralised UPS shall use a N+1 UPS topology.

#### .2 Exceptions:

.1 Mission Critical Facilities shall be equipped with either 2N+1 or 2(N+1) UPS scheme.

.2 All LRT projects: Refer to applicable LRT design guidelines.

.3 Where validated by city: Telecommunication racks (NAR rooms).

.4 Confirm redundancy level upon project initiation.

.2 N+1 VS 2N topology: Clarification on upstream and downstream distribution systems:

#### .1 N+1 topology:

##### .1 UPS:

- At least one UPS assembly capable of supplying 100% of the load's power demand shall be installed to form an uninterruptible power distribution system.
- Said assembly shall have multiple input and output rectifiers and inverters assemblies with at least one "hot" standby spare module for both input and output.
- The system shall include a common "static" and "wrap around / maintenance bypass" assembly.
- The assembly shall be made of either cabinet or racks with not accessible energized parts.

##### .2 Batteries:

- UPS to be equipped with at least two battery strings, each capable of supporting the UPS operation on battery power for the specific running time and at full rated output.
- Multi strings systems shall have at least the required capacity when 1 string is taken out of service. E.g A 3 string system shall be able to operate at maximum run time and full rated output when only 2 strings are available.

##### .3 Outputs:

- The UPS shall supply an independant active distribution path.
- Critical loads shall be either single or dual corded
- Loads may have both AC and DC input (LRT).

##### .4 Inputs:

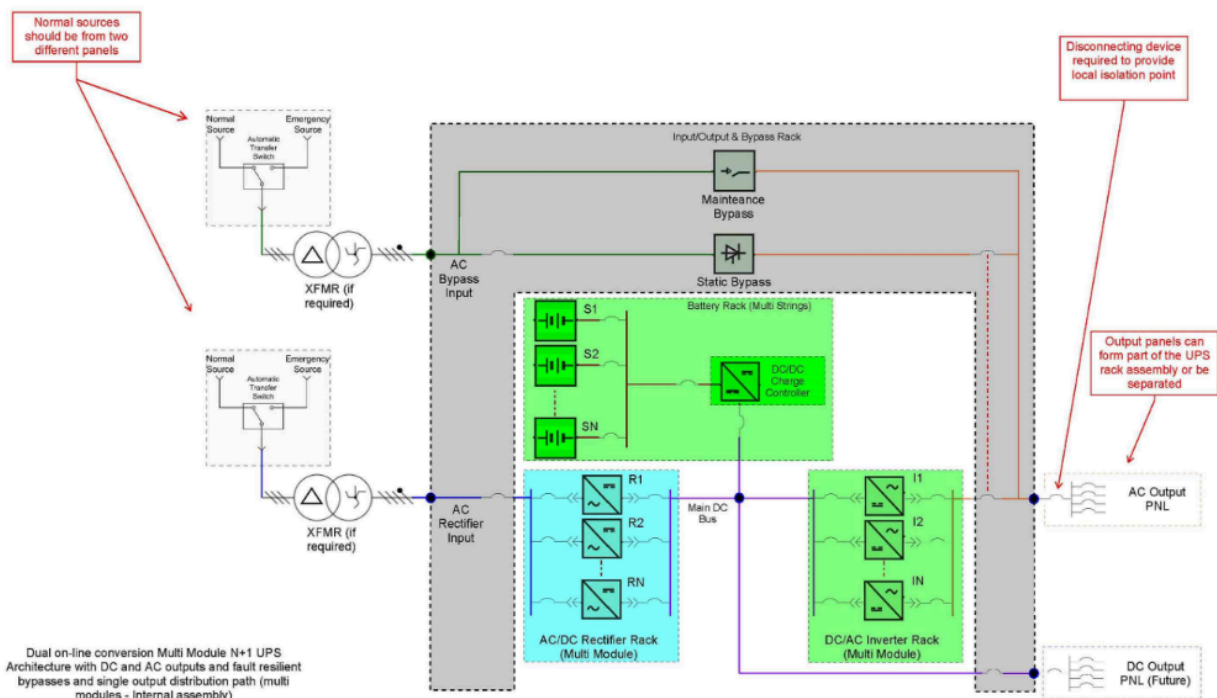
- Each UPS input (rectifier and bypasses) shall be supplied from different sources

panels.

- Where required, harmonic mitigating transformers shall be used to adapt the facility voltage to the UPS input.
- All inputs shall be supplied from both utility and emergency power source (if present)

.5 Typical input and output topology

THIS STANDARD DRAWING/DETAIL AND/OR SPECIFICATION IS PROVIDED TO CONVEY THE CITY'S TYPICALLY IDEAL GENERAL ARRANGEMENT AND REQUIREMENTS. REPRESENTATIONS MAY NOT BE TO SCALE. THEY MAY BE SUBSTANTIALLY SCHEMATIC IN NATURE AND/OR REQUIRE FURTHER ELABORATION AND DEVELOPMENT. AS SUCH THIS DOCUMENT IS NOT SUITABLE FOR INTEGRATION INTO A SPECIFIC IMPLEMENTATION WITHOUT REVIEW AND MODIFICATION AND IS ONLY INTENDED FOR USE BY A COMPETENT DESIGNER EXERCISING PROFESSIONAL JUDGMENT. THE DESIGNER SHALL MODIFY AND SUPPLEMENT AS NECESSARY TO PROVIDE A COMPLETE, PROPERLY FUNCTIONING, DESIGN THAT CONFORMS IN ALL RESPECTS TO THE CITY'S FUNCTIONAL REQUIREMENTS. WHEN ACTUALIZED IN A PARTICULAR IMPLEMENTATION IT IS THE DESIGNER'S RESPONSIBILITY TO ENSURE THE SIZE, LOCATION, AND SPACING OF ALL ELEMENTS, AND ALL COMPONENTS/SPECIFICATIONS, ARE SUITABLE AND SAFE FOR THE USE AND LOCATION INTENDED, AND ANY APPLICABLE CODE, LEGISLATIVE, AND AUTHORITY REQUIREMENTS ARE ADHERED TO IN ADDITION. ANY ACCESSIBILITY, OPERATIONAL, AND MAINTENANCE REQUIREMENTS MUST BE MET. DEVIATIONS FROM THE REPRESENTED NOMINAL DESIGN PARAMETERS, QUESTIONS OF INTENT OR ACCURACY, OR ANY OTHER APPARENT CONFLICTS, SHALL BE RECONCILED WITH AN APPROPRIATE CITY REPRESENTATIVE. FINALLY, WHEN EMPLOYING ANY ASPECT OF THIS DOCUMENT, THE ULTIMATELY RESPONSIBLE PROFESSIONAL DESIGNER SHALL REMOVE ANY AUTHENTICATION OF THE ORIGINAL AUTHOR(S), NOTE ANY PROVENANCE AS APPROPRIATE, AND APPLY THEIR OWN AUTHENTICATION AS REQUIRED.



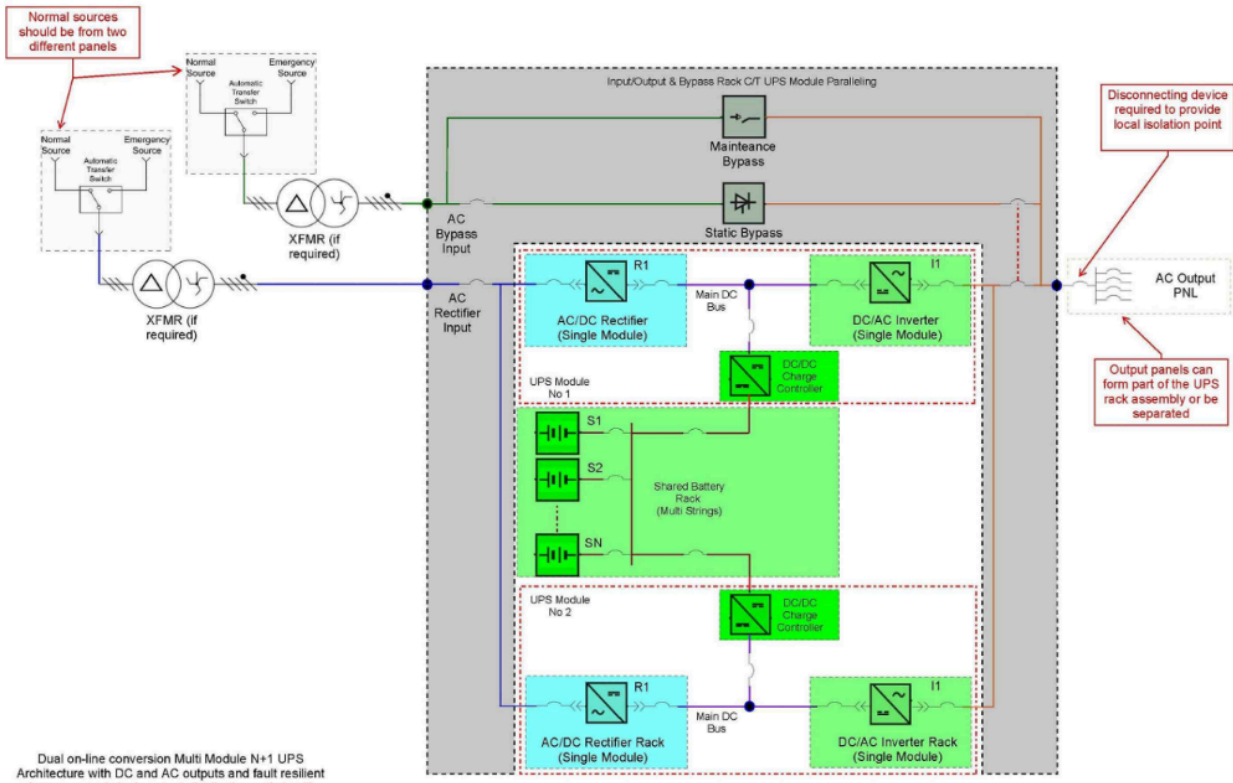
Dual on-line conversion Multi Module N+1 UPS Architecture with DC and AC outputs and fault resilient bypasses and single output distribution path (multi modules - internal assembly)

UNINTERRUPTIBLE POWER SUPPLY DESIGN GUIDELINES

N+1 UPS DISTRIBUTION TOPOLOGY (INTERNAL MULTI MODULE SYSTEM)

Description	CONSULTANT MANUAL STANDARD DETAIL			
Location ID	N/A	Project #	N/A	
Discipline	ELECTRICAL	Author	RC	Review JM Check JM
Volume	01	Drawing Number	<b>E-003</b>	
Sheet	4 of 7			
File	UPS_STD_date_v1.0.dwg			

THIS STANDARD DRAWING/DETAIL AND/OR SPECIFICATION IS PROVIDED TO CONVEY THE CITY'S TYPICALLY IDEAL GENERAL ARRANGEMENT AND REQUIREMENTS. REPRESENTATIONS MAY NOT BE TO SCALE. THEY MAY BE SUBSTANTIALLY SCHEMATIC IN NATURE AND/OR REQUIRE FURTHER ELABORATION AND DEVELOPMENT AS SUCH THIS DOCUMENT IS NOT SUITABLE FOR INTEGRATION INTO A SPECIFIC IMPLEMENTATION WITHOUT REVIEW AND MODIFICATION AND IS ONLY INTENDED FOR USE BY A COMPETENT DESIGNER EXERCISING PROFESSIONAL JUDGMENT. THE DESIGNER SHALL MODIFY AND SUPPLEMENT AS NECESSARY TO PROVIDE A COMPLETE, PROPERLY FUNCTIONING, DESIGN THAT CONFORMS IN ALL RESPECTS TO THE CITY'S FUNCTIONAL REQUIREMENTS. WHEN ACTUALIZED IN A PARTICULAR IMPLEMENTATION IT IS THE DESIGNER'S RESPONSIBILITY TO ENSURE THE SIZE, LOCATION, AND SPACING OF ALL ELEMENTS, AND ALL COMPONENTS/SPECIFICATIONS, ARE SUITABLE AND SAFE FOR THE USE AND LOCATION INTENDED, AND ANY APPLICABLE CODE, LEGISLATIVE, AND AUTHORITY REQUIREMENTS ARE ADHERED TO. IN ADDITION, ANY ACCESSIBILITY, OPERATIONAL, AND MAINTENANCE REQUIREMENTS MUST BE MET. DEVIATIONS FROM THE REPRESENTED NOMINAL DESIGN PARAMETERS, QUESTIONS OF INTENT OR ACCURACY, OR ANY OTHER APPARENT CONFLICTS, SHALL BE RECONCILED WITH AN APPROPRIATE CITY REPRESENTATIVE. FINALLY, WHEN EMPLOYING ANY ASPECT OF THIS DOCUMENT, THE ULTIMATELY RESPONSIBLE PROFESSIONAL DESIGNER SHALL REMOVE ANY AUTHENTICATION OF THE ORIGINAL AUTHOR(S), NOTE ANY PROVENANCE AS APPROPRIATE, AND APPLY THEIR OWN AUTHENTICATION AS REQUIRED.



Dual on-line conversion Multi Module N+1 UPS Architecture with DC and AC outputs and fault resilient bypasses and single output distribution path (multi modules - External assembly)



UNINTERRUPTIBLE POWER SUPPLY DESIGN GUIDELINES

N+1 UPS DISTRIBUTION TOPOLOGY (EXTERNAL MULTI MODULE SYSTEM) C/W LOAD SHARING

Description		CONSULTANT MANUAL STANDARD DETAIL		
Location ID	N/A	Project #	N/A	
Discipline	ELECTRICAL	Author	RC	Review JM Check JM
Volume	01	Drawing Number	E-004	
Sheet	5 of 7			
File	UPS_STD_date_V1.0.dwg			

.2 2N or 2N+1 topology:

.1 UPS:

- At least two separated UPS assemblies, each capable of supplying 100% of the load's power demand, shall be installed
- System to form a fully independent "A" and "B" active distribution system.

.2 Outputs:

- Each UPS shall supply an independent active distribution path.
- Critical loads shall be either dual corded or equipped with load specific static transfer switches located in the same rack(s) where said loads are installed.
- Loads may have both AC and DC input (LRT).

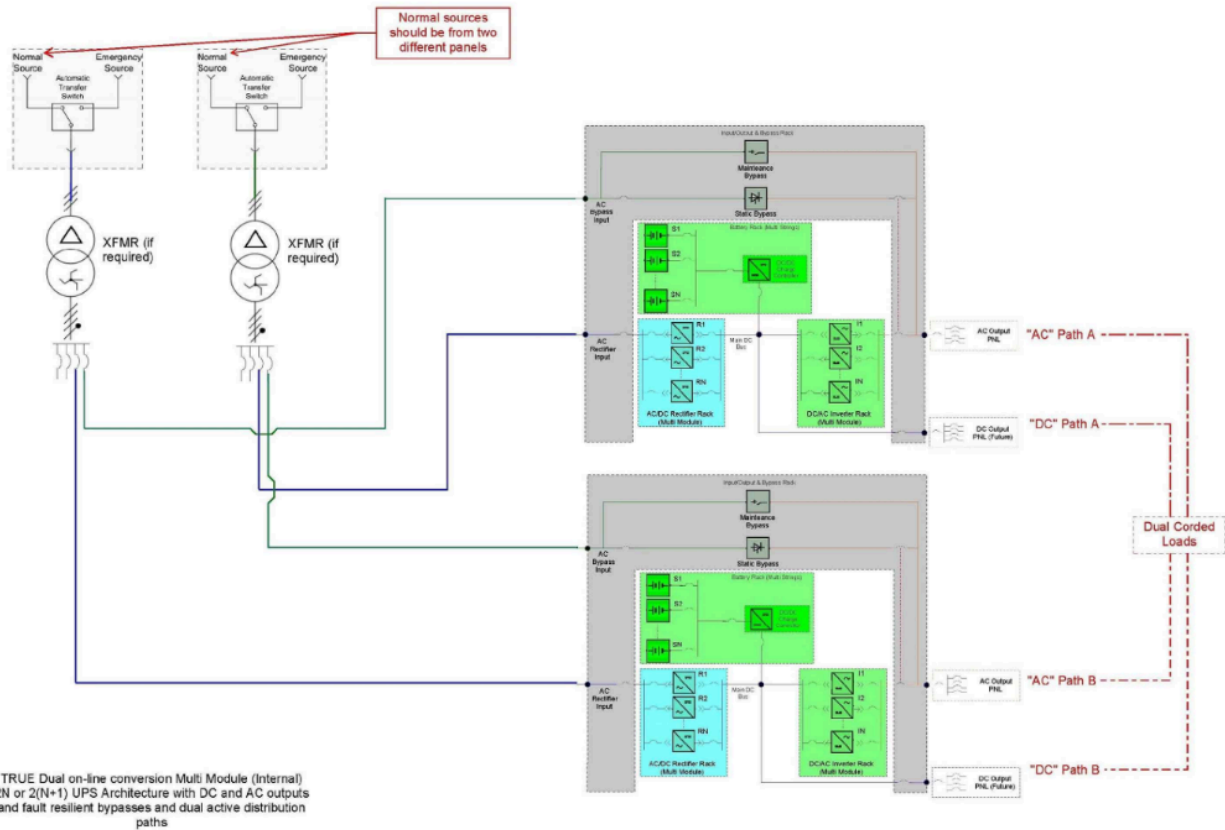
.3 Inputs:

- Each UPS input (rectifier and bypasses) shall be supplied from different sources panels.
- Where required, harmonic mitigating transformers shall be used to adapt the facility voltage to the UPS input & outputs.
- All inputs shall be supplied from both utility and emergency power sources (if present).

.4 Typical input and output topology



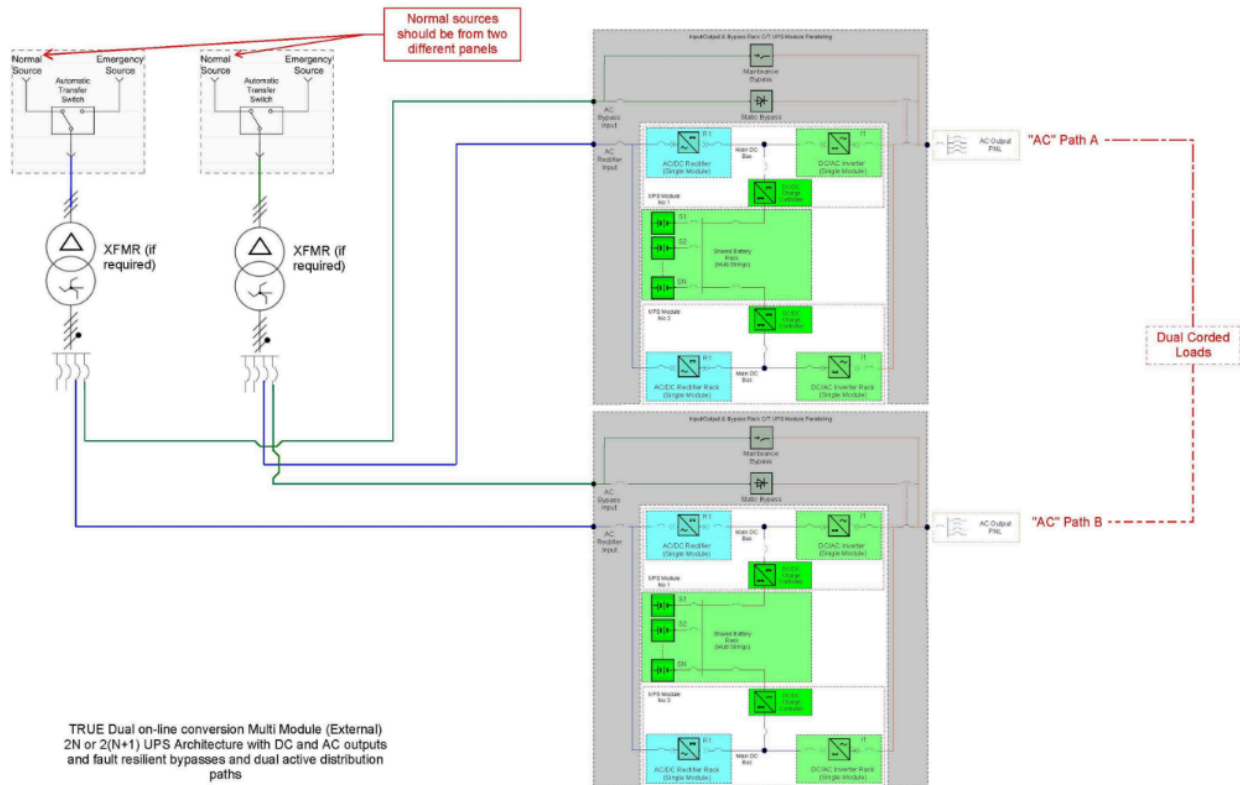
THIS STANDARD DRAWING/DETAIL AND/OR SPECIFICATION IS PROVIDED TO CONVEY THE CITY'S TYPICALLY IDEAL GENERAL ARRANGEMENT AND REQUIREMENTS. REPRESENTATIONS MAY NOT BE TO SCALE. THEY MAY BE SUBSTANTIALLY SCHEMATIC IN NATURE AND/OR REQUIRE FURTHER ELABORATION AND DEVELOPMENT. AS SUCH THIS DOCUMENT IS NOT SUITABLE FOR INTEGRATION INTO A SPECIFIC IMPLEMENTATION WITHOUT REVIEW AND MODIFICATION AND IS ONLY INTENDED FOR USE BY A COMPETENT DESIGNER EXERCISING PROFESSIONAL JUDGMENT. THE DESIGNER SHALL MODIFY AND SUPPLEMENT AS NECESSARY TO PROVIDE A COMPLETE, PROPERLY FUNCTIONING, DESIGN THAT CONFORMS IN ALL RESPECTS TO THE CITY'S FUNCTIONAL REQUIREMENTS. WHEN ACTUALIZED IN A PARTICULAR IMPLEMENTATION IT IS THE DESIGNER'S RESPONSIBILITY TO ENSURE THE SIZE, LOCATION, AND SPACING OF ALL ELEMENTS, AND ALL COMPONENTS/SPECIFICATIONS, ARE SUITABLE AND SAFE FOR THE USE AND LOCATION INTENDED, AND ANY APPLICABLE CODE, LEGISLATIVE, AND AUTHORITY REQUIREMENTS ARE ADHERED TO. IN ADDITION, ANY ACCESSIBILITY, OPERATIONAL, AND MAINTENANCE REQUIREMENTS MUST BE MET. DEVIATIONS FROM THE REPRESENTED NOMINAL DESIGN PARAMETERS, QUESTIONS OF INTENT OR ACCURACY, OR ANY OTHER APPARENT CONFLICTS, SHALL BE RECONCILED WITH AN APPROPRIATE CITY REPRESENTATIVE. FINALLY WHEN EMPLOYING ANY ASPECT OF THIS DOCUMENT, THE ULTIMATELY RESPONSIBLE PROFESSIONAL DESIGNER SHALL REMOVE ANY AUTHENTICATION OF THE ORIGINAL AUTHOR(S), NOTE ANY PROVENANCE AS APPROPRIATE, AND APPLY THEIR OWN AUTHENTICATION AS REQUIRED.



TRUE Dual on-line conversion Multi Module (Internal) 2N or 2(N+1) UPS Architecture with DC and AC outputs and fault resilient bypasses and dual active distribution paths

	<b>UNINTERRUPTIBLE POWER SUPPLY DESIGN GUIDELINES</b>		Description CONSULTANT MANUAL STANDARD DETAIL			
			Location ID	N/A	Project #	N/A
	Discipline	ELECTRICAL	Author	RC	Review	JM
	Volume	01	Drawing Number	<h1>E-005</h1>		
	Sheet	6 of 7				
	File	UPS_STD_date_V1.0.dwg				
	<b>2N OR 2N+1 UPS DISTRIBUTION TOPOLOGY (INTERNAL MULTI MODULES)</b>					

THIS STANDARD DRAWING/DETAIL AND/OR SPECIFICATION IS PROVIDED TO CONVEY THE CITY'S TYPICALLY IDEAL GENERAL ARRANGEMENT AND REQUIREMENTS. REPRESENTATIONS MAY NOT BE TO SCALE. THEY MAY BE SUBSTANTIALLY SCHEMATIC IN NATURE AND/OR REQUIRE FURTHER ELABORATION AND DEVELOPMENT. AS SUCH THIS DOCUMENT IS NOT SUITABLE FOR INTEGRATION INTO A SPECIFIC IMPLEMENTATION WITHOUT REVIEW AND MODIFICATION AND IS ONLY INTENDED FOR USE BY A COMPETENT DESIGNER EXERCISING PROFESSIONAL JUDGMENT. THE DESIGNER SHALL MODIFY AND SUPPLEMENT AS NECESSARY TO PROVIDE A COMPLETE, PROPERLY FUNCTIONING, DESIGN THAT CONFORMS IN ALL RESPECTS TO THE CITY'S FUNCTIONAL REQUIREMENTS. WHEN ACTUALIZED IN A PARTICULAR IMPLEMENTATION IT IS THE DESIGNER'S RESPONSIBILITY TO ENSURE THE SIZE, LOCATION, AND SPACING OF ALL ELEMENTS, AND ALL COMPONENTS/SPECIFICATIONS, ARE SUITABLE AND SAFE FOR THE USE AND LOCATION INTENDED, AND ANY APPLICABLE CODE, LEGISLATIVE, AND AUTHORITY REQUIREMENTS ARE ADHERED TO. IN ADDITION, ANY ACCESSIBILITY, OPERATIONAL, AND MAINTENANCE REQUIREMENTS MUST BE MET. DEVIATIONS FROM THE REPRESENTED NOMINAL DESIGN PARAMETERS, QUESTIONS OF INTENT OR ACCURACY, OR ANY OTHER APPARENT CONFLICTS, SHALL BE RECONCILED WITH AN APPROPRIATE CITY REPRESENTATIVE. FINALLY WHEN EMPLOYING ANY ASPECT OF THIS DOCUMENT, THE ULTIMATELY RESPONSIBLE PROFESSIONAL DESIGNER SHALL REMOVE ANY AUTHENTICATION OF THE ORIGINAL AUTHOR(S). NOTE ANY PROVENANCE AS APPROPRIATE, AND APPLY THEIR OWN AUTHENTICATION AS REQUIRED.



UNINTERRUPTIBLE POWER SUPPLY DESIGN GUIDELINES

2N OR 2N+1 UPS DISTRIBUTION TOPOLOGY (EXTERNAL MULTI MODULES)

Description	CONSULTANT MANUAL STANDARD DETAIL		
Location ID	N/A	Project #	N/A
Discipline	ELECTRICAL	Author	RC Review JM Check JM
Volume	01	Drawing Number	E-006
Sheet	7 of 7		
File	UPS_STD_date_V1.0.dwg		

**1.1.1.6. UPS Design Considerations: Scalability**

**.1 System scalability:**

- .1 Each UPS to comprise a multi module assembly (charger, rectifier, and batteries), either type internal or external as per above typical SLDs:
  - .1 UPS shall be equipped with sufficient modules to accommodate the load on “Day One”
  - .2 UPS chassi, inputs and outputs (cables, protective devices, panels) shall be sized for the maximum load expected in the future.
- .2 When the future ultimate load is not specified by the city, designers shall consider at least a 25% future load increase.
- .2 Optional: System components can be hot swappable.

**1.1.1.7. UPS input and output protective devices**

- .1 **Type:** AC and DC Moulded Case Breakers
- .2 **Optional (large system above 100kW):** Motorized

**1.1.1.8. UPS Integration: Topology**

**.1 Dedicated transfer switch**

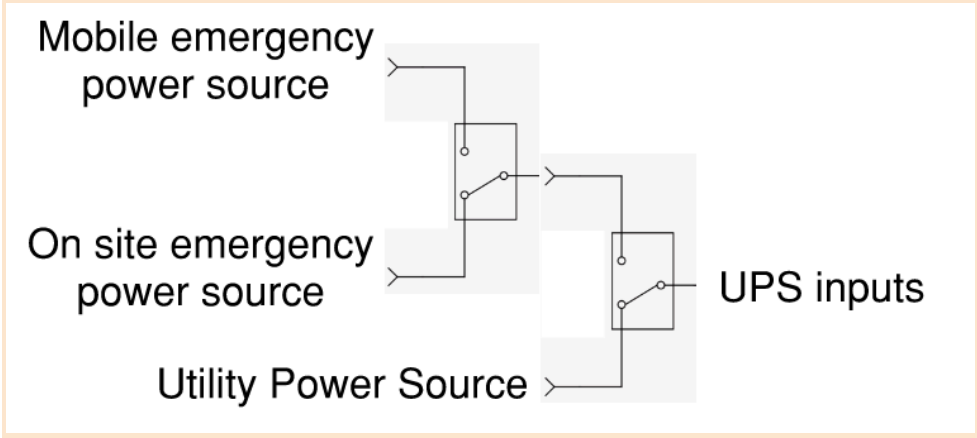
- .1 UPS distribution system shall be supplied from dedicated transfer switches.
- .2 The switches shall be supplied directly from the Service Entrance Board (SEB) and from the main emergency distribution power panel

**.2 Direct connection between bypass circuits and onsite backup power source**

- .1 UPS wrap around bypass circuit shall be supplied from dedicated transfer switches
- .2 The switches shall be supplied directly from the Service Entrance Board (SEB) and from the main emergency distribution power panel

**.3 Alternate Power Source:**

- .1 Sites equipped with UPS supporting 911 or emergency response centers or disaster recovery centers shall include a mobile generator connection box and electrically operated manual transfer switch at the UPS rectifier input.
- .2 This setup shall permit the use of a temporary generator capable of supporting the UPS operations for periods when the site’s normal and backup power sources are not available (e.g : maintenance, repairs, refurbishment).
- .3 **Topology:**
  - .1 Box to be equipped with Cam-lok connectors type E1016 Series, male and to be mounted in a quick connect assembly (c/w non-conductive mounting plate).
  - .2 E1016 Series to be rated 400A (minimum). Box to include a sufficient number of cam locks per phase to achieve the desired full load ampacity.



**Figure J1: UPS mobile connection box - principle**

**1.1.1.9. UPS Design Considerations: Charging Time**

- .1 Confirm with city requirement for UPS battery recovery time when battery is at 0% charging
- .2 Specify the use of additional charger/rectifiers as required to meet UPS battery recovery time as required.

**1.1.1.10. UPS batteries type and capacity (UPS run time):**

**.1 Life span:**

- .1 Non critical sites: Batteries to be rated 5 year “shelf life” with at least 3 year “continuous usable life”.
- .2 Critical sites: Batteries to be rated 10 year “shelf life” with at least 7 year “continuous usable life”.

**.2 Capacity:**

- .1 Running time definition based on application and battery condition:
  - .1 Non critical sites: Batteries shall be sized to provide the desired running time at full UPS rated output when new
  - .2 Critical sites and system dedicated to emergency lighting: Batteries shall be oversized to provide the desired running time at full UPS rated output when reaching their end of usable life
- .2 Running time: Battery systems shall be sized to provide the following running time while the UPS is operating at its full rated output:
  - .1 LRT: Refer to [LRT High Floor Design Guidelines](#)
  - .2 Emergency Lighting Systems:
    - Apply code requirements. System to be rated 2 hours running time minimum,
    - Note: UPS used as centralised energy storage and uninterruptible supply for emergency lighting systems shall not be supplying power to any other systems

(Dedicated Safety System).

.3 Mission Critical Loads:

- IT systems other than fire stations or police stations:
  - Without backup generator present on site: 30 min (minimum) or as required to provide ample time to proceed with an IT system shutdown
  - With Backup generator present on site: 15 min
- Police and fire stations:
  - At least 15 min minimum or
  - Longer running time may be mandated depending on the desired application (to be confirmed during the earliest stages of the design with city representatives)

.4 Note regarding emergency power and UPS applications:

- UPS shall not be used in lieu of emergency or backup generators
- With the exception of the above listed UPS dedicated to emergency lighting, sites requiring more than 30 min of run time shall be equipped with a backup generator as part of the UPS project.

.3 Acceptable Technologies:

.1 Lead Acid:

- .1 Lead acid batteries to be type Valve Regulated (VRLA)
- .2 Stationary or any other type of battery normally emitting hydrogen as part of their normal operating condition are not acceptable, no exceptions

.2 Nickel Cadmium (Ni-CAD):

- .1 This type is only acceptable for specific LRT applications and shall not be used otherwise.
- .2 Refer to the [LRT High Floor Design Guidelines](#) for references for further instructions.

.3 Lithium: This type of battery shall be used when application require:

- .1 A very high energy density in a limited available footprint making the use of VRLA unpractical and/or not economically viable, and/or
- .2 When the site has structural or footprint limitation incompatible with VRLA or Nickel Cadmium technologies, and/or
- .3 For sites where the city is willing to limit battery replacement.

.4 Battery String Topology:

- .1 Each UPS' battery string shall be housed in a cabinet or rack forming an integral part of the UPS lineup. All cabinets shall provide a full physical segregation between strings, the UPS, and the input/output cabinet(s).
- .2 Batteries to be type "**front access only terminal**" mounted on a draw-out shelf.

Wiring to be of sufficient length to allow operators to rack out battery shelves without disconnecting their battery cells. All battery terminals include isolation caps. Exposed and energised parts are not acceptable.

- .3 All strings to be equipped with control and monitoring wiring harness tied to a battery management system (BMS) and capable of:
  - Monitoring each individual battery cells,
  - Individually charge cells to maintain appropriate string voltage balance,
- .4 All UPS shall be provided with at least two battery stings as follows:
  - Non critical sites:
    - If only two strings are used, each string shall have at least 50% of the desired battery capacity,
    - If more than 2 strings are used, the disconnection of one string shall only result in a loss of capacity per the following formula:  $\text{Desired total capacity} / \text{number of strings}$ ,
  - Critical sites:
    - String design and sizing shall achieve a N+1 rating
    - If only two strings are used, each string shall have at 100% of the desired battery capacity
    - If more than two strings are used, the battery bank shall be designed to ensure a “N” capacity will remain available if one string is disconnected
  - String wiring and protection:
    - Each string shall be protected via a circuit breaker offering provision to implement a lockout and tag out procedure
    - A main breaker shall also be present to provide options to completely isolate all strings from the UPS
    - A DC panel forming an integral part of the UPS lineup shall be provided to house the above listed breakers. Interconnection between the main DC breaker and all string’s DC breakers to be type tin plate copper bus. **Aluminum bus or loose wiring are not acceptable.**

#### 1.1.1.11. UPS Loads:

- .1 IT systems (AC),
- .2 LRT systems (AC and DC)
- .3 BAS Head end (AC),
- .4 Client specific systems (Fire Rescue, Edmonton Police, Edmonton Public Library, Waste, etc), (AC), ,
- .5 Emergency lighting systems (AC).



.6 Specialty loads (AC),

1.1.1.12. **UPS Grounding:**

.1 Minimum Requirements

- .1 UPS to be designed for a solidly grounded system,
- .2 When present, UPS to be compatible with Neutral Grounding Resistor (high or low ground resistance) application. Compatibility can be achieved via using input and output isolation transformers.

.2 Where present:

- .1 Ensure UPS grounding and bonding strategy is coordinated with isolated ground, telecommunication and radio ground, and
- .2 LRT grounding systems (See LRT guidelines and stray current mitigation requirements),

1.1.1.13. **UPS loads and related distribution system:**

.1 Floor mounted PDU with or without transformer:

- .1 When the voltage level of the IT, AV, security or other mission critical load is not the same as the UPS output, include a Power Distribution Unit (PDU) complete with built in panel and transformer, and be type switched, and metered with CAT5e min connectivity for remote monitoring.
- .2 Transformer, when required, to be type zig zag harmonic mitigating, with 0 and 30 degree phase shift if multiple units are scheduled for installation.
- .3 PDU to be directly hard wired to the UPS output cabinet / panel and to be supplied by any UPS output (inverter, internal and external bypasses)

.2 In rack PDU (RPDU):

- .1 Small rack mounted Power Distribution Unit (RPDU) type power bar shall be configured either horizontally (1 or 2 units), or better, vertically, (zero unit) and be type switched, and metered with CAT5e min connectivity for remote monitoring
- .2 RPDU to be supplied from single or 3 phase (3P/4W) receptacles installed in the recessed ceiling above the rack. Receptacle to be type twist lock.

1.1.1.14. **UPS Control and Monitoring**

.1 **General Requirements**

- .1 UPS to be connected to facility's BMS for general trouble/failure alarm inclusive of issues related to the UPS, chargers-rectifier, battery systems, inverter and bypass outputs.
- .2 UPS to be complete with a web based interface which can be accessed via a dedicated IP address and via a face mounted ethernet connector. Interface to provide fully fledged Human Machine Interface function for monitoring only via the IP connection, and monitoring and control via the UPS faceplate ethernet connector.

.2 **UPS Network Monitoring capabilities:**



**.1 Built in Human Machine Interface (HMI):**

- .1 Type: LCD Touch Screen (Colour)
- .2 Functions: Full monitoring, status and control

**.2 Dry contacts:** UPS to include a series of dry output contacts rated up to 120Vac / 125Vdc. Contact to include:

- .1 UPS on normal power
- .2 UPS in static bypass
- .3 UPS on wrap around bypass
- .4 UPS overload
- .5 UPS failure
- .6 UPS trouble/alarm (general)

**.3 Networking Capabilities:**

- .1 **Protocol:** Ethernet TCP/IP
- .2 **Type:** Webpage based providing full mimic function matching those of HMI. System to be password protected.

**.4 UPS Monitoring: Alarm outputs to the BAS**

- .1 AC power failure,
- .2 Battery failure,
- .3 Output failure,
- .4 Dry contacts type “C form” for:
  - o UPS on battery power,
  - o UPS on internal bypass,
  - o UPS on external bypass,
- .5 Contacts to be both rated 120Vac and 125Vdc.



## **APPENDIX K - DISTRIBUTED GENERATOR (DG)**

## 1. Distributed Generators (DG):

### 1.1. Standards for Distributed Generators (DG):

#### 1.1.1. EPCOR:

- 1.1.1.1. [TECHNICAL GUIDELINE FOR THE INTERCONNECTION OF DISTRIBUTED ENERGY RESOURCES TO EPCOR DISTRIBUTION AND TRANSMISSION INC.'S DISTRIBUTION SYSTEM](#)

#### 1.1.2. Alberta Electric System Operator (AESO <http://www.aeso.ca>):

- 1.1.2.1. ["Guide-for-Distribution-Connected-Generation-less-than-5MW \(1\).pdf"](#)

#### 1.1.3. Alberta Utilities Commission (AUC)'s

- 1.1.3.1. [DISTRIBUTED-GENERATION APPLICATION GUIDELINE](#)

#### 1.1.4. City of Edmonton Standards (Photovoltaic Installations Guidelines):

- 1.1.4.1. [Volume 1 - Site Selection Guideline](#)
- 1.1.4.2. [Volume 2 - Design Guideline](#)
- 1.1.4.3. [Volume 3 - Construction Guideline](#)
- 1.1.4.4. [Volume 4 - Operations & Maintenance Guideline](#)
- 1.1.4.5. [Volume 5 - Asset Management Guideline](#)

#### 1.1.5. Institute of Electrical and Electronics Engineers (IEEE):

- 1.1.5.1. IEEE 1547a Interconnecting Distributed Resources with Electric Power Systems
- 1.1.5.2. IEEE 1547.1 Standard for Conformance Test Procedures For Equipment Interconnecting Distributed Resources With Electric Power Systems
- 1.1.5.3. IEEE 1547.2 Application Guide for IEEE Standard 1547 For Interconnecting Distributed Resources With Electric Power Systems
- 1.1.5.4. IEEE 1547.3 Guide for Monitoring, Information Exchange, And Control of Distributed Resources Interconnected With Electric Power Systems
- 1.1.5.5. IEEE 1547.4 Guide for Design, Operation and Integration of Distributed Resource Island Systems With Electric Power Systems
- 1.1.5.6. IEEE 1547.6 Recommended Practice for Interconnecting Distributed Resources with Electric Power Systems Distribution Secondary Networks
- 1.1.5.7. IEEE 1547.7 Guide to Conducting Distribution Impact Studies for Distributed Resource Interconnection
- 1.1.5.8. IEEE P1547.8 Recommended Practices for Establishing Methods and Procedures that Provide Supplemental Support for Implementation Strategies for Expanded Use of IEEE Standards 1547
- 1.1.5.9. IEEE SCC 21 IEEE Standards Coordinating Committee 21 for Fuel Cells, Photovoltaics, Dispersed Generation and Energy Storage

1.1.6. Underwriter Laboratories:

- 1.1.6.1. UL Subject 1741 Standard for Inverters, Converters, Controllers and Interconnection System Equipment for Use with Distributed Energy Resources.

**1.2. DG-PV / Solar Photovoltaic System**

1.2.1. Site Assessment

- 1.2.1.1. See Solar Photovoltaic Program - Volume 1 & Volume 2 - Design Guideline
- 1.2.1.2. The assessment shall factor the site BESS, if planned. See site's energy assessment study for details including a "helioscope" study. See also BESS and EV charger Sections for additional details.

1.2.2. Applicable design guidelines

- 1.2.2.1. See Solar Photovoltaic Program - Volume 2 - Design Guideline.
- 1.2.2.2. See Solid State Generators.

1.2.3. System integration

- 1.2.3.1. Consultant and Designer / Installer are responsible to cover all required aspects of the integration of solar arrays within facilities.
- 1.2.3.2. This includes but is not limited to:
  - 1.2.3.2.1. Reviewing the compatibility of the solar inverter with the facility's non linear loads (power quality and resonance related issues).
  - 1.2.3.2.2. Ensuring the site can accommodate the electrical connection of the proposed solar system. This includes confirming the availability of spare breaker space, ampacity capacity, and wiring routes from the PV inverters bank to the site's service entrance.
  - 1.2.3.2.3. Reviewing the site topology to plan the installation of "PV shutdown" or "Rapid Shutdown" push buttons at every hatches or door providing access to the roof.
  - 1.2.3.2.4. Factoring all required roof top unit access requirements to ensure said mechanical units will not be inaccessible due to the presence of Solar PV equipment. The installation of conduit runs and/or cable tray shall not impede the ability of maintenance personnel to access some part of the roof. Where required, walkway / catwalk and related stairs shall be added to provide all required means of access to roof top units, antennas, drains, etc.
  - 1.2.3.2.5. Reviewing the existing Lightning Protection System (LPS) to determine if it is suitable to protect the proposed PV array or if it shall be modified.
  - 1.2.3.2.6. Installing rapid shutdown systems and visible means of disconnection allowing fire services to power down the PV system and confirm electrical isolation.

1.2.4. Combined Operations With Other Generators

- 1.2.4.1. Refer to Combined Mode of Operation for sites equipped with multiple generator sources below for facilities equipped with several sources including but not limited to distributed generators (solid state inverters and co or tri generation systems), emergency generators, and backup generators.

## 1.3. DG-BESS / Battery Energy Storage Systems

### 1.3.1. Site Assessment

1.3.1.1. BESS may represent a tradeoff allowing the city to meet emission targets as per C-627

1.3.1.2. The use of BESS shall be justified based on an assessment factoring the site's PV solar array and inverters, and the presence of large intermittent loads (e.g.: EV Chargers), if present or planned. See site's energy assessment study for details. See also Solar Photovoltaic and EV charger Sections for additional details.

#### 1.3.1.3. Peak Shaving Unit

1.3.1.3.1. This type of application is desirable for sites where fleet EV chargers are deployed in significant numbers and where the city needs to recharge multiple EV simultaneously during a limited number of time frames in a 24 hour period.

1.3.1.3.2. This type of application often requires the installation of oversized utility service entrances which may be used at full capacity for only a portion of the day. This in turn result in installing costly service entrance boards, and this also result in higher demand charges form EPCOR

1.3.1.3.3. Where economically feasible, BESS shall be used to maximise the energy delivery capacity of the service entrance as follows:

1.3.1.3.3.1. The BESS will be sized to have sufficient capacity to act as a peak shaving unit during the peak hours of the site. Both BESS and utility sources will supply the energy required by the site.

1.3.1.3.3.2. During off hours, the BESS will be recharged using the available capacity of the utility sources.

#### 1.3.1.4. Photovoltaic Energy Storage Unit

1.3.1.4.1. When present, PV solar array energy shall be factored in the sizing of the BESS battery banks.

1.3.1.4.2. BESS storage capacity shall be sufficient to prevent the export of power and energy on the local utility grid.

### 1.3.2. Technology:

#### 1.3.2.1. Inverter:

1.3.2.1.1. See [Solid State Generators](#)

#### 1.3.2.2. Battery Types:

1.3.2.2.1. Lithium based BESS are the preferred choice for the city.

1.3.2.2.2. Other technologies such as vanadium redox/flow may be investigated if the capacity and instant power delivery requirements are exceeding what is practically achievable with lithium technologies

#### 1.3.2.3. Installation:

**1.3.2.3.1. Outdoor:**

1.3.2.3.1.1. The BESS shall be installed in a pre packaged weatherproof enclosure type walk-in

1.3.2.3.1.2. Solution based on the used of ISO 20, 40 and 60 foot long shipping containers are also acceptable

1.3.2.3.1.3. The pre packaged system shall be inclusive of all required systems including but not limited to:

1.3.2.3.1.3.1. Step up or step down transformers (see transformer section herein for details).

1.3.2.3.1.3.2. HVAC systems capable of maintaining an appropriate temperature for the batteries, rectifier/charger and inverter system.

1.3.2.3.1.3.3. A fire alarm panel and dedicated fire suppression system. The fire alarm panel shall be interfaced to the facility's main fire alarm panel for coordinated fire monitoring and suppression response with local emergency services. For details, see fire alarm section herein).

1.3.2.3.1.3.4. Anti intrusion and access control system meeting the typical requirements of the City.

**1.3.2.3.1.4. Indoor, within facilities:**

1.3.2.3.1.4.1. Not permitted.

**1.3.3. Connection to a facility's power distribution system:**

1.3.3.1. BESS shall be connected to a facility's main service entrance board (SEB). A dedicated circuit breaker shall be provided. The site shall also be equipped with a multifunction protective relay with instrumentation transformers (PTs and CTs) located at the following key locations:

1.3.3.1.1. At the branch circuits which will be serviced by the BESS (e.g.: PV inverter, EV chargers, other specialty loads).

1.3.3.1.2. At the SEB's main breaker. The purpose of this relay will be preventing a reversed power flow from the site onto the utility grid.

1.3.3.1.3. At the branch circuit breakers tying distributed generators to the SEB.

1.3.3.2. Where fixed frame (bolt on) breakers are used, the main electrical room shall be equipped with a non fused disconnect switch with viewing window allowing operators and emergency service to confirm the BESS has been isolated from the site's power distribution. This requirement will not be necessary if the BESS is tied to the SEB via a draw-out breaker.

1.3.3.3. Emergency Stop: An ESTOP push button shall be located in the main service entrance room to allow operators to shut down the BESS.

**1.3.4. Power Quality:**

1.3.4.1. During discharge (peak shaving mode), the BESS shall supply a perfectly sinusoidal voltage and current to the facility where they are installed. See PWM generators below for additional details.

1.3.4.2. During recharge, their harmonic distortion shall be within the limits prescribed by the IEEE 519 and EPCOR standards.

**1.3.5. Combined Operations With Other Generators**

1.3.5.1. Refer to **Combined Mode of Operation for sites equipped with multiple generator sources** below for facilities equipped with several sources including but not limited to distributed generators (solid state inverters and co or tri generation systems), emergency generators, and backup generators.

**1.4. DG-SSG / Solid State Generators:**

**1.4.1. Permissible types:**

1.4.1.1. The present section applies to the Solid State Generators (SSG) composed of IGBT (Insulated Gate Bipolar Transistor) operating in PWM (Pulse Width Modulation) mode.

1.4.1.2. These types of generators are typically operated with renewable energy sources (wind and solar), fuel cells, and BESS.

**1.4.2. Applicable Guidelines:**

1.4.2.1. IEEE 1547 IEEE Standard for Interconnection and Interoperability of Distributed Energy Resources with Associated Electric Power Systems Interfaces,

**1.4.3. Solid State Generators:**

**1.4.3.1. General Requirements**

1.4.3.1.1. These generators shall be rated for utility paralleling operations and distributed generation application.

1.4.3.1.2. Where required, they shall be capable of islanding operation.

1.4.3.2. **Solar:** For details, refer to the above section and to the City of Edmonton PV Solar guidelines.

1.4.3.3. **BESS:** For details, refer to the above section

**1.5. Performance:**

**1.5.1. Parallel Utility Operations :**

1.5.1.1. This type of generator shall be suitable for paralleling operation with local utility source.

1.5.1.2. Its power output shall be compatible with the local utility source, with the harmonic distortion limits mandated by EPCOR and by the IEEE-519, and with the facility's power factor requirements.

**1.5.2. Non Islanding Type:**

1.5.2.1. This type of device is typically associated with photovoltaic application. These systems are typically behaving as current generators and require a voltage reference from the utility source. They typically supply active power and have limited to no ability to generate reactive power.

1.5.2.2. Units installed at the City facilities shall be capable of offering some form of power factor correction or shall be associated with power factor correction units. For details, refer to the [power factor](#) section of the present document and to the City's PV [Solar Guidelines](#).

**1.5.3. Islanding Type:**

1.5.3.1. This type of Solid State Generators shall supply a perfectly sinusoidal voltage and current



waves to the facility where they are installed.

1.5.3.2. They shall supply active, reactive and apparent power to the site in all modes of operation. This can be achieved with built in circuitry or with external filters.

**1.5.4. Neutral Grounding and Connection**

1.5.4.1. Where present:

1.5.4.1.1. Generator neutral shall be type non-commuted.

1.5.4.1.2. Designer to ensure neutral current circulation between sources will be prevented.

1.5.4.2. For sites equipped with NGR or HGR, solid state generators shall be compatible with this neutral grounding strategy. Refer to the bonding and grounding section for additional requirements.

**1.6. DG-EG / Engine Generators and Emergency Generators**

**1.6.1. Generator Scheme Design based on Facility Type:**

**1.6.1.1. Emergency Generator for Life and Safety (L & S) Loads (All Facilities)**

1.6.1.1.1. Proper load segregation shall be per CSA 282 and CEC C22.1 for all generator installations powering Life & Safety (L & S) systems.

1.6.1.1.2. Where systems are required by code to run past 30 minutes, concrete encasement of conductors/conduit may be permitted in place of Mineral Insulated (MI) cable. City to provide direction on a case by case basis.

**1.6.1.2. Backup Generator for Standby Loads (Non Mission Critical)**

1.6.1.2.1. Refer to Section 4.45.4.2 - [Backup Power](#)

1.6.1.2.2. Provide a minimum of one receptacle in electrical and mechanical rooms connected to emergency power where a generator is installed.

1.6.1.2.3. Loads:

1.6.1.2.3.1. Power to electrically actuated washroom fixtures shall be on standby power circuits if available.

1.6.1.2.3.2. Power to sump pump designed to control underground water ingress within basements shall be on emergency power.

**1.6.1.3. Backup Generator for Standby Loads (Mission Critical)**

1.6.1.3.1. Cranking System:

1.6.1.3.1.1. These facilities shall be equipped with generators comprising a redundant battery, battery charger and cranking system.

1.6.1.3.1.2. This dual cranking system shall work in alternance, both when normally used and when tested.

1.6.1.3.2. 911 call centers, emergency response centers, disaster recovery centers, police stations, fire halls, Data Centers and ambulance facilities:

1.6.1.3.2.1. These facilities shall be designed based on the provision of the C282 compliant generator installations even if not required by code for life safety system service.

1.6.1.3.2.2. These facilities shall be equipped with N+1 or 2N generator schemes. Redundancy targets shall be discussed with the city upon project initiation and shall be coordinated with the mechanical discipline during design.

**1.6.1.4. Co and Tri Generation Applications**

1.6.1.4.1. Generator design shall be coordinated with the mechanical discipline. Refer to Section mechanical section of the present document - [Backup Power](#).

1.6.1.4.2. Where achievable, the generator control system shall be designed to permit islanding operations and to provide a close retransfer on utility power. This may include the design of a load shedding system if the facility's total power demand exceeds the capacity of the generator.

1.6.1.4.3. Emergency generators and backup generators shall not be operated in parallel with units used in a cogeneration or trigeneration application.

1.6.1.4.4. Emergency generators shall not be used as Co or Tri generation units.

1.6.1.4.5. These generator shall be tied to the building's Service Entrance Board (SEB).

**1.6.1.5. Generator Installation (All Types):**

1.6.1.5.1. Generator to be installed within the facility, in dedicated room, or

1.6.1.5.2. Where not feasible and with City approval, a climate controlled, sound attenuated, walk-in enclosure equipped with motorized louvres may be acceptable.

1.6.1.5.3. For cogeneration and trigeneration applications, generators shall be installed in a dedicated space engineered for frequent maintenance and servicing operations.

**1.6.2. Alternator: Permissible Types:**

1.6.2.1. **Synchronous:** Generators shall be composed of a prime mover and an alternator (synchronous machine with built-in excitation system) capable of generating, active, apparent and reactive power.

**1.6.2.2. Asynchronous:**

1.6.2.2.1. Systems using an induction motor operated above synchronous speed to produce active power ***ARE NOT*** acceptable.

1.6.2.2.2. No exception.

**1.6.3. Rating Requirements**

**1.6.3.1. Rating:**

1.6.3.1.1. **Stand By Rating:** Any emergency power application other than Mission Critical shall use a stand-by rated unit,

1.6.3.1.2. **Prime Power Rating:** Not permitted. Where extended operations are required, units to be continuously rated.

1.6.3.1.3. **Continuous Rating:** Mission Critical application shall use continuously rated generators

capable of providing power for extended operation when loaded at 100% of their rated nameplate capacity

**1.6.3.2. Nominal Capacity and Future Growth:**

1.6.3.2.1. Units shall be sized to accommodate future growth while ensuring minimum manufacturer loading is achieved upon commissioning of the generator system.

1.6.3.2.2. For example:

1.6.3.2.2.1. Diesel generators shall not be operated at less than 40% to prevent “cylinder glazing / wet stacking” effects and other related damaging effects unless approved by the manufacturer.

1.6.3.2.2.2. Site with foreseeable backup power demand growth which cannot meet this condition shall be designed to accommodate the addition of future generators capable of being operated in parallel with each other. For further details, see parallel generator scheme below.

1.6.3.2.3. Final Site Design Load Calculation(s) to be included in the drawing set. Notes shall include clear identification of spare capacity. Site Design load to be posted on each transfer switch with red lamacoid (white writing). Minimum size 50 mm x 100 mm.

**1.6.3.3. Transient Loads and Motor Starting Capacity:**

1.6.3.3.1. When installed at sites comprising large intermittent loads, designer shall confirm if the proposed generator will have the capacity of accommodating the the following:

1.6.3.3.1.1. Motor starting current inrush,

1.6.3.3.1.2. Transformer current inrushes,

1.6.3.3.1.3. Large rectifier sudden loading (e.g. single or multiple EV charger type level 2 or 3)

1.6.3.3.1.4. Sudden disconnection of the above listed loads

1.6.3.3.2. For application including parallel operation with the utility and/or present of solid state inverters (e.g.: PV solar), designer shall also confirm the suitability of prime movers and alternators with all related transient phenomena tied to operating PWM inverters, active power factor corrections, active harmonic corrections, and harmonic distortions from non linear loads.

**1.6.4. Prime Mover’s Type & Fuel**

**1.6.4.1. Emergency Power (Life & Safety Loads):**

1.6.4.1.1. Generators supplying emergency power to Life and Safety rated loads shall be using diesel as their fuel.

1.6.4.1.2. Dual fuel units supplied from the local natural gas distribution network and local propane storage tanks may be acceptable if validated with the local Authority Having Jurisdiction and if installing local propane storage tanks is practical and physically achievable.

1.6.4.1.3. Engines to be type multi-cylinder reciprocating piston driven engines.

**1.6.4.2. Standby / Backup Power (Non Life & Safety Loads):**

1.6.4.2.1. Generators supplying backup power to loads other than life and safety equipment may use

either diesel, or natural gas, or propane as their fuel sources.

1.6.4.2.2. Propane or natural gas unit to be specified as **dual fuel units** capable of operating on either propane or natural gas. Options for installing local propane storage tanks shall be investigated when practical and physically achievable.

1.6.4.2.3. Units supplied on a blend of hydrogen (H<sub>2</sub>) and natural gas or purely on H<sub>2</sub> are also acceptable if it can be demonstrated that a local supply is present and economical.

1.6.4.2.4. Engines to be type multi-cylinder reciprocating piston driven engines or aero derivatives gas turbines (turbohaft or equivalent).

#### 1.6.5. Single Generator System:

1.6.5.1. The generator shall be complete with a built in controller governor system capable of interfacing with the start and stop signals issued by the facility transfer scheme or switches

1.6.5.2. When present, the generator shall be integrated and fully configured to operate and load shed feeder breakers under overload conditions. **See load shedding below for details.**

#### 1.6.6. Multi Generator System (Parallel Generator Scheme):

1.6.6.1. Parallel generator schemes with or without redundancy (N, N+1, N+2, 2N, 2(N+1)) shall only be considered for extremely high availability applications and/or large loads where the use of a single generator is neither practical nor advisable due to a combination of technological, practical, and reliability considerations

1.6.6.2. All parallel scheme shall be as follows:

1.6.6.2.1. All generators shall be in operation and sharing the loads,

1.6.6.2.2. Options shall be present to disable one or several units if the load sharing may result in operating the units below their recommended minimum kW loading (i.e.: Avoiding wet stacking / cylinder glazing effects)

1.6.6.2.3. Each generator shall be piloted in an **ISOSYNCHRONOUS** mode to ensure even load sharing between units

1.6.6.3. Control Type:

1.6.6.3.1. Preferred: Generator control, and synchronisation system shall be integrated “generator to generator” direct control and telecommunication or

1.6.6.3.2. If not achievable due to a multi-year installation plan, they shall be PLC controlled and fully configured to operate any required and loading scheme under failed generator and/or overload conditions. **See load shedding below for details.** The PLC system shall be inclusive of all required synch-check relay protection.

#### 1.6.7. Alternator Pitch:

1.6.7.1. Preferred Pitch

1.6.7.1.1. All applications including close transfer or continuous parallel operation with the local utility source shall be using a  $\frac{2}{3}$  pitch.

1.6.7.1.2. Applications including multiple generator units running in parallel shall also be based on  $\frac{2}{3}$  pitch alternators.

1.6.7.1.3. Other pitch ratios may be permitted for single standby emergency generator applications which will be paired with open transfer scheme / switches.

1.6.7.2. New Systems:

1.6.7.2.1. Multi generator system shall be composed of several units equipped with alternators with identical pitch and kW rating,

1.6.7.2.2. No exceptions,

1.6.7.3. Existing System Upgrades (generator addition):

1.6.7.3.1. Multi units system with identical alternator kW rating:

1.6.7.3.1.1. An existing system scheduled for one or several generator additions shall be equipped with a new unit(s) matching the alternator pitch of the existing unit(s).

1.6.7.3.1.2. If this is not achievable, the city may exceptionally allow the installation of dissimilar alternator pitch if it can be demonstrated that the addition of the following solutions is possible, economical and practical:

1.6.7.3.1.2.1. Possible Options:

- Option 1: Adding neutral reactor(s) to eliminate all resulting harmonic current circulation between alternator neutrals and/or utility transformer's "Xo". Since a complete elimination of harmonic current is typically not achievable with this method, the designer shall calculate the derating of each generator based on the known residual neutral harmonic current still flowing after installation of the reactor(s).
- Option 2: Converting the generator from a 3 phase 4 wire system to a 3 phase 3 wire system and adding an artificial zig zag neutral grounding transformer at the paralleling switchgear and/or isolation transformers.

1.6.7.3.1.2.2. Performance validation: For 4-wire generator installations made with dissimilar generator pitches, each generator's neutral current shall be measured to confirm that paralleling operations will not result in overload problems or premature generator failure. The designer may allow system operation with measured residual neutral currents and compensate by derating the alternator. At minimum, the derating shall be per the following formula:

1.6.7.3.1.2.3. Maximum allowable load on alternator (KVA) =

$$(KVA) = I_R / [(I_R^2 + I_N^2)^{1/2} (KVA_{gen})]$$

1.6.7.3.1.2.4. Where:

$I_R$  = output current of the generator set at full load and rated power factor

$I_N$  = neutral current of the generator set at full balanced load, paralleled (residual neutral circulation between alternators)

$KVA_{gen}$  = alternator rated KVA at maximum temperature rise

1.6.7.3.1.2.5. The generator manufacturer shall be contacted to verify if a better / more stringent

hardware specific formula shall be used for derating purposes in place of the above listed formula.

1.6.7.3.2. Multi units system with dissimilar alternator kW rating:

1.6.7.3.2.1. Not permitted,

1.6.7.3.2.2. No exceptions.

**1.6.8. Distributed Generation: Single or Multi Generator System with Parallel Utility Operation**

1.6.8.1. Generators:

1.6.8.1.1. Generator(s) installed to operate in parallel with utility sources shall be protected against neutral circulating current between sources and related voltage 3rd order harmonic distortion resulting from difference in wave forms between alternators and utility sources.

1.6.8.1.2. The protection shall be achieved by various means including but not limited to:

1.6.8.1.2.1. Installing only a 3 phase 3 wire system where practical,

1.6.8.1.2.2. High resistance neutral grounding and/or hybrid grounding system with or without artificial grounding transformer,

1.6.8.1.2.3. Neutral reactors,

1.6.8.1.3. When installed, the system's residual neutral current shall be estimated by design and confirmed with appropriate current measurement during commissioning. Upon confirming the neutral circulating current value, the designer shall then calculate each source's maximum allowable load for each source (source de-rating) using the above listed formula or any manufacturer recommended method if available.

**1.7. Load Shedding System:**

1.7.1.1. Load shedding scheme shall be integrated in a dedicated PLC based system which also communicates with the generator(s) installed on site.

1.7.1.2. The load shedding system shall be programmed with the following order of importance:

1.7.1.2.1. Life and safety loads shall never be part of the load shedding system

1.7.1.2.2. System preventing building damages due to freezing / cold weather should be disconnected last

1.7.1.2.3. Mission critical loads shall be protected and shall be the second last to be disconnected

1.7.1.2.3.1. Other type of loads: the disconnection sequence shall be discussed with project and facility key stakeholder to confirm order of preferences

1.7.1.2.4. BAS only load shed is not acceptable:

1.7.1.2.4.1. Preferred: The PLC can be designed to have direct control over the loads targeted as part of the load shedding scheme (e.g.: open/close command to breakers, and motor starters)

1.7.1.2.5. Alternately, the aforementioned PLC shall issue signals as required to the BAS to ensure proper load disconnection. This solution will be accepted only if the designer can



demonstrate that this alternate implementation results in both procurement and operational savings.

## **1.8. Load Transfer System**

### **1.8.1.1.1. General Requirements**

1.8.1.1.1.1. Transfer systems to be capable of remote monitoring of generator status and state.

1.8.1.1.1.2. The monitoring shall be in form of a Human Machine Interface (HMI) as follows:

1.8.1.1.1.2.1. Small (up to 150kW) open transfer standby generators: pilot light

1.8.1.1.1.2.2. Larger application or close transfer, or paralleling applications: Touch Screen Interface (TSI)

1.8.1.1.1.2.3. This HMI can be combined with the one used to monitor the facility's main service entrance panel, UPS, generators, etc...

### **1.8.1.1.2. Acceptable Technologies:**

#### **1.8.1.1.2.1. Transfer Switches:**

1.8.1.1.2.1.1. Transfer switches can be based on breaker or contactor technologies.

1.8.1.1.2.1.2. Transfer switches used in Mission Critical Application shall have a built-in electrically actuated bypass circuit.

1.8.1.1.2.1.3. Transfer switches shall not be installed in distribution panels / centers enclosures to prevent issues related to long outage during equipment replacement or repairs

#### **1.8.1.1.2.2. Breaker Based Transfer Scheme Located in Distribution Equipment**

1.8.1.1.2.2.1. Breaker based transfer scheme system shall be controlled by a PLC based system.

1.8.1.1.2.2.2. When present, it is acceptable to combine this function with the generator paralleling PLC and/or load shedding PLCs

### **1.8.1.1.3. Type of transfer system:**

#### **1.8.1.1.3.1. Open Transfer:**

1.8.1.1.3.1.1. Transfer switch or transfer schemes shall make use of a built in controller and a combination of electrical and mechanical interlocking mechanism to prevent accidental paralleling of sources even of the controller is de energized or failed

1.8.1.1.3.1.2. The interlocking mechanism shall be selected to prevent operators to manually interconnect all sources.

#### **1.8.1.1.3.2. Close Transfer:**

1.8.1.1.3.2.1. Transfer switches or transfer schemes shall be equipped with a dedicated sync check relay preventing a source paralleling if said source are out of sync.

1.8.1.1.3.2.2. The control system shall prohibit extended source paralleling operation by use of timers and default to a selectable preferred source.

1.8.1.1.3.2.3. The control system shall be integrated with the generator scheme controls to ensure the local and/or mobile generator set can automatically enter in full synch condition



with the utility source.

## 1.9. Mobile Generator and Load Bank Connection Box

1.9.1.1. Sites not equipped with a permanently installed load bank shall be equipped with a combined mobile generator and load bank connection box

1.9.1.2. Topology:

1.9.1.2.1. Box to be equipped with “two-way” Cam-lok connectors type E1016 Series, male and to be mounted in a quick connect assembly (c/w non-conductive mounting plate).

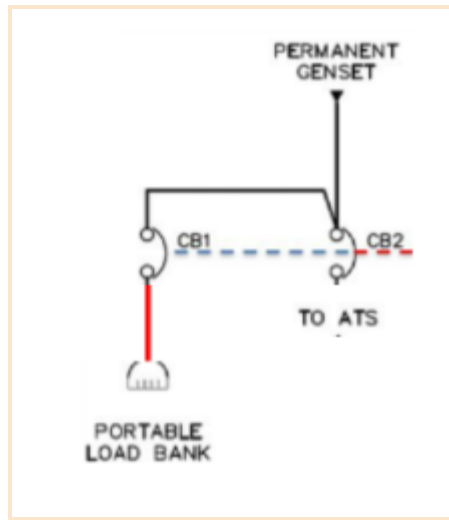
1.9.1.2.2. E1016 Series to be rated 400A (minimum). Box to include sufficient number of cam lock per phase to achieve the desired full load ampacity.

1.9.1.3. Connection and operation of the box:

1.9.1.3.1. **Option 1: Dual output generator**

1.9.1.3.1.1. Applicable for “simple” sites with only one generator.

1.9.1.3.1.2. Generator to be equipped with dual fully rated output breakers, one for the facility’s loads, one for connecting a portable load bank.



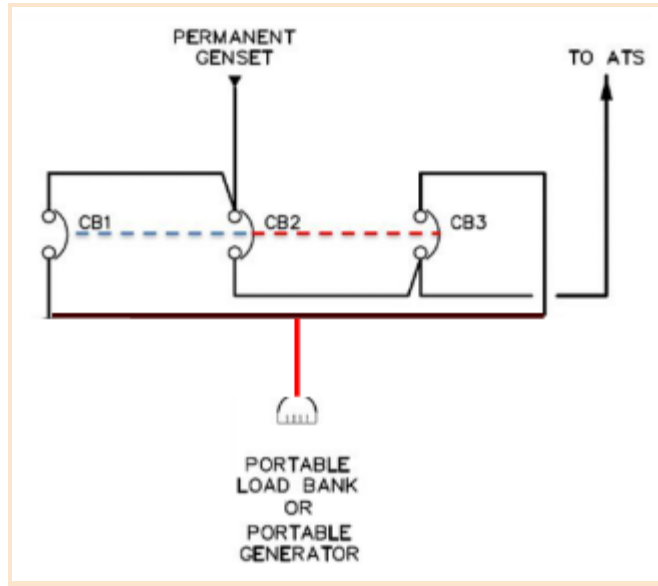
**Figure K1: Dual output breaker generator principle**

1.9.1.3.1.3. The generator shall be equipped with “LSI” breaker w/ shunt trip and aux. contacts

1.9.1.3.2. **Option 2: 3 way transfer switch**

1.9.1.3.2.1. Applicable for “simple” sites with only one generator.

1.9.1.3.2.2. Assembly to be complete with an electrically operated 3 way manual transfer switch allowing operators to select the mode of operation (generator testing with connection of a portable load bank or connection of a portable generator).



**Figure K2: 3 way transfer switch principle**

1.9.1.3.2.3. The 3 way switch shall be made of “LSI” breaker w/ shunt trip and aux. contacts

1.9.1.3.2.4. Combination Manual Transfer switch - portable generator cabinets are preferred.

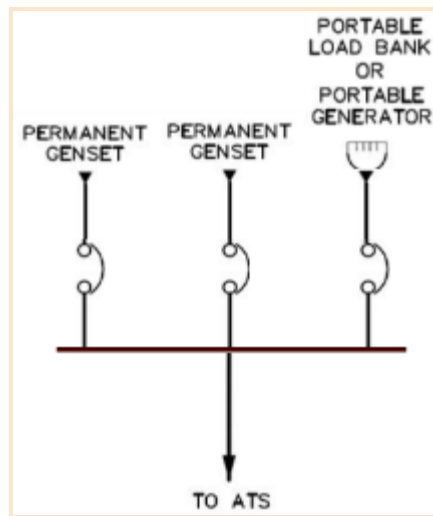
**1.9.1.3.3. Option 3: Connection box only**

1.9.1.3.3.1. Applicable for:

1.9.1.3.3.1.1. Sites already comprising a permanently installed load bank, and/or

1.9.1.3.3.1.2. Sites equipped with complex generator system including paralleling switchgear with PLC controls.

1.9.1.3.3.2. Assembly to comprise only some Cam-lock. Box to be wired to a dedicated breaker located in the main emergency distribution center



**Figure K3: Portable Generator and Load Bank Connection**

**1.9.1.3.4. Common requirements:**

1.9.1.3.4.1. For both option 1, 2 and 3: The internal control system, when set on load bank use, shall immediately and automatically disconnect the load bank if the facility loses its connection to its utility power source and if emergency power is required.

1.9.1.3.4.2. Portable generator controls:

1.9.1.3.4.2.1. Box to be equipped with a “shore power” terminal block consisting of a 3P/4W 120/208V 100A rated branch circuit

1.9.1.3.4.2.2. Box to also include a terminal block wired to the facility transfer scheme control system and providing the following functions:

1.9.1.3.4.2.2.1. A pair of wire for generator start signal

1.9.1.3.4.2.2.2. A pair of wire for generator stop signal

1.9.1.3.4.2.2.3. A connection for a C form dry contact providing a common alarm/fault signal from the generator. Control / signal voltage to be either 120Vac or 125Vdc, depending on the facility generator’s P & C control voltage.

1.9.1.3.4.3. Connection capacity:

1.9.1.3.4.3.1. The quantity and capacity of the connection boxes shall be discussed upon project initiation.

1.9.1.3.4.3.2. For example, 2N systems shall have a dedicated connection box for each of their “A” and “B” sides. N+1 systems shall have connection boxes with at least the capacity to replace one generator.

**1.10. DG Permanent Load Bank**

1.10.1.1. Characteristics:

1.10.1.1.1. Minimum load on generator to be 40% (or as dictated by monthly testing for installations to CSA C282).

1.10.1.1.2. A permanent load bank is to be installed unless it can be shown that the site’s demand will not drop below the minimum load requirement.

1.10.1.1.3. Permanent load bank to be installed outdoors. Location selection shall be near the generator’s room or outdoor enclosure to minimize cable run length, and out of reach from the public.

1.10.1.1.4. Settings:

1.10.1.1.4.1. Minimum requirements: The load bank shall provide options to manually select the load level and offer at least 4 settings in 25% increment from 0% to 100%.

1.10.1.1.4.2. Advanced controls: When load banks are operated in parallel with the site’s emergency loads to maintain minimum generator manufacturer’s recommended loading, the load bank shall have 10 settings in 10% steps from 0% to 100%.

1.10.1.1.5. Controls:

1.10.1.1.5.1. Manual:

- 1.10.1.1.5.1.1. Load banks shall be equipped with a control panel with lockable door allowing operator to select any available settings.
- 1.10.1.1.5.1.2. A mimic panel shall be installed in the generator room or generator enclosure to provide full load bank controls.

1.10.1.1.5.2. Automatic (Advanced control only):

- 1.10.1.1.5.2.1. Load banks are operated in parallel with a site's emergency loads to maintain minimum generator loading and shall be controlled by a microprocessor based system. The system shall include current sensors monitoring the alternator total current output and the load's demand
- 1.10.1.1.5.2.2. The control system shall automatically adjust the load bank setting as required and shall also provide options for a manual override.
- 1.10.1.1.5.2.3. The load bank's loading can be achieved via solid state or contactor based switching.

1.10.1.2. Sound and thermal management and dissipation:

- 1.10.1.2.1. The load bank shall be equipped with a built in forced air cooling fan system capable of maintaining the load bank within its maximum temperature limits without any time limitation.
- 1.10.1.2.2. The load bank hot air output shall be carefully managed. it shall not be discharged near other mechanical units or building's air intake.
- 1.10.1.2.3. The noise generated by the load bank fan and air discharge system shall be carefully managed as required using chimneys or other types of sound management systems to direct the sound upward. The load bank noise shall be factored in the noise dissipation and compliance study done for the generator installation.

1.10.1.3. Setup for stand alone generator:

- 1.10.1.3.1. The facility generator shall be equipped with two circuit breakers, one for the facility, and one for the load bank (dual output breaker generator)
- 1.10.1.3.2. Each breaker shall be 100% rated and its ampacity shall match the generator full FLA

1.10.1.4. Setup for multi generator connection (paralleling generator scheme):

- 1.10.1.4.1. The load bank breaker shall be installed in the main paralleling emergency distribution center and shall be rated as follows:
  - 1.10.1.4.1.1. N and N+1 system: The load bank shall be rated to support the operation of all units at full load
  - 1.10.1.4.1.2. 2N and 2(N+1) system:
    - 1.10.1.4.1.2.1. Each N or N+1 system shall be equipped with a dedicated load bank rated to support the operation of all units at full loads
    - 1.10.1.4.1.2.2. A single load bank may be acceptable if a distribution and source selection system is installed to allow for concurrent maintenance as follows:

- 1.10.1.4.1.2.2.1. The operation of the load bank with one side shall not impede the operation or maintenance or the other side
- 1.10.1.4.1.2.2.2. Each side shall have sufficient disconnecting means to fully disconnect and isolate the load bank.

## **1.11. Sites with Multiple Generator Sources: Permissible Combined Mode of Operations**

### **1.11.1. Sites Equipped With Multiple Types of Generators:**

- 1.11.1.1. Consultants shall design the interconnection of all sources (utility, distributed generators, backup and emergency generators) to prevent:
  - 1.11.1.1.1. Source overloads and/or derating resulting from abnormally high and neutral current circulation between distributed generators.
  - 1.11.1.1.2. Generator damages due to harmonic distortion and related resonance issues resulting from the operation of non linear loads and parallel solid state “PWM” generators.
- 1.11.1.2. With a few exceptions as listed below, distributed generators, backup generators, and emergency generators shall NOT supply power to the local utility grid (reverse power flow to grid). The site’s Service Entrance Bard (SEB) protection and control system shall be designed (new system ) or retrofitted (existing systems) to prevent a reverse power flow from the site to the grid. The exceptions are:
  - 1.11.1.2.1. Solar inverters,
  - 1.11.1.2.2. Vehicle to Grid (V2G) enabled EV charger systems.
  - 1.11.1.2.3. Lifting and hoisting system (e.g.: elevators) equipped with regenerative braking drives.

### **1.11.2. Large Intermittent loads and harmonic protection:**

- 1.11.2.1. The presence of large intermittent loads (e.g.: EV chargers, pool wave making system, large air compressors, large chillers, large heat pumps) may add further stresses on distributed generators during both utility paralleling operation and islanding operations
- 1.11.2.2. Designers shall review all possible modes of operations to determine if some additional Protective and Control (P & C) measures are required:
  - 1.11.2.2.1. Each source (i.e.: utility transformers and onsite generators or energy storage systems) impedance characteristics and ability to withstand load driven inrush currents shall be evaluated to ensure continuous operation and prevent nuisance tripping due to transient overloading, flicker, voltage sag and swell, and frequency drop or surge. Complex multi source systems shall be engineered to ensure that:
    - 1.11.2.2.1.1. Large intermittent loads’s inrush currents will:
      - 1.11.2.2.1.1.1. Be supplied from the utility connection first and foremost.
      - 1.11.2.2.1.1.2. Not result in abnormally high transient voltage drops exceeding the limits prescribed by the local utility company or frequency decay.
    - 1.11.2.2.1.2. Large intermittent loads going off line will not result in voltage surges and over frequency conditions.
    - 1.11.2.2.1.3. The intermittent power output of weather dependent solid state generators will not result

in unacceptable voltage and power factor swings on site.

## **1.12. Distributed Emergency Generators (with Life & Safety Loads):**

### **1.12.1.1. Utility Paralleling Operation:**

1.12.1.1.1. Not permitted.

1.12.1.1.2. Brief paralleling related to close transfer schemes are permitted.

1.12.1.1.3. Note for peak shaving: Using the generator as a peak shaving unit may be permissible as long as the generator is not paralleled to any other source

### **1.12.1.2. Islanding Operations:**

1.12.1.2.1. Emergency generators shall NOT be operated in parallel with any other distributed generators, especially solid state inverters such as those used with photovoltaic and or Battery Energy Storage Systems (BESS) applications.

1.12.1.2.2. Life and safety loads shall be supplied from dedicated transfer switches which are themselves supplied directly from the emergency generator or main emergency distribution panel and from the Service Entrance Board (SEB).

1.12.1.2.3. Transfer Scheme:

1.12.1.2.3.1. The transfer switch/scheme shall be preferably type “open transfer / break before make”.

1.12.1.2.3.2. If the transfer switch/scheme is type “close transfer / make before break”, the system shall be as a fast transfer scheme with a paralleling time not exceeding 100 milliseconds.

1.12.1.2.3.3. A four (4) pole (switched neutral) scheme shall be used.

1.12.1.2.4. The emergency generator shall not:

1.12.1.2.4.1. Be used to recharge the BESS, even momentarily during close transfers.

1.12.1.2.4.2. Supply power to non emergency loads due to backfeed to the SEB during close transfer or retransfer operations.

## **1.13. Backup Generators:**

### **1.13.1.1. Utility Paralleling Operation:**

1.13.1.1.1. Permanent paralleling operations are not permitted unless the generator system is designed as a peak shaving unit with a prime mover and alternator rating type “continuous”.

1.13.1.1.2. Note: Brief paralleling related to close transfer schemes are permitted irrelevant of the generator’s type.

### **1.13.1.2. Islanding Operations:**

1.13.1.2.1. Parallel operation with other distributed generators while in islanding mode is permissible as long as the co or tri generator is not used to compensate for other generator(s)'s limited ability to produce reactive power, if applicable. Paralleling operations with photovoltaic inverters is not permitted, no exceptions.

1.13.1.2.2. BESS, if present, can be used to assist the backup generator plant to supply power to the site. It shall act as a peak shaving unit.

1.13.1.2.3. The generator plant shall not be normally used to recharge the BESS unless the site is equipped with large intermittent loads (E.g.: Level 3 EV Chargers). In such a case, each load's mode of operation shall be carefully reviewed to determine if there could be a situation where the generator plant could be underloaded. To prevent generator damages due to underloading, it is permissible to use the BESS as a load.

**1.13.2. Co or tri generation systems:**

**1.13.2.1. Utility Paralleling Operation:**

1.13.2.1.1. Permanent paralleling operations are permitted.

**1.13.2.2. Islanding Operations:**

1.13.2.2.1. Parallel operation with other distributed generators while in islanding mode is permissible as long as the co or tri generator is not used to compensate for the other generator(s)'s limited ability to produce reactive power. Paralleling operations with photovoltaic inverters is not permitted, no exceptions. During islanding conditions, the PV arrays's inverters shall be disconnected using the system's rapid shutdown function.

1.13.2.2.2. BESS, if present, can be used to assist the Co or Tri gen plant to supply power to the site. It shall act as both a peak shaving unit and as a buffer system capable of supplying momentary current demand (inrushes) resulting from motor starting operation (transient) or large intermittent load (e.g. EV chargers) coming on line.

1.13.2.2.3. Electrical and mechanical designers shall coordinate to define the co or tri generator mode of operation in both utility paralleling and islanding modes. Co and trigeneration systems are typically engineered to act as heating and cooling systems first and foremost, and their power output is considered as a "secondary output", which is dependent on the load demand for the primary output (e.g.: heat). If islanding operations are required, the co or tri generator must be equipped with additional means of dissipating the primary output (e.g.: atmospheric cooler) to allow operation at alternator full rated output.

1.13.2.2.4. The Co or Tri gen plant shall not be normally used to recharge the BESS unless the site is equipped with large intermittent loads (E.g.: Level 3 EV Chargers). In such a case, each possible mode of operation shall be carefully reviewed to determine if there could be a situation where the generator's alternator could be underloaded. To prevent generator damages due to underloading, it is permissible to use the BESS as a load.

**1.13.3. Photovoltaic Solid State Inverters:**

**1.13.3.1. Utility Paralleling Operation:**

1.13.3.1.1. Permanent paralleling operations are permitted.

**1.13.3.2. Islanding Operations:**

1.13.3.2.1. Not permitted, no exceptions

1.13.3.2.2. When distributed generators are present on site (e.g.: PV Solar inverters, combined heat and power systems (CHP)), and if said systems can be operated in islanding mode, designers shall ensure that the solar inverter's anti islanding protection feature will not be



defeated by the presence of other generators.

1.13.3.2.3. When emergency or backup generators are present on site:

1.13.3.2.3.1. The solar inverter shall not be tied to the load side or the generator side of the generator's transfer scheme/switch, or

1.13.3.2.3.2. Site equipped with 100% backup system shall comprise an interconnection between the transfer system controller and the PV inverter. When the site is supplied from the generator, the transfer system shall issue a rapid shutdown signal to the inverters.

#### 1.13.4. Elevator and lifting system equipped with regenerative braking systems

##### 1.13.4.1. Utility Paralleling Operations:

1.13.4.1.1. Permitted.

##### 1.13.4.2. Islanding Operations:

1.13.4.3. When operated in a facility equipped with a distributed generators capable of operating in islanding mode, the power generated by this type of regenerative braking system shall be carefully appraised to evaluate if it is compatible with the distributed generator in terms of:

1.13.4.3.1.1. Harmonic distortion,

1.13.4.3.1.2. Voltage sag or swell,

1.13.4.3.1.3. Flicker.

1.13.4.3.1.4. Reactive power control

1.13.4.4. The power demand of the loads requiring backup power and the capacity of the backup generator shall be carefully appraised to ensure the regenerative braking will not result in generator underloading conditions.



## **APPENDIX L - HAZARDOUS CLASSIFICATION STUDY**

## 1. Hazardous Classifications Studies & Related Design Activities

### 1.1.1. Preamble

1.1.1.1. The City of Edmonton operates various sites where flammable and explosive material may be stored and/or handled. When presence of such material is confirmed, designers shall prepare a hazardous classification study to determine the classification of the areas where said compounds are present, and to identify all required protective systems such as intrinsically safe equipments, blast proof structures, specialty ventilation systems, fire detection and suppression systems, and sensor schemes with all related alarming equipment and interconnection to the facility's CCure. This may include but is not limited to:

- 1.1.1.1.1. Storage of chemical substances which may emit flammable and/or explosive gas such as paint cans.
- 1.1.1.1.2. Study of hazardous locations related to the use of wood processing equipment (dust explosion hazard).
- 1.1.1.1.3. Installing and operating salt based natatorium water treatment system (hydrolysis of salt in water with hydrogen production as a byproduct).
- 1.1.1.1.4. Operation of large ice plants with an ammonia based cooling system.
- 1.1.1.1.5. Fuelling station and fuel storage tanks (Diesel, gasoline, hydrogen).
- 1.1.1.1.6. Vehicle maintenance facilities.

1.1.1.2. The City of Edmonton's "[C627 Climate Resilience Policy](#)" has also resulted in the implementation of various pilot programs and studies centered around the usage of hydrogen as a source of energy. This in turn resulted in an emerging need to conduct various hazards assessments including code, standards and hazardous classification studies targeted on the delivery, use and storage of Gaseous or Cryogenic liquid Hydrogen.

### 1.1.2. Coordination with Other Disciplines

1.1.2.1. The study shall be coordinated with other disciplines including but not limited to:

- 1.1.2.1.1. Architectural and structural (e.g.: building envelope, blast proof structure, fire rating of wall and related separation, etc...)
- 1.1.2.1.2. Mechanical ( e.g.: ventilation requirements, fire suppression systems, etc...)
- 1.1.2.1.3. Occupational Health and Hazard specialists (OH & S) for additional consideration relate to the toxicity of the flammable compounds, if applicable.

### 1.1.3. Applicable Standards

1.1.3.1. The following codes shall be reviewed while preparing all studies:

- 1.1.3.1.1. Canadian Electrical Code CEC C22.1 - hazardous classification section 18 (Hazardous Classification) and related Appendix B Sections including but not limited to the references standards listed in Table B18-1 which are applicable to all city's projects falling in the scope of the consultant/designer
- 1.1.3.1.2. Where hydrogen gas is present:

- 1.1.3.1.2.1. **IEC 60079-10-1** “Explosive atmospheres - Part 10-1: Classification of areas - Explosive gas atmospheres”
- 1.1.3.1.2.2. **API RP505** “Recommended Practice for Classification of Locations for Electrical Installations at Petroleum Facilities Classified as Zone 0, Zone 1, and Zone 2, Second Edition”
- 1.1.3.1.2.3. **NFPA 497** “Recommended Practice for the Classification of Flammable Liquids, Gases, or Vapors and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas”
- 1.1.3.1.2.4. **API 4615** “Emission Factors for Oil and Gas Production Operations”
- 1.1.3.1.3. Additional sources which may be consulted for reference only:
  - 1.1.3.1.3.1. **NFPA 70** “National Electrical Code (USA)”

**1.1.4. Study principles:**

1.1.4.1. General Guidelines:

1.1.4.1.1. From the IEC 60079-10-1:

*“The hazardous area classification should be carried out by persons who understand the nature of flammable substances, gas dispersion and ventilation and are familiar with the process aspects for the plant under consideration. It may be beneficial for other engineering disciplines, e.g. electrical and mechanical engineers, and personnel with specific responsibility for safety to be part of and have an input to the hazardous area classification process. The competency of the person shall be relevant to the nature of the plant and methodology used for carrying out the hazardous area classification. Appropriate continuing education or training should be undertaken by personnel on a regular basis where required”*

1.1.4.1.2. C22.1 Canadian Electrical Code Appendix L:

*“The engineering profession is responsible for determining what levels of competence are required for a given discipline or activity. There is currently no regulated “certification” requirement verifying competence for an engineer in order to perform an area classification study. However, there is still professional responsibility for the practicing engineer to be knowledgeable and competent in practicing the profession, hence in performing an area classification study”*

1.1.4.1.3. Study requirements

1.1.4.1.3.1. The study shall be conducted as part of a multidisciplinary effort:

1.1.4.1.3.1.1. The study engineer shall coordinate with the engineering discipline who is responsible for specifying / designing the system(s) which may emit flammable or explosive substances. For example, process engineers or equipment specialists shall be consulted to identify all operating modes of the equipment included in the scope of the study. Specialists familiar with the characteristics and reactivity of the chemical compounds forming part of the study scope shall also be consulted to identify if additional risks may also be present (e.g.: reactivity, toxicity, etc...).

1.1.4.1.3.1.2. Coordinating as required with mechanical (ventilation) and architectural (building envelope) disciplines shall form an integral part of the study to identify the most cost

efficiency strategies to limit classification requirements.

1.1.4.1.3.2. When dealing with sites where explosive atmospheres can be present, explosive hazards may be present during both normal and abnormal (failure) operations due to operator's error, accidents, or hardware failure. Studies shall consider all possible operational scenarios, including normal mode of operation and mode of failure. This means studies shall not rely solely on considerations based on minimum code requirements, but also on common sense and on site specific conditions:

**1.1.4.1.3.3. Hazardous Classification Study Considerations:**

1.1.4.1.3.3.1. The study shall consider the facility/site's "normal" operation(s) and shall factor both operational procedures (i.e.: operators' duties) and equipment usage and/or functions(normal and alternate operating mode) :

1.1.4.1.3.3.1.1. "Normal" is when equipment and site personnel are operating within its normal parameters/ conditions inclusive of maintenance activities. This shall include both main and alternate mode of operation as applicable.

1.1.4.1.3.3.1.2. Important note: Abnormal conditions do not apply to (**See HAZOP Below**):

- "Rare malfunctions" or "catastrophic failures",
- Activities such as testing, commissioning or turnaround activities,

1.1.4.1.3.3.2. Practical considerations shall be factored in the studies to determine the likelihood of occurrence, emission quantities, volume and dilution, of all possible operational mode including failure, and potential ignition sources in hazardous locations:

1.1.4.1.3.3.2.1. Site specific conditions,

1.1.4.1.3.3.2.2. Usage of equipment,

1.1.4.1.3.3.2.3. Structure / enclosure / building characteristics (e.g. vapor tight walls?)

1.1.4.1.3.3.2.4. Ventilation systems and natural air movements,

1.1.4.1.3.3.3. The study shall consider and document:

1.1.4.1.3.3.3.1. Group classification and Auto-ignition temperature and/or T-Code

1.1.4.1.3.3.3.2. Flammable and/or explosive substance emissions during regular operations,

1.1.4.1.3.3.3.3. Probability of explosion curve,

1.1.4.1.3.3.3.4. Probability of a Component Leak,

1.1.4.1.3.3.3.5. Ignition source and their related ignition potential,

1.1.4.1.3.3.3.6. WHMIS/GHS/(M)SDS

1.1.4.1.3.3.4. "Simplified Method" VS "Source of Release Method":

1.1.4.1.3.3.4.1. The study shall clearly identify the methodology used to prepare the classification study complete with the rationale justifying the choice of the selected method

1.1.4.1.3.3.4.2. The method shall be selected based on the project complexity and site condition and shall not result in over classifying areas.

1.1.4.1.3.3.5. Preventative strategies to prevent damages and protect personnel (e.g.: ventilation,

use of intrinsically safe equipment...) shall be identified and recommended as part of the study. The solutions shall be devised as a means to prevent the occurrence of ignition and explosion.

#### **1.1.4.1.3.4. Hazard and Operability Analysis (HAZOP) Considerations:**

1.1.4.1.3.4.1. The study shall consider the facility/site's "abnormal" operation(s) and shall factor both operational procedures (i.e.: operators' emergency duties) and possible equipment failure mode(s):

1.1.4.1.3.4.1.1. "Abnormal" is when equipment's failure or accidental occurrence of catastrophic flammable or explosive compounds emissions occurs.

1.1.4.1.3.4.1.2. Important note: Operator mistakes resulting in significant flammable or explosive substance release shall be carefully analysed to determine if they should be factored as "abnormal" or "normal" conditions. The review shall be based on multiple factors such as volumes, dilution, risk and severity.

1.1.4.1.3.4.2. The study shall be based on a detailed risk analysis which will quantify the possibility or likelihood of occurrence and the severity of all resulting hazards.

1.1.4.1.3.4.3. Mitigation strategies to limit damages and protect personnel (e.g.: specific fire suppression, activation of fail safe systems such as fuel shut off emergency valve, fire suppression such as deluge system etc...) shall be identified and recommended as part of the study. The solutions shall be devised as a means to control and minimize hazards and damages.

#### **1.1.5. Study Approach for new and existing sites:**

##### **1.1.5.1.1. Existing Sites:**

1.1.5.1.1.1. The study shall produce an "as-is" site appraisal determining the type of hazardous classification levels required to install a new system which may emit flammable/explosive substances as part of its normal operating conditions, and/or intermittently, and/or accidentally

1.1.5.1.1.2. The study shall then appraise the type of modifications to be implemented on site to reduce the Hazardous Classification requirements, if possible. The approach to implement changes shall be based on the requirements outlined in the section "Minimizing Requirements for Hazardous Classification".

##### **1.1.5.1.2. New Sites:**

1.1.5.1.2.1. The study shall form an integral part of the preliminary assessments conducted for planning a site (concept design).


1.1.5.1.2.2. The studies results shall be factored in the site's design to ensure hazardous classification can be either reduced or eliminated where possible by code.

1.1.5.1.2.3. The approach to implement changes shall be based on the requirements outlined in the section "Minimizing Requirements for Hazardous Classification".

#### **1.1.6. Minimizing Requirements for Hazardous Classification:**

##### **1.1.6.1. Hierarchy of Controls**

1.1.6.1.1. The city consider the following hierarchy of controls as the cornerstone approach to proceed with hazardous area classification:

Effectiveness	Control Type	Example
Most Effective    Least Effective	Elimination	Physically remove the hazard
	Substitution	Replace the hazard
	Isolation	Isolate people from the hazard
	Engineering Controls	Engineer out the hazard
	Administrative Controls	Change the way people work
	PPE	Protect the work with Personal Protective Equipment

**Figure L1: Hierarchy of Controls**

1.1.6.1.2. Hazardous classification studies shall be based first and foremost on strategies in the following order:

- 1.1.6.1.2.1. 1) a philosophy driven by seeking ways of eliminating hazards,
- 1.1.6.1.2.2. 2) implementing a strategy of substitution to replace/eliminate hazards,
- 1.1.6.1.2.3. 3) then isolation,
- 1.1.6.1.2.4. 4) then engineering controls via the installation of building's safety systems.

1.1.6.1.3. Notes:

- 1.1.6.1.3.1. While equipment designed to handle flammable or explosive substances may be equipped with built-in sensing and alarming system, ventilation and other measures designed to prevent and/or control the emission of said flammable or explosive substances (e.g.: storage cabinets, fume hoods, H2 powered vehicles, etc...), the city does not consider that said built-in safety features as sufficient.
- 1.1.6.1.3.2. Facilities scheduled to house these specialty equipment shall be equipped with their own safety systems including but not limited to sensor arrays, ventilation systems, alarm system, and any other architectural, structural and mechanical features designed to minimise or eliminate or contain accidental emission of flammable or explosive compounds. This shall apply to any and all areas where the equipment may be located or driven (vehicles).
- 1.1.6.1.3.3. Said safety systems shall be designed while considering both normal and abnormal conditions (e.g.: normal operations and failure modes including but not limited to equipment failures, accidents, operators mishaps, etc...).
- 1.1.6.1.4. Administrative controls and PPE shall NEVER be considered as a default first line of



defense solution which can be substituted to the above first 4 strategies. Facilities shall be engineered complete with automatic systems capable of protecting all personnel, equipment and the facility itself against explosive and flammable compounds emissions.

1.1.6.2. Where permitted by codes, and where practically and economically achievable, the following strategies shall be implemented to protect both operators, equipments and facilities against the dangers related to explosive atmospheres:

1.1.6.2.1. **Note:** The below listed strategies do not constitute a comprehensive list. Designer to proposed strategies based on site specific conditions and on the operational requirements of both existing and new systems scheduled for installation.

1.1.6.2.2. **First Layer: Elimination Strategies**

1.1.6.2.2.1. Distribution centers, motor starters shall not be installed within hazardous areas

1.1.6.2.2.2. Where achievable and practical, equipment capable of emitting flammable or explosive substances should be located in segregated areas, or outdoors (e.g.: fuel storage tanks, fuel station, etc...).

1.1.6.2.2.3. Adjacent areas should be equipped with positive pressure HVAC systems to prevent the migration of explosive or flammable atmospheres.

1.1.6.2.3. **Second Layer: Substitutions Strategies**

1.1.6.2.3.1. Where practically achievable, employing different types of systems presenting less hazards may be desirable.

1.1.6.2.3.2. Relocating equipment in zones where the hazards will no longer be an issue is also attractive (e.g.: equipment **located** outdoors).

1.1.6.2.4. **Third Layer: Isolation Strategies**

1.1.6.2.4.1. Any areas which may be regularly exposed to explosive or flammable compounds shall be segregated from the rest of the facility

1.1.6.2.4.2. For example:

1.1.6.2.4.2.1. Hydrogen or fuel storage and dispensing system shall be placed in isolated/segregated areas engineered to contain accidental leaks and/or to quickly dissipate flammable or explosive gasses outside of the facility, or in the open atmosphere, or through a flare stack

1.1.6.2.4.2.2. Stationary batteries should be located in dedicated rooms,

1.1.6.2.4.2.3. Piping carrying flammable or explosive compounds should be segregated from other pipes,

1.1.6.2.4.2.4. Chemical storage cabinets / enclosures should be within an enclosure complete with ventilation systems, etc...

1.1.6.2.5. **Fourth Layer: Engineering Controls Strategies**

1.1.6.2.5.1. Electrical apparatus installed within hazardous areas shall be intrinsically safe and limited to end devices only (lighting systems and specialty equipment required by operators to carry out their tasks within said zone).

- 1.1.6.2.5.2. When equipment (including vehicles) susceptible of emitting flammable or explosive substances as part of either its normal operation or accidentally, is installed within facilities, said equipment internal sensor and alarming system, if present shall NOT be considered as sufficient:
  - 1.1.6.2.5.2.1. The facility shall be equipped with dedicated sensors capable of detecting the emission of explosive or dangerous substances in all areas where the equipment may be located/used/driven.
  - 1.1.6.2.5.2.2. Said areas shall then be classified and/or equipped with the relevant systems complying with the required ventilation apparatus and intrinsically safe devices as mandated by code.
  - 1.1.6.2.5.3. Areas susceptible of being exposed to hydrogen and other types of flammable or explosive vapours shall employ a comprehensive system composed of detectors/sensors and multistage ventilation and containments system to constantly maintain a high rate of air change per hours, and to rapidly evacuate all leaks which may accidentally occur on site. Sites relying on ventilation and sensor schemes to limit their requirements for classifying areas as hazardous shall be provided with backup power OR shall comprise natural / passive ventilation means.
- 1.1.6.2.6. **Final two layers: Administrative Controls and PPE**
  - 1.1.6.2.6.1. As a last resort, these final two layers of defense shall be suggested to the site management to complement the first 4 layers of controls who will develop training procedures and emergency procedures to address hazardous situations.
  - 1.1.6.2.6.2. While the city recognize the fundamental need for developing procedures and train operators, the city does not consider that said procedures and training programs can supersede or replace the first four control layers as discussed above, the city consider that admin controls and PPE are the last lines of defense which can be used to protect operators against hazards. Facilities shall be engineered with safety in mind, and as such, they shall be equipped with all required systems to protect operators. Said systems shall be automatic and fail safe as much as practically achievable.
  - 1.1.6.2.6.3. PPE and administrative procedures shall never be considered first when assessing the requirements for hazardous classification for a facility.