Transit Oriented Communities

Reference Concept Design – Electrical Engineering – Cosburn

Contract RFS-2019-NAFC-110

PO 214244

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Ontario Line Technical Advisor

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Abbreviations

ANSI – American National Standards Institute

ASHRAE – American Society of Heating, Refreigiration and Air Conditioning Engineers

BICSI – Building Industry Consulting Service International

CACF – Central Alarm and Control Facility

Civil Project Co – Design, Build and Finance contractor responsible for South civil works

EF – Entrance Facility

EMI – Electromagnetic Interference

ER – Equipment Room

HVAC – Heating, Ventilation and Air-conditioning

ICT – Information and Communications Technology

IEEE – Institute of Electrical and Electronics Engineers

LED – Light Emitting Diode

LV – Low Voltage

MPH – Mechanical Penthouse

MV – Medium Voltage

OESC – Ontario Electrical Safety Code

OLTA – Ontario Line Technical Advisor

PVC – Poly Vinyl Chloride

RCD – Reference Concept Design

RGS - Rigid Galvanized Steel

SLS – Serviceability Limit State

TC – Telecom Closet

TDMM – Telecommunications Distribution Methods Manual

TIA – Telecommunications Industry Association

TOC – Transit Oriented Community

TR – Telecom Room

UPS – Uninterruptible Power Supply

1 Introduction

1.1 Background

The Ontario Line rapid transit project being delivered by Infrastructure Ontario and Metrolinx will be a 15.6-kilometre stand-alone rapid transit line connecting the Ontario Science Centre to Exhibition/Ontario Place through the Toronto downtown core. Fifteen stations are proposed, with numerous connections to the city's broader transit network. The project also intends to develop Transit Oriented Communities (TOCs) at selected stations to enhance communities along the length of the transit line.

In developing the TOC strategy, the Cosburn site was identified as an opportunity area for development and a TOC was advanced at this location.

The sites for the Cosburn TOCs are located at South Site: 1002-1028 Pape Ave, 103-109 Cosburn Ave and North Site: 1030-1052 Pape Ave. To construct the rail infrastructure Civil Project Co will demolish the existing buildings and build the new OL Cosburn station. The station entrance will occupy part of the footprint of the TOC North Site building. The station emergency egress building will occupy part of the footprint of the TOC South Site building. The TOC is projected to fill the remaining length of each site.

The TOC was designed as a mixed-use development, allocating most of the floor area for residential use, with the ground level allocated to mostly retail space.

1.2 Purpose and Limitation of Document

This document presents the basis of design for the reference concept design developed for the Cosburn TOC developments. It is intended to be part of the Disclosed Data (in the data room) to provide Proponents with context to the development of the RCD. The reference concept designs for the TOCs represent an approximate 10% level of design development. As such, this report provides only key engineering parameters required for the concept design. A number of areas will require future consideration, and these are noted through the report.

The report describes the station interfaces, design criteria and design approach for the TOC electrical design.

This memo is not intended to dictate how to design and construct the project or relieve the developer of design responsibility. Moreover, the document is not prescriptive and does not limit or prevent the TOC Developer from adapting the design to suit the future TOC. Instead, this document intends to be informative and outline the design data used to develop the reference design and presents a potential design option for this location.

1.3 Referenced Documents

This memo is intended to be read in conjunction with the following key documents:

- Station – TOC Interface Drawings (MMCL)
- TOC architecture reference concept design (SvN)
- TOC structural reference concept design (MMCL)Station architecture reference concept designs (HDR)
- Mechanical concept design memo
- Structural concept design memo
- Geotechnical concept design memo
- Constructability memo (MMCL and HDR)
- Available existing building record drawings from City of Toronto

2 Design Responsibilities

Division of responsibilities related to the general design of the TOC Development:

Infrastructure Ontario

Infrastructure Ontario (IO) is the client and leads the development of the TOCs associated with the Ontario Line subway project.

Civil Project Co

Civil Project Co identifies the joint venture selected by Metrolinx to design and build the Railway Civil Infrastructure for the South Ontario Line segment.

Rolling Stock, Systems, Operation and Maintenance Project Co

Rolling Stock, Systems, Operation and Maintenance (RSSOM) Project Co identifies the joint venture selected by Metrolinx to design, build, operate, and maintain the Ontario Line Infrastructure for 30 years following substantial completion of the works.

City of Toronto

The City of Toronto is a key stakeholder in the Ontario Line project and will grant planning approvals for the development of the TOC.

TOC Developer

The TOC Developer will be responsible for developing and constructing the TOC building in accordance with the latest editions and revisions of applicable codes and standards, City of Toronto guidelines and the constraints identified in the Developer Agreement.

3 Site Overview

3.1 Site Information

Site Name: Cosburn North and Cosburn South

Location: The TOC will be located on the northwest and southwest blocks of the intersection of Pape Avenue and Cosburn Avenue.

TOC Address: North Site: 1030-1052 Pape Ave
South Site: 1002-1028 Pape Ave, 103-109 Cosburn Ave

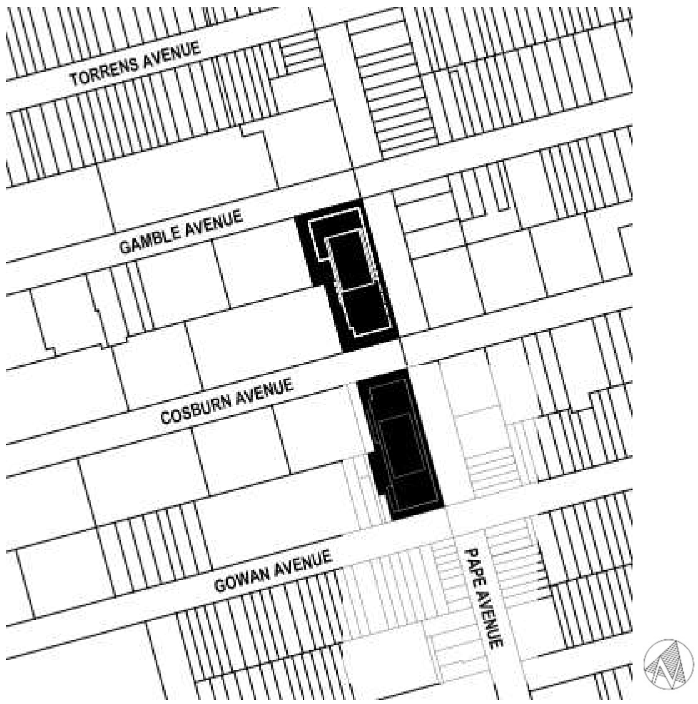

Figure 3-1. Site Location Plan

4 Design Criteria

4.1 Introduction

Electrical systems should be designed and installed based on efficient use of space, energy efficiency, optimum ratings, adequate clearances, relevant codes, standards, and industry practice. The electrical and communications services to the building or facility will terminate at a service entrance equipment for distribution within the building. The location of such equipment should be as close to the point of entry of service to the building/premises as possible to minimize the travel of utility service within the building.

4.2 Main Features

4.2.1 Operational Safety and Reliability

The electrical systems should include safety by design. All electrical systems and operations should be in conformance to CAN/CSA-Z462-21 Workplace Electrical Safety. Safe conditions should be ensured under all operating conditions (normal and emergency). Provide emergency power to all emergency lighting, life safety systems and fire pump(s) as well as any other loads that require backup power. Electrical system design should ensure sufficient reliability, redundancy, and resiliency.

4.2.2 Maintainability and Accessibility

Electrical systems should be designed with optimum service clearances to be accessible for maintenance and capable of being repaired and replaced.

4.2.3 Standardization of Equipment and Materials

Electrical equipment selection should include standard products from reputable suppliers and should be CSA/ULC approved. Equipment which, at the time of purchase, is known to become obsolete in the near future should not be selected. Equipment of similar nature, identical components, and construction should be of the same manufacturer.

4.2.4 Interface with Building Services

The design and installation of electrical systems should be coordinated with other divisions to minimize interferences.

4.2.5 Energy Efficiency

All electrical equipment should be selected to maintain highest efficiency in the use of electrical energy.

4.3 Code, Standards and Requirements

The TOC Developer will be responsible for adapting the design to suit applicable code revisions that are published after this reference design. Electrical systems should be in accordance with applicable codes, standards and requirements of authorities having jurisdiction including, but not limited to:

- CSA C22.1 - Canadian Electrical Code, Part I Safety Standard for Electrical Installations - 25th Edition, 2021
- CSA C282:19 Emergency electrical power supply for buildings - 7th Edition, 2019
- CAN/CSA-Z462-21 Workplace Electrical Safety
- CSA-B72:20 Installation Code for Lightning Protection Systems
- National Building Code of Canada - 2020 Edition
- National Energy Code of Canada for Buildings 2020 (NECB)
- National Fire Code of Canada 2020
- ASHRAE 90.1 – Energy Standard for Buildings Except Low-Rise Residential Buildings
- Ontario Building Code (OBC) 2020 with applicable amendments
- Ontario Electrical Safety Code (OESC) 28th edition - 2021
- Ontario Fire Code 2022
- ANSI/TIA-568.1 - Commercial building telecommunications cabling standard
- ANSI/TIA-568.2 - Balanced Twisted-Pair Telecommunications Cabling and Components Standard
- ANSI/TIA-568.3 Optical Fiber Cabling and Components Standard
- ANSI/TIA-607-D Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises.
- BICSI TDMM 14th Edition
- The Lighting Handbook, Illuminating Engineering Society (IES), 10th edition
- CAN/ULC-S524-19 - Standard for the Installation of Fire Alarm Systems
- CAN/ULC-S536:2019 – Standard for Inspection and Testing of Fire Alarms
- Toronto Green Standard Version 4
- Toronto Hydro Requirements for the Design and Construction of Customer-Owned High Voltage Substations
- IEEE-80-2013 Guide for Safety in AC Substation Grounding

4.4 Utilities

4.4.1 Power Distribution Network

Connection to local power distribution network is under the jurisdiction of Toronto Hydro, therefore, all design and construction related to incoming electrical supply should be based on Toronto Hydro requirements. Point of demarcation is the property line and the design should cover route of the incoming service feeder in concrete encased duct bank from property line to the location of the medium voltage (MV) switchgear. The Toronto Hydro normal supply voltage is either 13.8kV or 27.6 kV depending on site location. The route of the incoming service should be based on ease of construction and least interference with building elements. The location of the MV switchgear should be chosen for the shortest distance and as straight a run of the duct bank as possible from the demarcation point to the MV switchgear. Feeder sizes should be based on load calculations provided during detail design phase.

4.4.2 Telecommunication Network

Connection to local telecommunication network is under the jurisdiction of local telecom service providers, e.g., Rogers & Bell. Accordingly, all design should be based on their requirements. Point of demarcation is the property line and design should cover route of the incoming service in concrete encased duct bank from property line to the location of the main Entrance Facility/Telecom Room. The route of the incoming service should be based on ease of construction, as straight a path as possible and shortest distance from the demarcation point to the EF. Entrance Facility, Equipment Room, Telecom Room and Telecom Closets should be located and sized in accordance with BICSI TDMM.

4.5 Power Distribution

4.5.1 Distribution Voltage

Power distribution system should be designed based on following criteria:

- Provide 347/600V, 3 phase, 4-wire for larger electrical and mechanical loads.
- Provide 120/208V, 3 phase, 4-wire for power to smaller loads, receptacles communications equipment, fire alarm system, security system, etc.

4.5.2 Equipment

Equipment for power distribution should be sized based on the loads they service and spare capacity for future loads. The location of the electrical equipment should be in the main electrical room, transformer/switchgear room, low voltage (LV) electrical room and electrical/telecom riser closets.

Power distribution equipment consists of the following elements:

<u>Switchgear</u> – location in the main electrical room or in transformer room. Size should be based on Toronto Hydro requirements, type of connection of the incoming service feeder and type of system available on specific site.

<u>Main Transformer</u> – should be dry type, three-phase delta/wye, 347/600V secondary for larger buildings where 347/600V supply is required for mechanical loads or 120/208V secondary for smaller buildings where there is no issue of voltage drop. Locate main transformer in main electrical room or in transformer/switchgear room.

<u>LV switchboard</u> - locate in the main electrical room or LV electrical room.

<u>Distribution panels and other LV equipment</u> - should be located in LV electrical rooms and in riser closets.

4.5.3 Electrical Rooms, Risers, and Closets

Electrical rooms, risers, and closets should be designed as per relevant codes, standards, and industry practice. Locations of the main electrical room and switchgear/transformer room are dictated by Toronto Hydro requirements and location of the available incoming service feeder as shown on services plan. The main service entrance facility (main electrical, transformer or switchgear room) may be above grade or on Level B1 as per available space and agreement with Toronto Hydro. Design of the main electrical room, transformer or switchgear room which will accommodate MV switchgear, transformers and the other related electrical equipment should be based on the latest revision of the document: “Toronto Hydro Requirements for the Design and Construction of Customer-owned High Voltage Substations”. During detail design phase all technical solutions which need to secure accessibility and maintainability of the room and the equipment must be coordinated, reviewed, and approved by Toronto Hydro. Where there are no ramps to underground levels the location of the main electrical room or switchgear room should be above grade for ease of accessibility and maintenance. LV electrical rooms may be located on lower levels. Where space is limited above grade, transformer or switchgear rooms may be designed to accommodate only switchgear and main transformer. The rest of the LV equipment can then be in LV rooms on lower levels.

For high-rise buildings over 20 stories high, additional LV electrical room on the Mechanical Penthouse level should be provided. As per Toronto Hydro requirements where the service entrance must be in such a location that underground cables cannot be pulled directly into the electrical room an acceptable cable pull room, or cable chamber should be provided to facilitate medium voltage cable installation.

For mixed use buildings (commercial & residential) or buildings comprising several occupancies, such as, commercial, residential, hospitality, recreational, healthcare, etc., design should include separate main electrical rooms for each occupancy.

The electrical risers should be provided in all buildings. Locations of riser closets should be coordinated with other services. Where space constraints exist, risers should be designed to share space for power and ICT cabling. Where power and ICT services share space, separation between such services should be maintained to mitigate electromagnetic interferences. Separation should be in accordance with BICSI TDMM requirements. Electrical closets should be designed to allow space for electrical panels and telecommunication panels installed on alternate floors. Size of riser closet to be determined by the size of equipment and required clearances.

Electrical demand load calculations are performed in accordance with watts per square meter and demand factors in Table 14 of the OESC (Table 4-1 of this report) and per best engineering practices based on similar construction projects. This calculation is preliminary and developed based on information available at this stage of concept design. The purpose of the calculation is not for sizing of services but only for space proofing for the electrical equipment. In coordination with architectural discipline up to 20% spare capacity has been included in sizing the rooms to accommodate the electrical equipment. A summary of electrical data based on electrical load calculation is shown in Table 4-2.

Detailed load calculation will be developed during detail design and the load schedule including lighting, mechanical, small power, ICT, and other loads will be validated as part of the detail design development.

Table 14 Watts per square metre and demand factors for services and feeders for various types of occupancy (See Rules 8-002 and 8-210.)			
Type of occupancy	Watts per square metre	Demand factor, %	
		Insulated service conductors or cables	Feeders
Store, restaurant	30	100	100
Office:			
First 930m2	50	90	100
All in excess of 930m2	50	70	90
Industrial and commercial	25	100	100
Church	10	100	100
Garage	10	100	100
Storage Warehouse	5	70	90
Theatre	30	75	95
Armouries and auditoriums	10	80	100
Banks	50	100	100
Barbershops and beauty parlours	30	90	100
Clubs	20	80	100
Courthouses	20	100	100
Lodges	15	80	100

Table 4-1. OESC Table 14

Station	Site	Building / Block	Electrical riser/Closet dimension (mm)	Electrical room location/type	Electrical room minimum space required (m2)	Total Electrical Load (kW)
Cosburn	North	Residential Tower	2450x480	Level B1/ Switchgear room	40	**1582.19**
				Level B1/LV Electrical room	90	
				MPH Level/LV Electrical room	20	
Cosburn	South	Residential Tower	2450x480	Level B1/ Switchgear room	40	**1636.95**
				Level B1/LV Electrical room	100	
				MPH Level/LV Electrical room	20	

Table 4-2. Electrical Data

4.5.4 Metering

Utility metering and sub-metering for units should be provided. Sub-meters for units should be located inside the electrical riser closets.

4.5.5 Voltage Drop

Voltage drop on main feeders and on branch circuit should not exceed the limits prescribed by the OESC.

4.5.6 Cable Management System

The primary system for the low voltage wiring will be cable in conduit. In areas where cable in conduit is not feasible, Teck Cable in tray may be used. All wiring to be run in conduits in slab, conduits in walls or conduits in ceiling space. Raceway criteria is as follows:

- Rigid galvanized steel (RGS) for exposed interior non-corrosive area
- PVC coated RGS conduits for corrosive environment
- Rigid PVC conduits direct buried as allowed by OESC
- Concrete encased PVC duct bank for medium voltage cables
- For fiber optic service entrance and backbone cable: Direct buried or concrete encased PVC conduit below grade and RGS inside the building
- Minimum conduit size should be 21mm

5 Description of TOC Design

5.1 General

Electrical and communications systems should be designed and installed to maximize usable space within the building while maintaining optimum service clearances for maintenance and repair.

5.2 Electrical Systems

5.2.1 Exterior and Interior Lighting

Interior lighting design should be based on illuminance levels for each area as recommended in the IES Lighting Handbook. Luminaire selection should be based on area being served. All interior lighting should be energy efficient LED type. Occupancy and vacancy sensors, daylight sensors, dimming modules and manual override switches to be used where appropriate. Exterior lighting design should be based on illuminance levels recommended in the IES Lighting Handbook. Exterior lighting should be controlled via a timer and by a photocell control. Exterior lighting to be LED with luminaires suitable for the environment. Emergency lighting should be unswitched and should be fed from the life safety lighting panel. Exit signs and signs that integrate egress components should be fed from the life safety lighting panel. Egress light levels should be in accordance with OBC requirements.

5.2.2 Grounding and Lightning Protection

The entire electrical installation consisting of non-current carrying metal parts (I.e., raceways, cable trays, panelboards, boxes, cabinets, fixtures, switches, transformers, equipment, etc.) should be completely and effectively grounded and bonded in accordance with OESC. A grounding system should be provided, including electrical room grounding and communications room grounding. A ground potential rise study should be conducted in accordance with IEEE-80 standard. The grounding system should be designed in accordance with the grounding study to control the touch and step potentials in the service entrance facility and/or the switchgear room as mandated by the OESC.

Provide ground grid comprising driven ground rods, spaced per the grounding study, connected together with bare stranded copper conductor, and installed in conformance to IEEE-80 standard. Connect main service entrance equipment to the ground grid. Ground grid may be installed exterior to the building or inside the main switchgear room. The ground rods should be Copper-clad 19mm in diameter, 3m long.

Carry out risk assessment of loss due to lightning strike. Based on the results of the risk assessment provide lightning protection system for the building. The lightning protection system should be designed in accordance with CSA B72:20 standard.

Grounding and bonding for the information and communications technology equipment in the building should be provided in accordance with ANSI/TIA-607 standard.

5.2.3 Emergency and Standby Power

An emergency power system should be provided to meet the requirements of CSA282:19 standard. Emergency Power System should provide automatic backup power in the event of normal power loss. The emergency and standby power should be provided for life safety equipment and essential loads. Life safety equipment includes egress lighting, emergency lighting, smoke evacuation system, fire alarm system, fire pump(s), elevators. The essential loads include: the UPSs and HVAC units serving service rooms with security, control, and telecommunication equipment. Standby emergency generators should be natural gas engine driven and should have gas supply completely separate from gas supply for the rest of the building. The generator should be located in generator room on the roof, outdoor on the roof or on ground at grade level if space permits. Size of the generator room should be designed based on the generator size, necessary clearances and space needed to accommodate associated mechanical and electrical equipment. Space for outdoor generators should be provided based on generator dimensions with enclosure included. Generator enclosure should be weatherproof with sound attenuation in compliance with the City Bylaws. Location for generator rooms and outdoor generators should meet the conditions for easy accessibility and maintenance. Installation of generators on MPH or roof level will be by using a crane. Future operational space for the crane needs to be considered by the architectural team. At this stage we are providing high-level estimate sizes of generators based on our load estimate calculation. Detailed load classification and accurate sizing of generators should be developed during detail design and further space development of the space needed should follow. For mixed use buildings or buildings comprising multiple occupancies, separate generators may be provided for each occupancy. The selected generator sizes with minimum space required are shown in Table 5-1.

Station	Site	Building / Block	Type	Location	Minimum space required (m^2)	Size of Generator (kVA/kW)
Cosburn	North	Residential Tower	Gas/outdoor	Roof	35	**625/500**
Cosburn	South	Residential Tower	Gas/outdoor	Roof	35	**625/500**

Table 5-1. Emergency Generator Selection

5.2.4 Fire Alarm System

Fire detection and alarm system should be provided in accordance with CAN/ULC-S524 Standard for the Installation of Fire Alarm System. Fire alarm system should be verified in accordance with CAN/ULC-S536 standard. The building Fire Alarm panel should be interconnected with Fire Alarm panel of the adjacent transit Station.

5.2.5 Security System

Provide access control system (Security System) for each building. Access control and intrusion detection devices should be provided at all critical locations. Power supplied to the security systems should be provided from a UPS panel in the LV Electrical Room. A separate conduit system should be provided for security devices. Control panels will be located in the security room and fed from UPS power.

5.2.6 CCTV System

CCTV camera coverage should be provided for all critical areas. Camera communication cables should use a separate raceway system with Category 6 (Cat6) copper cable. Generally, a Cat6 cable will be adequate for a cable run of up to 90 m. If longer runs are required, provide 1GB/s “Gamechanger” Cat6 cable from Paige Datacom Solutions to increase cable run up to 200m. For cable runs in excess of 200m provide multi-mode fiber optic cable. For outdoor installations provide cameras with weatherproof housing with heater in the housing for condensation control. Power over Ethernet (PoE) may not be sufficient for the heaters, as such, 120VAC power may be required for such heaters. All headend monitoring and control equipment should be fed from UPS power and located in the security room.

5.2.7 Communications

The communications service will enter the communications entrance facility which is the telecom room at Level B1 via a concrete encased duct bank containing one 103 mm duct for fiber optic cable and one 103 mm duct for multiconductor copper cable. The service provider company (e.g., Bell, Rogers) will provide the service to the EF. From EF the cables need to transition to the combined Electrical and Telecom Closets on the upper levels. Provide equipment for terminating and distributing the cables. All rooms containing communications equipment should be designed in accordance with BICSI TDMM. Provide equipment racks, distribution racks, patch panels, cable management infrastructure, provision for cooling, power supply from a UPS, lighting, security access and fire alarm devices connected to the building fire alarm system. Grounding and bonding of communications systems should be provided in accordance with ANSI/TIA-607 standard and in accordance with BICSI TDMM.

5.2.8 Service rooms

Provide monitoring and control headend equipment and fire alarm system control panel in a separate room located on the ground floor level. The control and fire alarm equipment should be located in a dedicated Central Alarm and Control Facility room. The CACF room should be located on ground level to accommodate elevator’s control equipment and Fire Alarm control equipment. The Minimum size of CACF should be $10m^2$.

6 Station and TOC Interfaces

6.1 Electrical Interfaces

The electrical and communication systems of the TOC will be separate from the station. However, the lightning protection system of the TOC should be integrated with the station's lighting protection system using externally accessible connection points in the station building. These connection points should be provided as a provision during installation of the lightning protection system of station building to allow possible future upgrade for TOC lightning protection system.

The Fire Alarm system of the TOC should be interconnected with the Fire Alarm system of the station.

6.2 Construction Constraints

The Cosburn TOC is located in a medium density Toronto neighbourhood, bordered by one major arterial road: Pape Ave and one minor arterial road: Cosburn Ave. Major equipment delivery route, replacement access route and pipework connection to civil network should minimize the impacts toward the roads and the operation of the station.