3.0 URD DESIGN GUIDELINES

3.1 Overview of ATCO's Electricity URD System Design

The power supply to all single lot underground residential services is through front lot service. Single phase transformers are connected to secondary pedestals, which in turn provide the connection to the residential service. The secondary design provides looping of the secondary conductors between the service pedestals. This allows more efficient and responsive restoration of service to customers in the event of an outage.

Appendix C, Drawings C.1.2A and C.1.2B illustrate a typical front lot service with the subdivision primary and secondary pedestal cable and secondary service cable connections. The supply is at 120/240 volts.

Note: For Single Family Dwellings, with the exception of commercial customers fed from a separate transformer, all secondary services are served from a secondary pedestal connected to a transformer.

3.2 Landscaping Adjacent to Underground Electrical Equipment

Before commencing the design of a URD system, the Developer and/or its agent(s) must confirm landscaping plans for all vegetation in the area with the Municipal Authority (see Appendix D, for drawing details).

3.3 URD Design

This section outlines the responsibilities and standards for design of an underground electrical distribution development within a neighborhood or major subdivision. It is intended to assist the Developer and/or its agent(s) in preliminary design discussions with ATCO's Engineering Representative.

3.3.1 Design Responsibilities

ATCO is responsible for planning and designing the express and source primary feeders which supply a URD. In addition, ATCO is responsible for

the planning, design, construction, installation and termination of three phase switch cubicle facilities.

ATCO's Electricity Engineering Representative will, at the request of the Developer and/or its agent(s), provide:

a) information on the switch cubicle requirements (dimensions, schedule, and locations); and

b) the System Planning Study for the development area.

Appendix D, Drawing D.2.4 is a schematic representation of the facilities ATCO and the Developer are each responsible to provide and install.

3.3.2 Design Standards

All underground electrical distribution facilities must be designed in accordance with ATCO's standards as outlined in this specifications document. Adherence to the planning and design standards ensures ATCO can maintain the required service levels.

3.3.2.1 Primary System Design

The design proposed by the Developer and/or its agent(s) must incorporate the system planning study for the development area provided by ATCO.

Subdivision development may proceed in several phases and time frames. As such, arrangements for temporary looping and/or extension to future phases must be considered. Decisions regarding the system configuration at the boundary limits must be discussed with ATCO's Engineering Representative prior to design submission. Options to be considered include:

a) creation of a temporary underground loop by parking the elbows at the two padmount transformers nearest to the stage limit and/or;

b) creation of a temporary overhead loop;

c) installation of ducts to the development boundary; and,

d) placement of padmount transformers at the development boundaries.

Note: Designs for a URD shall minimize splices wherever possible. **There should be no splices within the boundary of any project.** Each unnecessary splice introduces another element which can fail and degrade the performance of the system.

3.3.2.2 Secondary System Design

The design proposed by the Developer and/or its agent(s) must include secondary looping between pedestals (see Appendix C, Drawing C.1.2A). In the event of a secondary system failure, each pedestal must have an alternate source of supply.

3.3.2.3 Street Light Design

The Roadway Authority (typically the Municipality) will dictate the roadway lighting requirements. Refer to the Municipality's most recent guidelines.

The Developer and/or its agent(s), unless directed otherwise by the governing authority, shall utilize the "Guide for the Design of Roadway Lighting" published by Transportation Association of Canada (TAC) 2006, as the **minimum requirement** for the design of safe roadway lighting.

The Developer and/or its agent(s) must confirm the roadway classifications with the Roadway Authority before submitting any detailed engineering design. Street lighting design calculations and documentation

must be submitted for ATCO's acceptance at design review; the minimum requirements are described in Section 3.5.6. A sample of inputs and calculations utilizing AGI 32 is provided in Appendix C, Document C.1.5.

All designs must be based on a uniform tilt of zero degrees (0^o) parallel to the road surface. In residential areas, streetlights should be placed on lot lines, where practical. In subdivisions with curved roads and irregular lot sizes, alternate locations may have to be determined to meet lighting requirements. A streetlight may be fed from either a transformer or a pedestal.

See Appendix D, Drawings D.7.1, and D.7.2 for streetlight alignment details.

3.4 Performance Requirements

3.4.1 Grounding

The Consulting Engineer is responsible for ensuring all the requirements of the grounding system meet ATCO's standards (see Appendix B, All E Drawings).

3.4.2 Voltage Drop

The Consulting Engineer shall use the voltage drop calculator provided on ATCO's website (see Appendix C, Report C.1.4 for Sample Voltage Calculation Report) to ensure:

a) the voltage drop from the transformer secondary to all customer meters shall not exceed 3%; and,

b) during a single contingency situation (i.e., the loss of a single phase padmount transformer, a subdivision primary feeder, etc.), the voltage drop from the transformer secondary to all customer meters shall not exceed 7.5%.

3.4.3 Transformer Loading

Tables 3.1, 3.2 and 3.3 identify the maximum number of 100 amp, 200 amp or a combination of 100/200 amp customers (services) that can normally be supplied from ATCO's standard single phase 14.4kV – 120/240V (nominal) rated primary and secondary loop-feed transformers to maintain the voltage within the limits identified in Section 3.4.2.

The number of services that can be supplied may be limited by size restrictions of the secondary compartments and/or the allowable secondary power cable voltage drop. ALL designs and calculations submitted must meet voltage and loading requirements.

Table 3.1 - Maximum Number of 100 A Services Supplied by Padmount Transformers

Transformer Size	100 A Services
50kVA	16
75kVA	24
100kVA	31

Table 3.2 - Maximum Number of 200 A Services Supplied by Padmount Transformers

Transformer Size	200 A Services
50kVA	8
75kVA	12
100kVA	15

Table 3.3 - Maximum Number of a Combination of 100 A and 200 A Services Supplied by Padmount Transformers

Transformer Size	100 A Services	200 A Services
50kVA	12	2
75kVA	16	4

100kVA	22	8

3.5 Design Detail

3.5.1 Cable Trench Alignments/Depths

Standard alignments and trenching specifications for underground power and other joint-use facilities are generally defined by the Municipal Authority. It is the responsibility of the Developer and/or its agent(s) to obtain the most current version of the Municipal Standards. Any deviations to the standard vertical or horizontal trench details must be approved by ATCO's Engineering Representative prior to design submission. Refer to the following drawings in Appendix B and D for details:

One Party Trenching details – See Appendix B, Drawings U1, U2, U3, U3A, U4, and U4A

Two or Three Party Trenching details – See Appendix B, Drawings U5 and U6

Four Party Trenching details – See Appendix B, Drawing U7

Alignment details – See all Appendix. D Drawings

Road Crossing Installation details – See Appendix D, Drawing D.2.1

Clearances to other facilities details—See Appendix D, Drawing D.1.0

3.5.1.1 Service Entry Trench to Lot

There are two options for service entries for Single Family Dwellings: service boxes OR meter pedestals/meter posts.

The first option for Single Family Dwellings is a service box with stakes to be installed as per Appendix D, Drawing D.5.1 Service boxes must be installed on the non-driveway side of the lot.

For Multiple Family Dwellings, service boxes are not typically required as the secondary cables shall be stubbed a minimum of 1.5m from the building's foundation as per the Customer Metering and Services Guide (Townhouse Multi-Metering section 3.1.7). Which can be found on the ATCO Electric's Website

3.5.2 Primary and Secondary Cables

3.5.2.1 Primary Cables

The only acceptable cable to be used for subdivision primary service is:

1/C – #1 AWG TRXLPE compact aluminum strand 60% Cu concentric neutral

See Appendix E, Drawing E.1 for the primary cable information.

3.5.2.2 Secondary and Service Drop Cables

The following cables are to be used for secondary service:

2/C - #2 600V aluminum conductor jacketed type USEB90 reduced #6 Cu concentric neutral

2/C – 4/0 600V aluminum conductor jacketed type USEB90 reduced #1 Cu concentric neutral

2/C – 300 MCM 600V aluminum conductor type USEB90 full size 300 MCM Cu concentric neutral

See Appendix E, Drawing E.2 for the secondary cable information.

For Single Family Dwelling services, the service cable coiled inside the service box shall be three quarters of the lot length.

For Multiple Family Dwelling Services, the service conductor shall be 2/C – 300 MCM Aluminium. Developers shall be responsible for trench and installation of secondary conductors up the multi-meter junction box as per the Customer Metering and Services Guide (Townhouse Multi-Metering section 3.1.7). Which can be found on the ATCO Electric's Website

3.5.3 Switch Cubicles

If a switch cubicle is required, the Developer and/or its agent(s) are responsible to propose a final location to be approved by ATCO's Engineering Representative.

The switch cubicle must be located a minimum distance of 3.0m from the curb, and an 8.0m x 8.0m easement is required. If necessary, the Developer and/or its agent(s) will provide ATCO with the easement.

Note: Due to the size of the switch cubicles, they limit the line of site at intersections and should not be installed at these locations. In addition, the distance from the curb must take into consideration the size and location of the base ground grid, which extends 0.5m to 2.3m beyond the boundary of the switch cubicle (see Appendix B, Drawings E22, E23, E24 and E25)

3.5.4 Padmount Transformers and Secondary Pedestals

3.5.4.1 Installation

For the purposes of these specifications, padmount transformers will be single-phase, 14.4kV – 120/240V (nominal) rated primary and secondary, loop-feed transformers, and three-phase, 25kV – 120/208V or 347/600V (nominal) rated primary and secondary, loop-feed transformers.

For Single Family Dwellings, services shall be fed directly from a secondary pedestal.
For Multiple Family Dwellings, services will be fed directly from the transformer; a secondary pedestal is not required.

Padmount transformers are to be installed as follows:

a) The transformers must be mounted on pre-cast bases located at intersecting lot lines and coordinated with other facilities

located on the street so as not to encumber both lot lines of any residential family zoned lot.

b) The pre-cast base, where possible, should be located 0.5m from easement on a boulevard, or 0.5m from the edge of the trench, but only if the required ground grid will not be under existing or proposed sidewalks, curbs, roadways, and other known structures or on private property. If such a conflict exists; the pre-cast base must be shifted to allow for the ground grid installation. The Developer and/or its agent(s) are responsible to provide the required alignments (see Appendix D, Drawing D.3.1)

c) Transformers must:

i. not be installed onto pie-shape properties inside a cul-de-sac.
ii. not be set less than 6.0m from a cut corner.
iii. not be located within 1.0m from any other utilities above ground facilities and less than a 2.0m clearance to bus stops.
iv. not be set in a sidewalk.
v. not be placed on the driveway side of a lot; or
vi. be positioned so its access lid/door faces the roadway.
vii. Not to be placed in ditch bottoms in rural applications

Secondary Pedestals are to be installed as follows:

a) When installing pedestals, it is recommended to pair pedestals with streetlights to minimize facility locations and the visual impact to lot owners.

b) When the pedestal is parallel to the road, the pedestal door faces the house; this includes pedestal/transformer combinations and streetlight/pedestal combinations.

c) When the pedestal is placed perpendicular to the road surface, the door shall be positioned so that the worker is facing oncoming traffic when accessing the pedestal.

d) The pedestal must not be placed on the driveway side of a lot (If this cannot be avoided, ATCO's Engineering Representative should be consulted).

See Appendix D, Drawings D.1.0, D.2.1, D.3.1, D.3.2 D.7.1, D.7.2, and D.7.9, for transformer and pedestal alignment, orientation and clearance details.

3.5.4.2 Equipment Identification

The circuit and equipment identification and tagging requirements on the engineering drawings must match the identification and tags on the cables and equipment installed (see Appendix B, Drawing H9).

3.5.4.3 Grounding

The Developer and/or its agent(s) are responsible, as part of the overall installation of the URD system, to complete the design, installation and interconnection of the grounding facilities at each piece of equipment (padmount transformer, secondary pedestal, streetlight, etc.) as per Drawings in Appendix B The grounding materials must meet the requirements of Appendix E.5.

All conductive above-ground facilities (e.g., metal guard posts or bollards, stand-alone cable TV and communication pedestals, metering pedestals, etc.) within 3.0m of any electric utility facilities shall be bonded to the electric utility facilities' ground grid.

3.5.5 Primary Fusing

ATCO will complete the primary fuse coordination at the switch cubicle and supply the required on-site fuse units.

3.5.6 Street Lighting

3.5.6.1 Installation

The streetlight is to be positioned as follows:

- Single Davit: Where possible, the access door is to be positioned so that the employee is facing oncoming traffic when working in the light standard.
- Double Davit installed on an island: The door is to be installed parallel to the road so that the employee has visibility of approaching traffic from either direction when working in the standard.

3.5.6.2 Standard Luminaires

For residential street lighting, the standard davit pole is 9.0 m in height, and the davit arm is 2.0 m in length. (See Drawing in Appendix B) If other davit poles or davit arms are required, please contact ATCO's Engineering Representative.

See Appendix B, X Drawings for the standard lamps for subdivisions, for LED Streetlight options.

3.5.6.3 Photometric Files

A standard AGI 32 template will be available upon request from ATCO's Engineering Representative.

Contractors not using AGI 32 are required to modify the photometric files to match the standard luminaires in Section 3.5.6.2. These files are also available upon request from ATCO's Engineering Representative.

3.5.6.4 Design Task and Calculation Type

The following table specifies the standard calculation type for each design task:

Table 3.4: Standard Calculation Type

Design Task	Calculation Type
Straight Roadways	Luminance
Curved Roadways and Interchanges	Illuminance
Cul-de-Sacs	Illuminance
Sidewalks	Illuminance
Intersections	Illuminance
Crosswalks	Illuminance
Roundabouts	Illuminance

For residential subdivisions, ATCO requires calculations to be done on roadways and interchanges (straight and curved), cul-de-sacs, intersections and roundabouts. Sidewalks and crosswalks are not required unless otherwise specified or required by the Roadway Authority

3.5.6.5 Calculation Grids

Separate calculation grids are required when the design task changes. This section discusses the grid settings required for each design task.

3.5.6.5.1 Roadways and Interchanges

a) The calculation grid shall cover the entire road surface (curb-to-curb) unless the Roadway Authority states otherwise. It shall start and finish at a luminaire with all luminaires within the section covered in between.

b) The left-to-right spacing between grid points is equal to the narrowest spacing between two luminaires in that section divided by 10, but may not exceed 5.0 m. The top-to-bottom points should be placed along the ¼ point of the lane width for straight roads, and 2.0 m apart for curved roads.

c) Symmetrical spacing (staggered, opposite, and median lighting) requires calculation for all lanes in a single direction of travel. For single-sided spacing with two-way traffic (divided by a yellow line or a median), a separate calculation should be undertaken for the lane(s) in each direction of travel. The worst case luminance/illuminance and uniformity ratio for either direction shall take precedence.

d) Curved roads with less than five degrees (5^{o}) curve shall be treated as straight roads, and luminance calculation type shall be applied.

3.5.6.5.2 Cul-de-Sacs, Intersections and Roundabouts

The grid points should be placed 2.0 m apart and take the shape of the area. The boundaries are determined by the end of curb return or cut corner.

3.5.6.5.3 Sidewalks (If Required)

Horizontal calculations for sidewalks should include a single line of grid points on the centreline of the sidewalk using the same grid as used for the roadway. If the sidewalk is over 2.0 m wide, additional rows of equally spaced grid points will be required. In all cases, each grid line should not be more than 1.0 m from the edge of the walkway. The horizontal grid should be at the surface grade of the sidewalk.

The vertical illuminance values should be calculated at a height of 1.5 m in the two directions parallel to the main pedestrian flow, along the centreline of the sidewalk using the roadway longitudinal grid, but not including grid points under the luminaires.

3.5.6.5.4 Crosswalks (If Required)

The calculation grid within the crosswalk is required on a vertical plane across the roadway at a height of 1.5 m, with calculation points spaced at 0.5m. Only a single line of calculation point is required. This calculation line should be centred in the crosswalk and extend from the curb line to the centreline of the roadway. The calculation direction should be towards the approaching driver. For intersection with multiple crosswalks, each crosswalk should be calculated separately.