February 21, 2023

via RESS

Ms. Nancy Marconi
Registrar
Ontario Energy Board
2300 Yonge Street
P.O. Box 2319
Suite 2700
Toronto, ON M4P 1E4
Email: Boardsec@oeb.ca

Dear Ms. Marconi:

Re : EB-2022-0024 – Elexicon Energy Inc. ("Elexicon") ICM Application (the "Application"): Phase 2 Responses to OEB Panel Questions

Pursuant to the provisions established in Procedural Order No. 4 ("P.O. #4"), issued on February 8, 2023, Elexicon is filing its responses to Additional Question #1 provided in P.O. #4, and responses to the additional four OEB Panel questions issued on February 10, 2023.

All of the responses and live Microsoft Excel models have been filed through the OEB's web portal ("RESS") and include the following:

- EE_PO4_Panel Responses_C-5-Yr DCF Model Calculation Results
- EE_PO4_Panel Responses_C-10-Yr DCF Model Calculation Results
- EE_PO4_Panel Responses_C-15-Yr DCF Model Calculation Results
- EE_PO4_Panel Responses_C-20-Yr DCF Model Calculation Results
- EE_PO4_Panel Responses_D-5-Yr DCF Model Calculation Results – Single 27.6 kV Pole Design
- EE_PO4_Panel Responses_D-10-Yr DCF Model Calculation Results – Single 27.6 kV Pole Design
- EE_PO4_Panel Responses_D-15-Yr DCF Model Calculation Results – Single 27.6 kV Pole Design
- EE_PO4_Panel Responses_D-20-Yr DCF Model Calculation Results – Single 27.6 kV Pole Design

Stephen Vetsis
Vice President Regulatory Affairs & Stakeholder Relations
Elexicon Energy Inc.

cc: John Vellone

Elexicon Energy Inc.

Answer to OEB Commissioner's Questions

Additional Question #1:

Does Elexicon Energy forecast that its return on equity in 2022, 2023, 2024 or 2025 will exceed 300 basis points over the 2023 deemed return on equity approved by the OEB? Please explain.

Response:

Elexicon confirms that its forecasted return on equity in 2022, 2023, 2024 and 2025 will not exceed 300 basis points over the 2023 deemed return on equity approved by the OEB.

Elexicon Energy Inc.

Answer to OEB Commissioner's Questions

OEB Panel-1:

Ref 1: Appendix B-2 – Sustainable Brooklin Business Case

Ref 2: Interrogatory Staff-12 d), Attachment 1

Please provide a map clearly illustrating options 1, 3 and 4 in Appendix B-2 commencing at the Whitby TS that includes major roads in the area, existing and proposed feeders and voltages, the step-down equipment location, and the location of the Sustainable Brooklin project (Phase 2) as illustrated in reference 2. Please clearly illustrate the existing distribution circuits by kV size and options 1, 3 and 4 in separate colours."

Response:

Option 1: Build two 27.6kV feeders and the associated assets from the last two available breakers at Whitby transformer station ("TS") all the way to the intersection of Columbus Road West and Ashburn Road. The total distance of one feeder is about 10 km. There is currently no pole line on Lake Ridge Road from the Whitby TS to Highway 7/Winchester Road, Elexicon has a three phase 8.32kV circuit from Highway 7 to Highway 407 and three phase 13.8kV circuit from Coronation Road to Ashburn Road.

See Attachment 1 accompanying this response for a map illustrating this option.

Option 3: Build a new TS at the intersection of Seventh Concession Road and Lake Ridge where the Hydro One circuit P15C crosses the intersection. A new TS will have to be included in the next Regional Infrastructure Plan, which will need to be initiated by a Needs Assessment, a Scoping Assessment, then added to the next Integrated Regional Resource Plan, and the Regional Infrastructure Plan. The transmission circuit P15C is being considered for an End-of-Life study by the IESO and may not be ready to accept new load until 2029-2030. Building a TS may take up to 7 years to complete considering all required planning, design and approvals, environmental study, municipal and planning approvals. It is difficult to justify a new TS while capacity is available at the Whitby TS and the cost of a new TS plus the feeders exceeds the option adopted.

See Attachment 2 accompanying this response for a map illustrating this option.

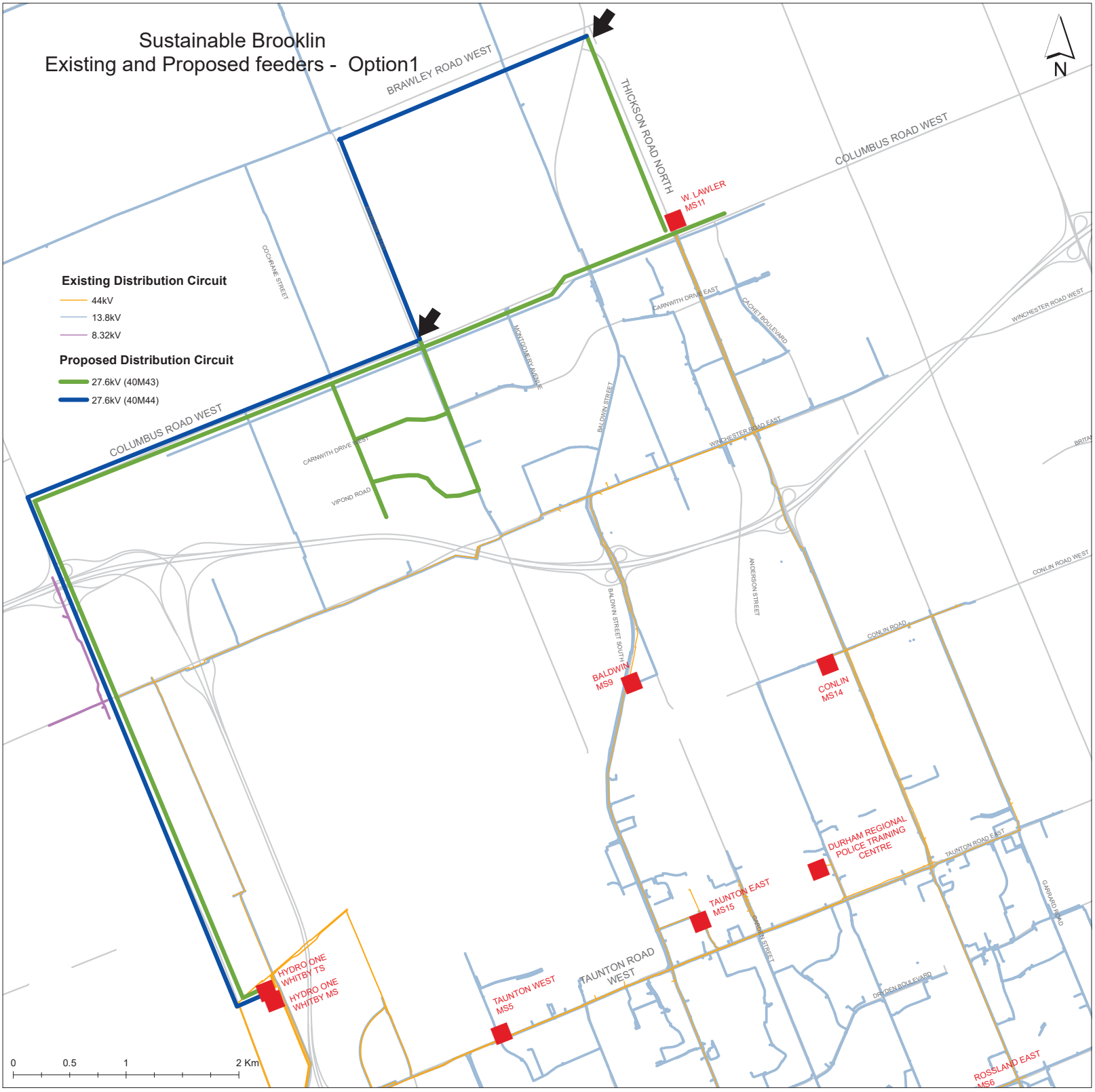
Option 4: The existing 44kV infrastructure in the area has reached its maximum capacity, and we is very limited to the amount of load that can be transferred between north Whitby and south Whitby without very large investments. The existing 13.8kV stations in the area cannot supply the new developments because of the 44kV limitation, in addition to this step-down 44kV to 13.8kV stations will have to be built to supply residential customers which may cost an additional $9M per station. See answer to OEB Panel-2 question g) for more details on why 44kV voltage was selected to supply power to commercial and industrial customers south of highway 407.

See Attachment 3 accompanying this response for a map illustrating this option.

OEB PANEL – 1

ATTACHMENT 1

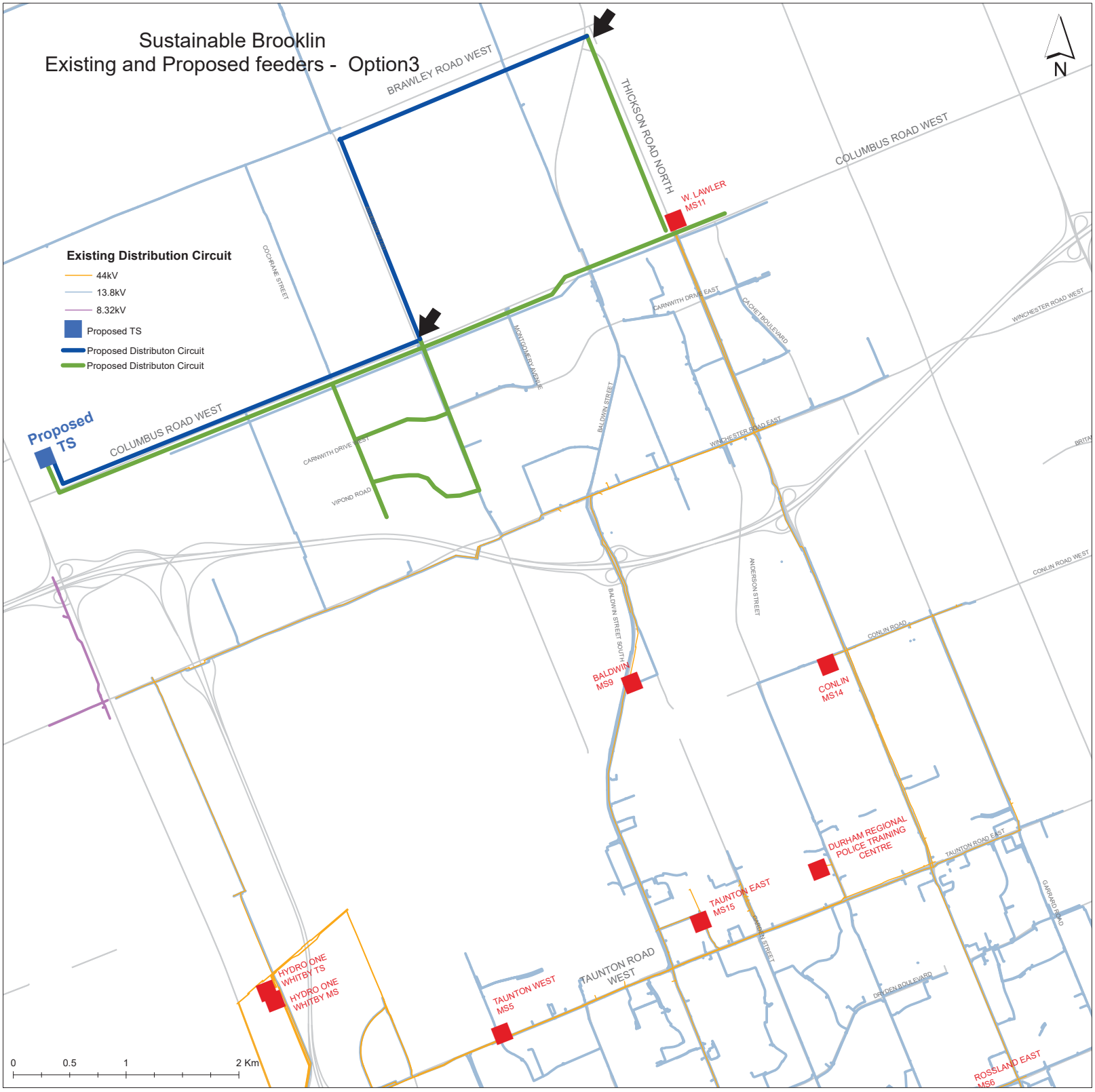
MAP ILLUSTRATING OPTION 1


Sustainable Brooklin
Existing and Proposed feeders - Option1
N
Existing Distribution Circuit
44kV
13.8kV
8.32kV
Proposed Distribution Circuit
27.6kV (40M43)
27.6kV (40M44)
BRAWLEY ROAD WEST
THICKSON ROAD NORTH
COLUMBUS ROAD WEST
W. LAWLER MS11
COCHRANE STREET
CARNWITH DRIVE EAST
CACHET BOULEVARD
WINCHESTER ROAD WEST
MONTGOMERY AVENUE
BALDWIN STREET
VIPOND ROAD
WINCHESTER ROAD EAST
ANDERSON STREET
CONLIN ROAD WEST
CONLIN ROAD
BALDWIN STREET SOUTH
BALDWIN MS9
CONLIN MS14
DURHAM REGIONAL POLICE TRAINING CENTRE
TAUNTON ROAD EAST
TAUNTON EAST MS15
GARRARD ROAD
DRYDEN BOULEVARD
HYDRO ONE WHITBY TS
HYDRO ONE WHITBY MS
TAUNTON WEST MS5
TAUNTON ROAD WEST
ROSSLAND EAST MS6
0
0.5
1
2 Km

OEB PANEL – 1

ATTACHMENT 2

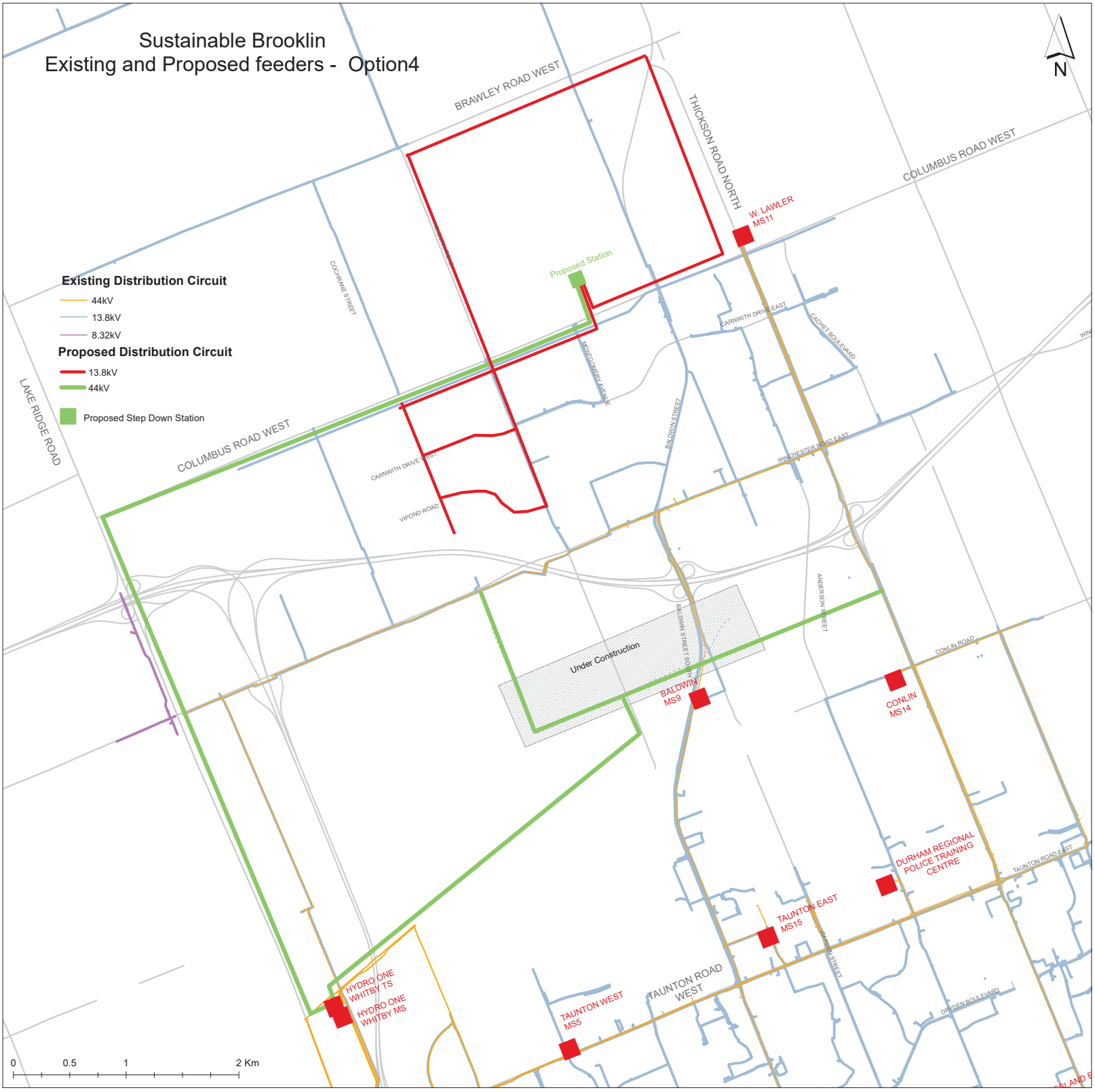
MAP ILLUSTRATING OPTION 3


Sustainable Brooklin
Existing and Proposed feeders - Option3
N
Existing Distribution Circuit
44kV
13.8kV
8.32kV
Proposed TS
Proposed Distributon Circuit
Proposed Distributon Circuit
Proposed TS
BRAWLEY ROAD WEST
THICKSON ROAD NORTH
COLUMBUS ROAD WEST
W. LAWLER MS11
COLUMBUS ROAD WEST
COCHRANE STREET
MONTGOMERY AVENUE
BALDWIN STREET
CARNWITH DRIVE EAST
CACHET BOULEVARD
WINCHESTER ROAD WEST
CARNWITH DRIVE WEST
VIPOND ROAD
WINCHESTER ROAD EAST
ANDERSON STREET
BALDWIN STREET SOUTH
BALDWIN MS9
CONLIN ROAD WEST
CONLIN ROAD
CONLIN MS14
DURHAM REGIONAL POLICE TRAINING CENTRE
TAUNTON ROAD EAST
TAUNTON EAST MS15
GARRARD ROAD
DRYDEN BOULEVARD
HYDRO ONE WHITBY TS
HYDRO ONE WHITBY MS
TAUNTON WEST MS5
TAUNTON ROAD WEST
ROSSLAND EAST MS6
0
0.5
1
2 Km

OEB PANEL – 1

ATTACHMENT 3

MAP ILLUSTRATING OPTION 4


Sustainable Brooklin
Existing and Proposed feeders - Option4
N
Existing Distribution Circuit
44kV
13.8kV
8.32kV
Proposed Distribution Circuit
13.8kV
44kV
Proposed Step Down Station
Proposed Station
BRAWLEY ROAD WEST
THICKSON ROAD NORTH
COLUMBUS ROAD WEST
LAKE RIDGE ROAD
COCHRANE STREET
MONTGOMERY AVENUE
BALDWIN STREET
CARNWITH DRIVE EAST
CARNWITH DRIVE WEST
CACHET BOULEVARD
WINCHESTER ROAD EAST
VIPOND ROAD
ANDERSON STREET
CONLIN ROAD
TAUNTON ROAD EAST
TAUNTON ROAD WEST
DRYDEN BOULEVARD
Under Construction
W. LAWLER MS11
BALDWIN MS9
CONLIN MS14
DURHAM REGIONAL POLICE TRAINING CENTRE
TAUNTON EAST MS15
TAUNTON WEST MS5
HYDRO ONE WHITBY TS
HYDRO ONE WHITBY MS
0
0.5
1
2 Km

Elexicon Energy Inc.

Answer to OEB Commissioner's Questions

OEB Panel-2

Ref 1: Appendix B-2 – Sustainable Brooklin Business Case

Ref 2: Technical Conference 1 -Transcript page 159

Ref 2: Interrogatory Staff-12 d), Attachment 1

Ref 3: Interrogatory Staff-13

Preamble:

Appendix B-2 commencing at page 18 provides 4 options of which options 1, 3 and 4 consist of different facility configurations.

Appendix B-2, Figure 1, page 6 illustrates the location of each of the proposed two new 27.6 kV circuits in option 1. Notes 1, 2, 3, and 4 indicate that the 27.6 kV feeder denoted in green will replace existing poles. Note 6 indicates that a portion of the 27.6 kV circuit denoted in blue will replace existing poles.

a) Who developed the cost estimate for the ICM funding request for Phase 1 of the Sustainable Brooklin project? If Elexicon Energy did not develop the cost estimate, please confirm that the cost estimate was performed in accordance with safety, accounting, and engineering specifications provided by Elexicon Energy. Please reference the answer provided at transcript page 159.

b) When was the Class 4 cost estimate for option 1 (two 27.6 kV feeders) developed? Given the proposed construction timeline and Q3 2023 energization date, please confirm that Elexicon Energy's position is that the Class 4 cost estimate is the best cost estimate for approving ICM funding and assessing prudence of actual costs at the time of rebasing.

c) Please provide the cost and distances of both the overhead and underground portions of option 1 shown in Table 1 response to Staff-13 were Elexicon Energy to construct only a single pole with two 27.6 kV feeders shown in blue in Appendix B-2, Figure 1. Also, as part of the cost and distance estimates for the overhead portion of the feeder please indicate the cost and distance for replacement of poles and existing kV circuit proposed to be attached to the replacement pole. For example, will the section of replacement poles in note 5 have a new 27.6 kV and 13.8 kV circuit be attached to the same section of replacement poles or is the existing 13.8 kV circuit being transferred to the new 27.6 kV pole?

d) Please provide the cost and distances of both the overhead and underground portions of option 1 shown in the Table 1 response to Staff-13 if Elexicon Energy to initially construct only a single pole with two 27.6 kV feeders shown in green in Appendix B-2, Figure 1. Also, please indicate the comparable cost and distances for replacement of poles and existing kV circuit proposed to be attached to the replacement pole. For example, will the section of replacement poles in notes 1, 2, 3 and 4 have a new 27.6 kV and 13.8 kV circuit attached to the same section of replacement poles or is the existing 13.8kV circuit being transferred to the new 27.6 kV pole?

e) If Elexicon Energy were to initially build only a single 27.6 kV pole line, which would be preferable to build, the portion denoted in blue or green in Appendix B-2, Figure 1? Please explain.

f) Has Elexicon Energy considered a single 27.6 kV pole line design initially with the second 27.6 kV pole line subsequently added once a certain demand/number of houses have been built?

g) Elexicon Energy indicated that it rejected option 3, utilizing an existing 44 kV line reserved for commercial and industrial growth, to serve the Sustainable Brooklin project. Please provide a list of all contracted demand or forecast demand in 2023 and 2024 to be served by this 44 kV line and provide the remaining capacity to serve the Brooklin Landowners. Is Elexicon Energy indicating that it is uneconomic to step down the 44 kV line to 27.6 kV, to match the voltage of the proposed option 1?

Response:

a) The cost forecast is based on a design that Elexicon has reviewed and approved in accordance with its standards. The consultant working on behalf of the Brooklin Group coordinated with Elexicon's engineering team on all aspects related to the design and engineering of the project following Elexicon's standards and requirements. Elexicon can confirm that the cost estimate was performed in accordance with Elexicon's safety, accounting and engineering design standards.

b) The submitted Class 4 cost estimate was finalized May 2022. Elexicon confirms that the Class 4 cost estimate is the best cost estimate for approving ICM funding and assessing prudence of actual costs at the time of rebasing. Elexicon expects that the OEB will review the actual project cost in comparison to the project forecast it approves in this ICM application during Elexicon's next rebasing application. Elexicon's understanding is the OEB will review the following:

- Review of actual (audited) costs of ICM project.
- Explanation for material variances between actual and forecasted costs (and timing, if applicable).
- The OEB may determine if any over- or under-recovery of ICM rate riders should be refunded to or recovered from ratepayers.
- ICM capital assets reflected in new rate base based on January 1 actual Net Book Value.

c) This response is subject to and qualified by Elexicon's response to part (e) below. The blue line estimate below is for building a single pole line with two 27.6kV circuits, including the transfer of the existing 13.8kV circuits to the new poles.

Table 1 – Blue Line estimate

UG PORTION Location	Elexicon Estimate Distance [m]	Cable (Circuits)	Concrete duct	DUCT BANK /CABLE	cost	
Whitby TS to Egress of HONI ROW - UG	530	2	4x2	Ductbank with cable	$	1,590,000
Lakeridge- under tower line 1- UG	270	2	4x2	Ductbank with Cable	$	810,000
Lakeridge- under tower line 2- UG	160	2	4x2	Ductbank with Cable	$	480,000
Columbus (Country Lane to Ashburn)- UG	1800	2	4x2	Ductbank with Cable	$	5,400,000
SUB TOTAL					$	8,280,000
	Total length [m]	2760				
	Unit Cost	$ 3,000				

OH PORTION					
Location	Distance [m]	number of circuits	Number of Poles	cost	
Lakeridge - Between two Tower line- OH	720	2	18	$	795,000
Lakeridge - North of HONI ROW to South of HWY407- OH	2,650	2	60	$	2,695,000
Lakeridge - South of HWY 407 crossing to Columbus - OH	1,400	2	32	$	1,445,000
Columbus(from Lakeridge to Country Lane)- OH	2,000	2	45	$	2,045,000
SUB TOTAL				$	6,980,000
	Total Length	8,600			
	Unit Cost	$ 812			

d) This response is subject to and qualified by Elexicon's response to part (e) below. The green line estimate below is for building a single pole line with two 27.6kV circuits, including the transfer of the existing 13.8kV circuits to the new poles.

Table 2 – Green line estimate

UG PORTION Location	Elexicon Estimate Distance [m]	Cable (Circuits)	Concrete duct	DUCT BANK /CABLE	cost	
Whitby TS to Egress of HONI ROW - UG	530	2	1	Ductbank with cable	$	1,590,000
Lakeridge- under tower line 1- UG	270	2	1	Ductbank with Cable	$	810,000
Lakeridge- under tower line 2- UG	160	2	1	Ductbank with Cable	$	480,000
Columbus (Country Lane to Ashburn)- UG	1,800	2	1	Ductbank with Cable	$	1,800,000
SUB TOTAL					$	4,680,000
	Total length [m]	2760				
	Unit Cost	$ 1,696				

OH PORTION Location	Distance [m]	number of circuits	Number of Poles	cost	
Lakeridge – Between two Tower line- OH	720	2	18	$	795,000
Lakeridge – North of HONI ROW to South of HWY407- OH	2,650	2	59	$	2,695,000
Lakeridge – South of HWY 407 crossing to Columbus – OH	1,400	2	35	$	1,445,000
Columbus (from Lakeridge to Country Lane)- OH	2,000	2	49	$	2,045,000
Columbus (Country Lane to Ashburn)- OH	1,800	2	41	$	2,255,000
SUB TOTAL				$	9,235,000
	Total Length	8,600			
	Unit Cost	$ 1,074			

e) Standard practice is for a main feeder (600Amp "trunk" line) to be designed in a "looped" configuration in order to minimize outage time in the event of an equipment failure or car hitting a pole etc. This development vastly exceeds the level at which a looped configuration would be expected. Standard line hardware is rated at 600Amps, half of which is 300Amps and at 27.6kV this equals approximately 15MVA per feeder. The total load at this development approximates the capacity of two feeders in a looped arrangement.

Elexicon determined that building one 27.6kV circuit would not be sufficient to supply the required power to the North Brooklin development knowing the projected pace and volume of customer growth over the next twenty years. Therefore, the one 27.6kV circuit option was determined not to be the most economical option. The second pole line is not only needed to provide redundancy in case of an outage caused by tree contacts or vehicle accidents, it is needed to provide contingency for future circuits that will service the same development when demand materializes in the next few years. It is a practice adopted by most if not all distribution companies to provide a resilient supply of power. Failure to provide a loop in a distribution system can eventually cause an unnecessary extended outage time to Elexicon's customers. Elexicon has legal obligations to maintain the safety, reliability and quality of supply to its customers. Elexicon's engineering experts are of the view that two pole lines are required to meet these obligations. If the OEB elects to only fund one of the two pole lines with an ICM, Elexicon will require the Brooklin Landowners to fund the second pole line as an expansion to its distribution system to ensure that the system continues to be designed and constructed in accordance with its engineering standards to satisfy its legal obligations.

f) In addition to the reasons provided above, the estimates provided in response to question c) and d) were calculated without any contingency for additional underground circuits. If Elexicon would have to build additional circuits in the future the cost will excessively exceed the total cost of $26.6M forecast in this application. If a single 27.6 kV pole line design is to be considered now, building a second 27.6 kV pole line few years from now will require Elexicon have to consider a completely new design and engineering charges, modifications to the under-ground duct-bank exiting the Whitby TS, and all additional charges related to assessments, permits, and approvals.

g) Elexicon has provided Table 3 below with a list of potential commercial and industrial customers to be connected to the 44kV line.

Table 3 - List of potential commercial and industrial customers north of Taunton Rd E and south of highway 407

Estimated demand [kW]	Nature of demand	Address	Development application number
1,100	COMMERCIAL	[redacted]	DEV-14-21 (SW-2021-04, Z-04-21)
2,900	INDUSTRIAL	[redacted]	DEV-15-21 (SP-7-21)
8,500	COMMERCIAL	[redacted]	N/A
650	COMMERCIAL	[redacted]	DEV-11-21 (OPA-2021-W/05, SP-06-21)
2,600	INDUSTRIAL	[redacted],	N/A
900	INDUSTRIAL	[redacted],	DEV-09-22 (Z-07-22, SP-05-22)
1000	INDUSTRIAL	[redacted],	N/A
1000	INDUSTRIAL	[redacted],	PRE-35-22 - 5380 Baldwin S
1,500	INDUSTRIAL	[redacted],	PRE-47-22
500	INDUSTRIAL	[redacted]	PRE-58-22 - 5455 Ashburn (Phase 2)
500	INDUSTRIAL	[redacted]	PRE-01-23

Elexicon energy does not believe there is economic benefit in stepping down the voltage from 44kV to 27.6kV to match the voltage in Option 1, as doing this will eventually increase overall costs. In addition to the cost of building 44kV feeders to North Brooklin, which will cost more than building a 27.6 KV line, Elexicon will still need to step down the voltage to supply residential customers. The current estimate to build a step-down station from 44kV to 13.8kV with two transformers is around $9M excluding the cost of land.

Elexicon's planning team is responsible for power system planning to accommodate a range of new customer growth across its *entire* service area. Knowing all the potential commercial and industrial demand projected in the Whitby area south of highway 407 from Ashburn to the Oshawa border (Known as the Mid-Block Arterial Road development), Elexicon has decided to use the 44kV voltage to supply that load, since the demand is substantive in nature and therefore requires large capacity feeders. In all situations, customers will be responsible to step-down the voltage locally using private substations. In addition to the 44kV feeders being built to supply power to the new commercial and industrial customers, they will provide flexibility and backup to the existing 44kV system in North Whitby; this was one of the reasons Elexicon could not supply North Brooklin from the 44kV system in the area.

Attachment 1 is a map showing the Town of Whitby's comprehensive plan for the area south of highway 407.

OEB PANEL – 2

ATTACHMENT 1

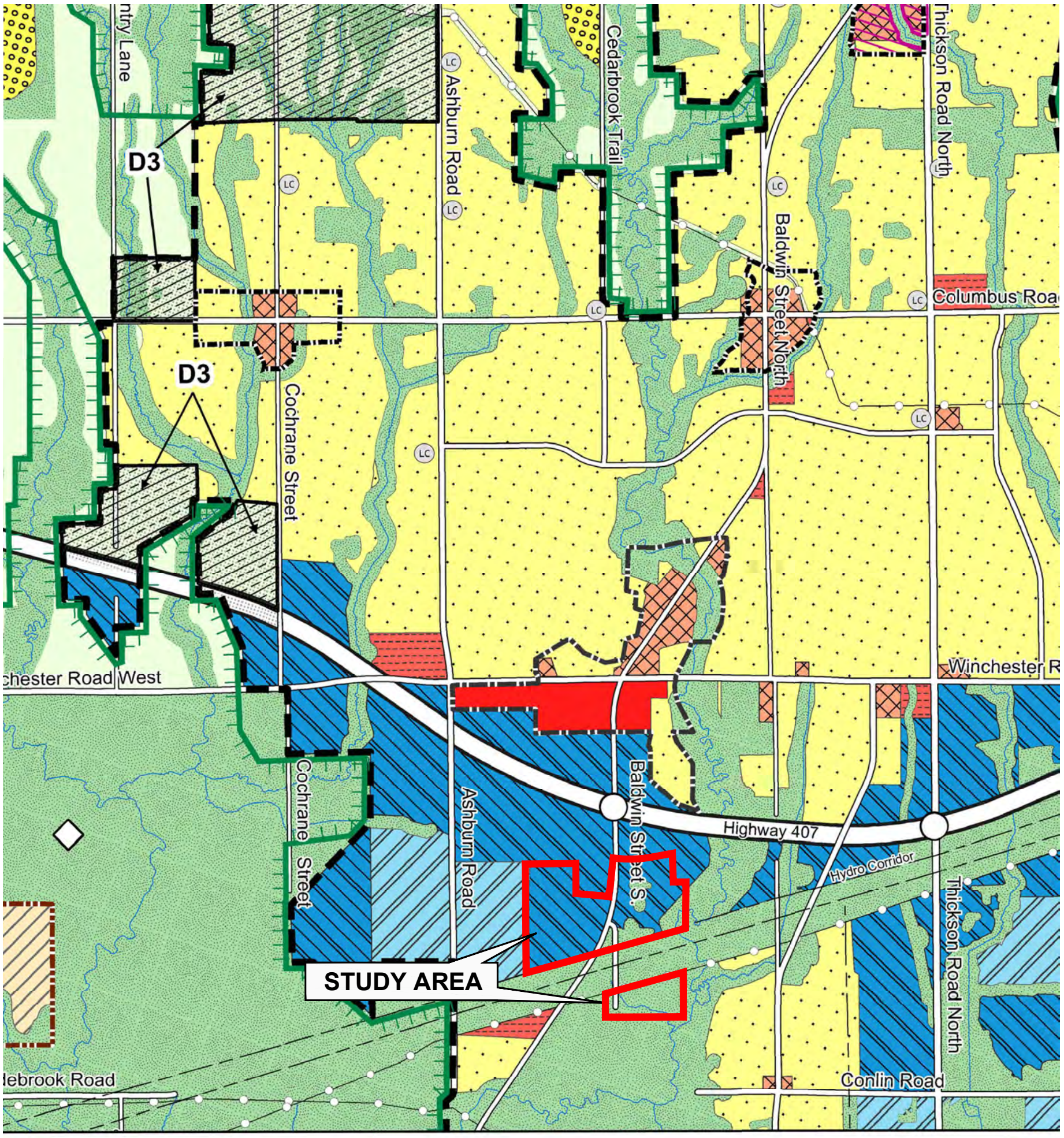
TOWN OF WHITBY

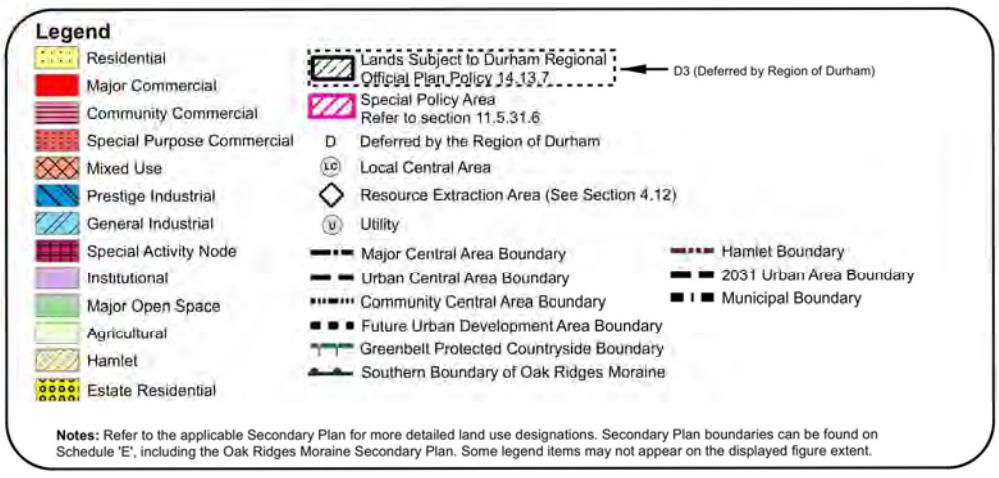
COMPREHENSIVE BLOCK PLAN

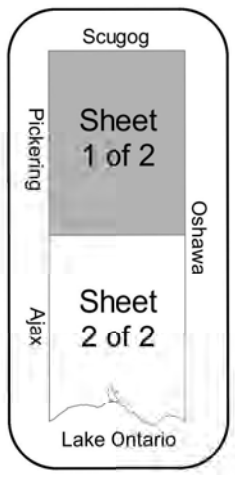
COMPREHENSIVE BLOCK PLAN

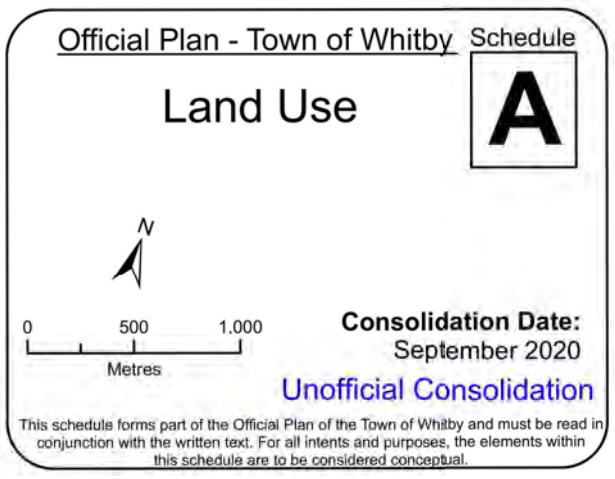
OFFICIAL PLAN AMENDMENT # 108

ghd.com









LEGEND

STUDY AREA

N

BROOKLIN
TOWN OF WHITBY

GHD

Fieldgate Developments Limited
WINASH SOUTH

EXCERPT FROM WHITBY OFFICIAL PLAN
SCHEDULE A - LAND USE AS AMENDED BY OPA 108

Job Number	11192576
Revision	A
Date	JUNE 2021

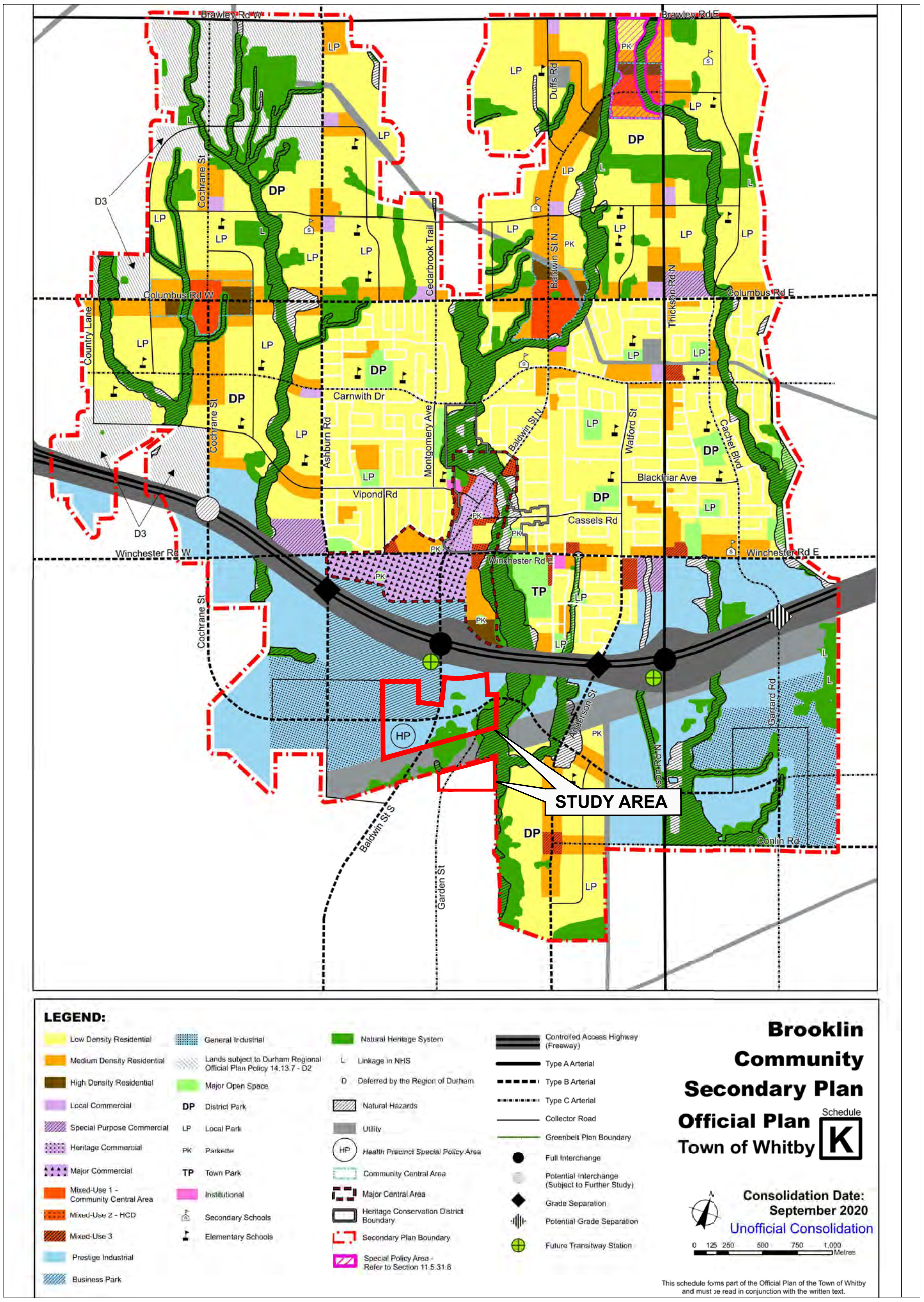
Figure 5

65 Sunray Street, Whitby Ontario L1N 8Y3 **T** 1 905 686 6402 **F** 1 905 432 7877 **E** info@ghdcanada.com **W** www.ghd.com

Plot Date: 6 October 2021 - 1:25 PM Plotted by: Jo-Anne Theurer
Cad File No: G:\111\11192576\CADD\Drawings\Planning\Batty-Baldwin-2016\Fieldgate DRAFT PLANS\figures for CBP\11192576-figures-CBP-2021-10-06.dwg

COMPREHENSIVE BLOCK PLAN

TOWN OF WHITBY OFFICIAL PLAN



LEGEND

STUDY AREA

N

BROOKLIN
TOWN OF WHITBY

GHD

Fieldgate Developments Limited
WINASH SOUTH

EXCERPT FROM WHYTBY OFFICIAL PLAN SCHEDULE K- BROOKLIN COMMUNITY SECONDARY PLAN

Job Number 11192576
Revision A
Date JUNE 2021

Figure 8

65 Sunray Street, Whitby Ontario L1N 8Y3 **T** 1 905 686 6402 **F** 1 905 432 7877 **E** info@ghdcanada.com **W** www.ghd.com

Plot Date: 6 October 2021 - 1:26 PM Plotted by: Jo-Anne Theurer
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Elexicon Energy Inc.

Answer to OEB Commissioner's Questions

OEB Panel-3

Ref 1: Technical Conference 1 – Transcript pages 161-162

Ref 2: Application – Appendix B-2, Figure 1

Ref 3: Interrogatory Responses – Staff-12 Attachment 1

Preamble:

On pages 161-162 of the technical conference transcript day 1, Elexicon Energy indicated that its planning standards and engineering standards require a loop feed design because the size of the load.

a) Please provide the Elexicon Energy planning/engineering standard that requires a loop feed in feeder design and the size threshold of the load that requires such design.

b) Please provide the number of outages caused by fallen poles on Lakeridge Road in the past 5-years. What was the range and average outage time for these outages?

c) Figure 1 of Appendix B-2 shows that there is a loop design for the Northeast quadrant of Ashburn and Columbus. However, there is no loop design in the North/Southwest quadrant of Ashburn and Columbus. Please explain how this design adheres to Elexicon Energy's loop feed standards?

Response:

a) The specific Elexicon planning and engineering standards for loop feed in feeder design have been included as Attachments 1 and 2. These standards have been migrated from legacy Whitby Hydro and Veridian Connections standards to Elexicon[1]. Elexicon's standard practice for designing main feeders (600 Amps), as well as subdivision feeders (200 Amps) is to have the conductors arranged in a loop configuration. A looped configuration, on separate pole lines, provides the necessary reliability and redundancy to minimize outage time in the event of planned and unplanned outages. Elexicon's design is intended to mitigate issues from planned maintenance, equipment failure or externally caused outages (e.g., vehicle accidents, tree contacts, etc.). A looped configuration will allow one of two lines to carry the full expected

[1] Please note that these are only marked draft because they are historical standards that have been migrated over from Veridian Connections and Whitby Hydro standards and guidelines.

(600 Amps) load to North Brooklin in the event of an outage, thus providing reliability in the form of reduced outages and an increase in restoration options following forced outages.

The North Brooklin Line is being designed for a maximum of 600 Amps per feeder, therefore requiring a looped configuration. These requirements can be found in the following sections of Elexicon's engineering standards:

- Attachment 1 Engineering guideline for load interrupt switches (LIS) was written based on the assumption that feeders are loops and can back each other up. Section 2.0 LIS application and reliability is specifically written for loop systems to make a calculated decision when installing overhead switches between two feeders so that capacity is transferred quickly in the event of planned or unplanned outage (i.e., the open point at Ashburn Road and Columbus Road West Appendix B Figure 1 page 6 of 37). The same document refers to building a pole line on the other side of the street in multiple circuits situation.
- Attachment 2 titled "Underground Distribution Expansion for Residential Development", Section 6.10 600 A Feeder System Overview refers to a typical looped design when the feeder(s) are the main circuits carrying the load. A nominal operation current of a single circuit is 300 Amps with the ability of carrying 600 Amps in a back up situation (i.e., feeder carrying a load of two feeders). Underground sections are part of the Phase 1 line at the Whitby TS and along Columbus Road.

b) Elexicon does not have a cause code for "fallen poles", however Elexicon does track the following causes relevant to the Ontario Energy Board's ("OEB") request: (a) unknown (cause code #0); (b) tree contacts (cause code #3); (c) adverse weather (cause code #6); and (d) foreign interference, such as vehicle accidents (cause code #9).

Table 1 below lists the outages for cause codes 0, 3, 6 and 9 on Lakeridge Road in the past 5-years using the available data. The outages range from 2 minutes to 27 hours and 17 minutes, with an average outage of approximately 4 hours. The column titled "customer hours" provides the scale the impact may have had on Elexicon customers (e.g., a short outage that may have impacted many customers).

Table 1 - Outages on Lake Ridge Road for Whitby and Veridian Rate Zone

FEEDER	System Voltage	CAUSE CODE	INTER DEV TYPE	INTER DEV ID	NUM CUST OUT	Hour	Customer Hours	Year
WHITM22	44kV	3	Breaker	WHITM22	4113	0.02	68.6	2018
WHITM22	44kV	3	Breaker	WHITM22	4	0.72	2.9	2018
WHITM22	44kV	6	Breaker	WHITM22	3734	2.42	9023.8	2020
16F3	13.8kV	6	Breaker	16F3	200	2.82	563.3	2020
40M21	44kV	6	Breaker	40M21	47	4.93	231.9	2020
40M21	44kV	9	Breaker	40M21	2455	0.98	2414.1	2021
12F2	13.8kV	0	Breaker	12F2	2463	0.03	82.1	2021
WHITM22	44kV	6	Breaker	WHITM22	1	2.52	2.5	2022
WHITM22	44kV	6	Breaker	WHITM22	44	8.55	376.2	2022
40M21	44kV	6	Breaker	WHITM21	2316	27.29	63197.9	2022
12F1	13.8kV	3	Breaker	VICWF1	372	1.64	609.4	2022
40M7	44kV	0	Breaker	40M7 CB	10267	0.03	342.2	2022
WHITM22	44kV	6	Breaker	WHITM22	3859	0.03	128.6	2022

Elexicon notes that the duration of outages on the Brooklin line can dramatically increase if it is not designed in a loop configuration. For example, Elexicon has seen almost 460 tree contacts system wide in the last 5 years with an average duration of almost 6 hours. This overall result includes feeders which are primarily designed in a loop configuration. Elexicon would expect the average duration of outages to be higher with a radial configuration as there would be no ability to provide back-up power to customers while failures are being repaired.

Finally, Elexicon believes that the count of past outages on the existing distribution circuits on Lake Ridge Road should not be extrapolated to the future state when the North Brooklin Line is constructed because the assumption that the frequency of outages along Lake Ridge Road are uniformly distributed and do not reoccur at certain problematic geographic locations may not reflect the future state.

c) The loop on the Northeast quadrant of Ashburn and Columbus as well as the loop on the North/Southwest quadrant of Ashburn and Columbus is part of Phase 2 and not part of this ICM application. Phase 1 consists of extending the feeders out of the Whitby TS to the corner of Columbus Road West and Ashburn Road. Phase 2 as described in the supplementary response filed by Brooklin Landowners Group Submitted January 9th, 2023, page 10 of 24, is the main feeders which will be built along the major roads and streets adjacent to the subdivisions that will eventually provide supply points to the loops inside the subdivisions. Phase 2 is still a work in progress with developers to design the downstream loops to connect the individual dwellings, which will require an advanced subdivision layout and design. The

ultimate routing of the feeders downstream from the Phase 1 supply will depend on the final road map and residential development layout.

OEB PANEL – 3

ATTACHMENT 1

ENGINEERING GUIDELINE

LOAD INTERRUPT SWITCHES

[ENG-010]

Asset Management

ENGINEERING GUIDELINE

For

LOAD INTERRUPT SWITCHES

Issued by: Jordon Young, CET
Approved By:
Elexicon Energy

Revision History

Name	Date	Revision Note	Version

Review Schedule

- Annually

Table of Contents

1.0 General

1.1 Purpose

This guideline describes looped circuit restoration schemes and load interrupt switch (LIS) locations, for Elexicon Energy sub-transmission and distribution voltages.

These policies and standards have been migrated from legacy utilities (Veridian Connections and Whitby Hydro).

2.0 LIS Applications and Reliability

LIS Applications

The LIS switch is designed for live-switching duties such as executing switching orders related to parallel or loop load splitting and load transfers.

In an emergency scenario they can be used to drop load as well.

Locations and Target Capacities

1) Between feeders as the normal open point.
2) Placed to sectionalize the feeders into manageable capacity groups:
    a. 44.0 kV – Capacity 22 MW
    b. 27.6 kV – Capacity 15 MW
    c. 13.8 kV – Capacity 8 MW
3) Installed at locations needed to ensure quick restoration to critical infrastructure.
4) And installed in a logical way that reflects the physical routing of the feeder in a way that introduces further options to restore power, such as having operable open points even between circuits on the same pole (LIS Tie-In configuration).

Risk Management

Consideration of critical infrastructure such as hospitals, medical facilities, civil services, must be given such that these services can be quickly restored, and therefore may require more switching options than deemed necessary when considering capacity only.

Where multiple feeder circuits are present on one pole line, due consideration shall be given to the impact of a downed pole or otherwise disruption causing de-energization of the pole line. Such remedies may include building an additional pole line on the opposite side of the street, or routing through adjacent streets, to minimize or mitigate the risk of a prolonged outage.

3.0 44.0 kV LIS Guidelines

All 44KV feeders are connected directly to a transmission station and supply a distribution station or a large customer. Some 44kv feeders are shared with other utilities.

The following example is assumed to be for 44KV feeders which supply only Elexicon customers.

The planning capacity for our 44KV feeders is usually 22MW, and these feeders can supply a combination of our 44KV to 13.8KV or 4.16KV Substations, and some commercial or residential customers.

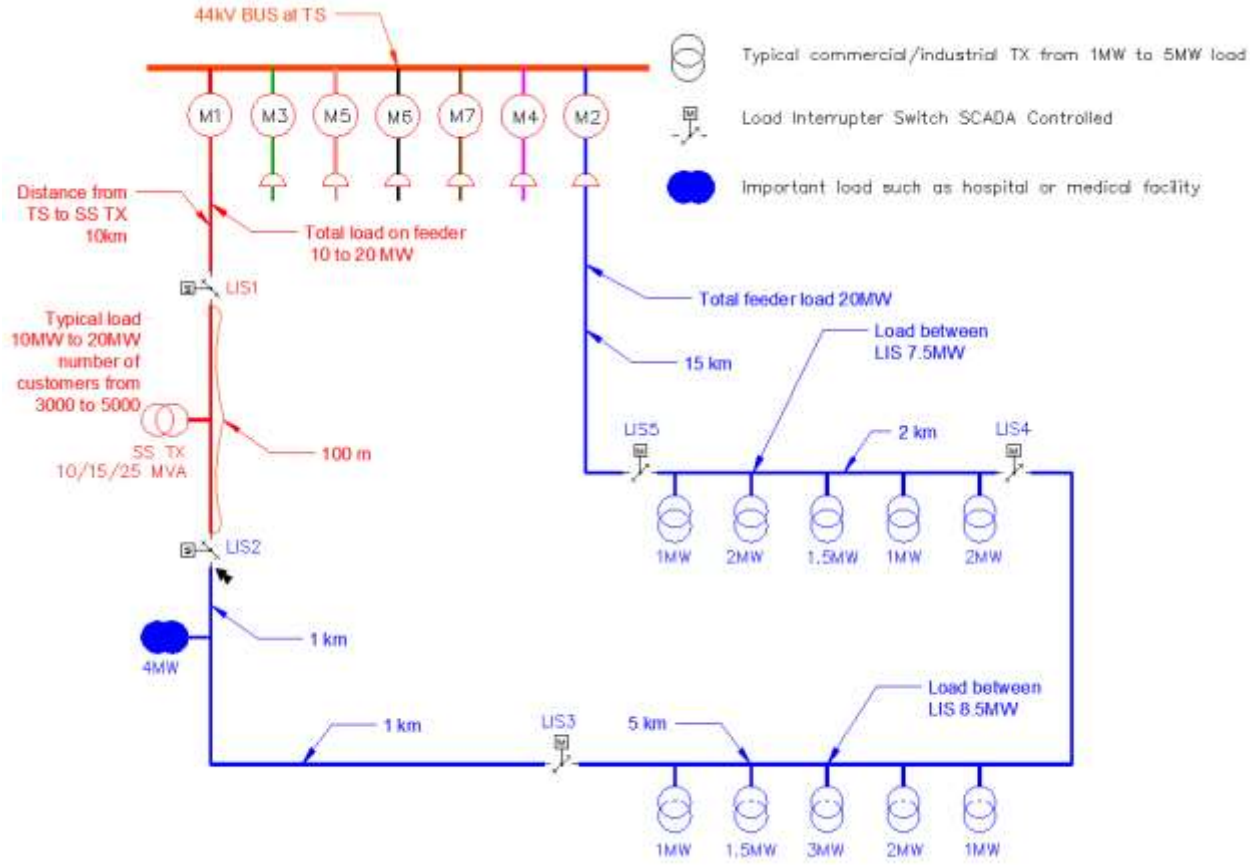


Figure 1 44.0 kV, Preferred LIS Locations

The location of the LIS'S are intended to reduce the number of prolonged outages to our customers, in the example of the M1 feeder the first LIS is located close to the transmission station, the second LIS is also the open point between the M1 and the M2 feeders.

If a fault occurs in the first part of the M1 feeder between the breaker at the TS and the first LIS, then the control room can open the LIS-1, this isolates the fault, then by closing LIS-2 this would then restore the supply to the customers between LIS-2 and LIS-1.

The location of the LIS'S on the M2 feeder requires more attention as the loads on the feeder are smaller and distributed along the feeder, in this example the feeder has been divided into four parts.

Section one between the breaker at the TS and LIS-5 has no load, but is the longest section of line at 15KM, the second section of the feeder has 7.5MW of load, the third section of the feeder has 8.5MW of load, and the fourth section of the feeder has important load of 4MW.

The loads have been separated by LIS'S which can then be operated to restore loads to the customers depending on the location of the fault on the feeder, this reduces the chances of having a prolonged outage to any of the customers.

The recommendation is to divide the feeder into each side of large or critical load, such as a substation or medical facilities, and where there are distributed loads to divide the feeder into 5 to 8 MW sections.

4.0 27.6 kV LIS Guidelines

Most of our 27.6KV feeders are connected directly to a transmission station.

The following example is assumed to be for 27.6KV feeders which supply only Elexicon customers.

The planning capacity for our 27.6KV is usually 15 MW, and these feeders can supply a combination of some commercial and residential customers.

The schematic below shows the preferred location of LIS'S.

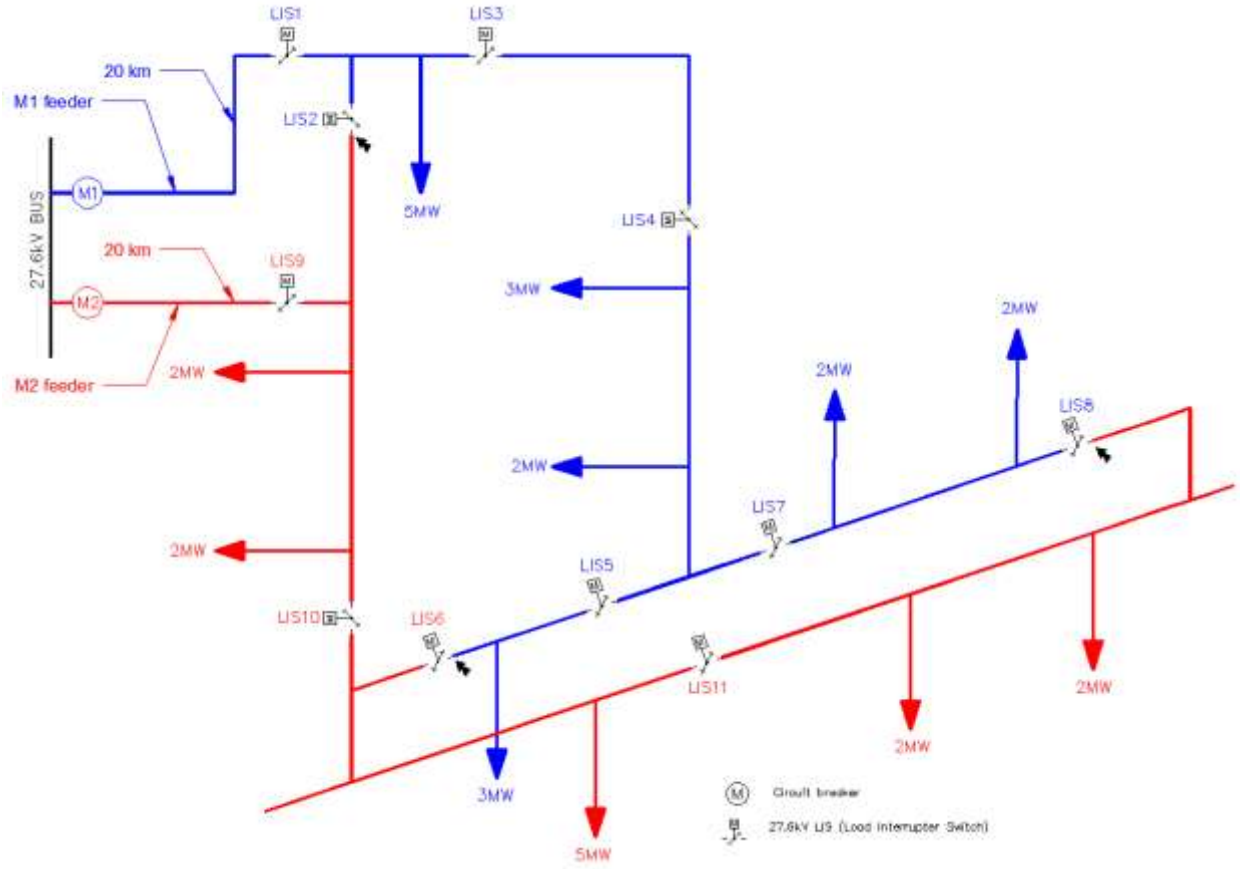


Figure 2 27.6 kV, Preferred LIS Locations

The location of the LIS'S are intended to reduce the number of prolonged outages to our customers, in the example of the M1 feeder the first LIS is located close to the first customers, the second LIS is just after the first customers. The location of the LIS'S divides the feeder into 4 to 5 MW sections. If a fault occurs in the first part of the feeder between the breaker and LIS-1, then the control room can open LIS- 1, this isolates the fault, then by closing LIS-2, LIS-6 or LIS-8, the supply to the customers would be restored.

The recommendation is to divide the feeder into 4 to 5 MW sections (approx. 1,000 to 2,000 customers).

5.0 13.8 & 12.47 kV LIS Guidelines

Most 13.8KV, or 12.47KV feeders are directly from our stations, and supply only of our customers.

The example given is for a 44KV to 13.8KV SS, with two 15/20/25MVA transformers and, six 13.8KV feeders. The planning capacity for our 13.8KV feeders is usually 8MW, and these feeders can supply a combination of commercial and residential customers.

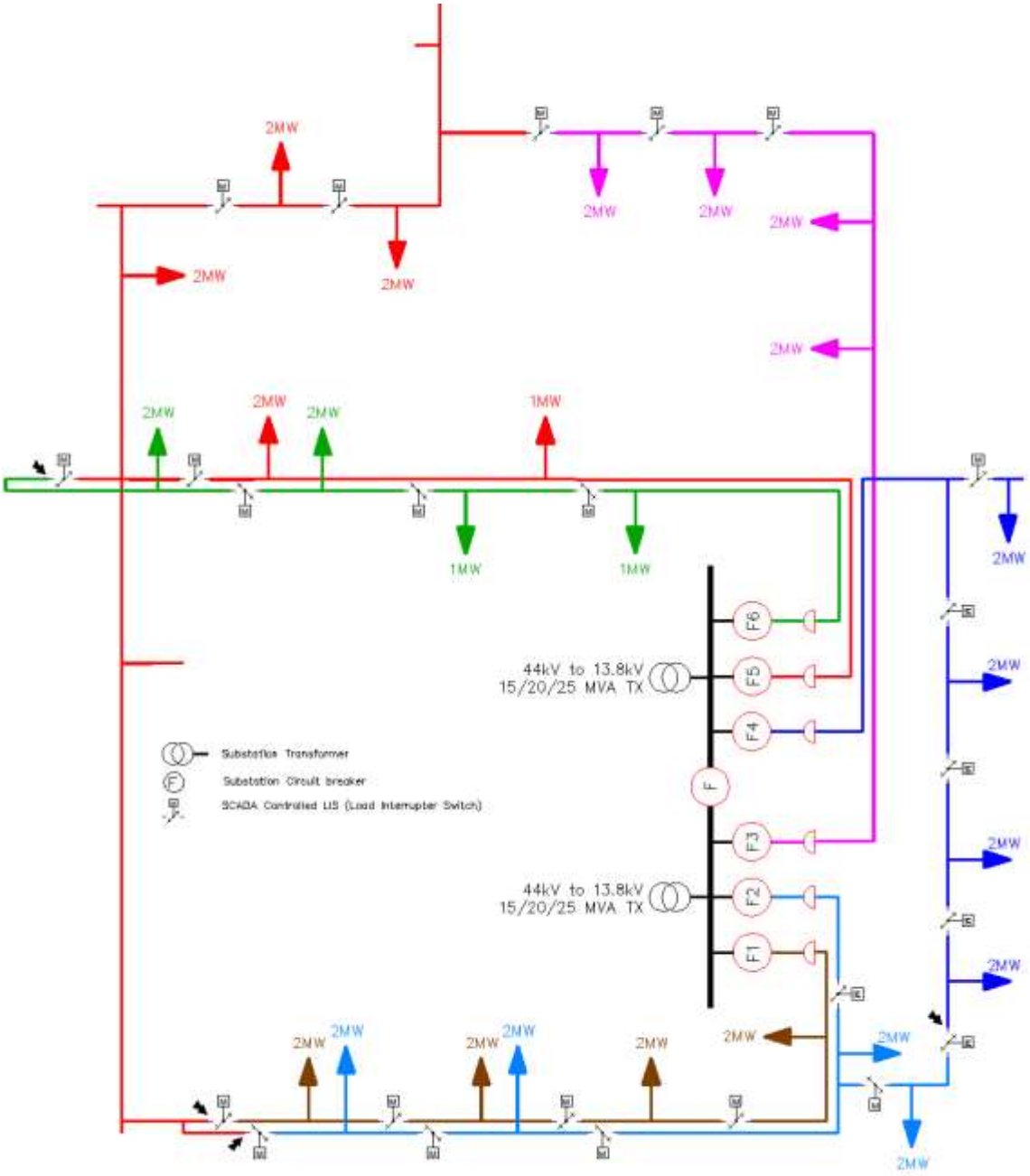


Figure 3 13.8 kV, Preferred LIS Locations

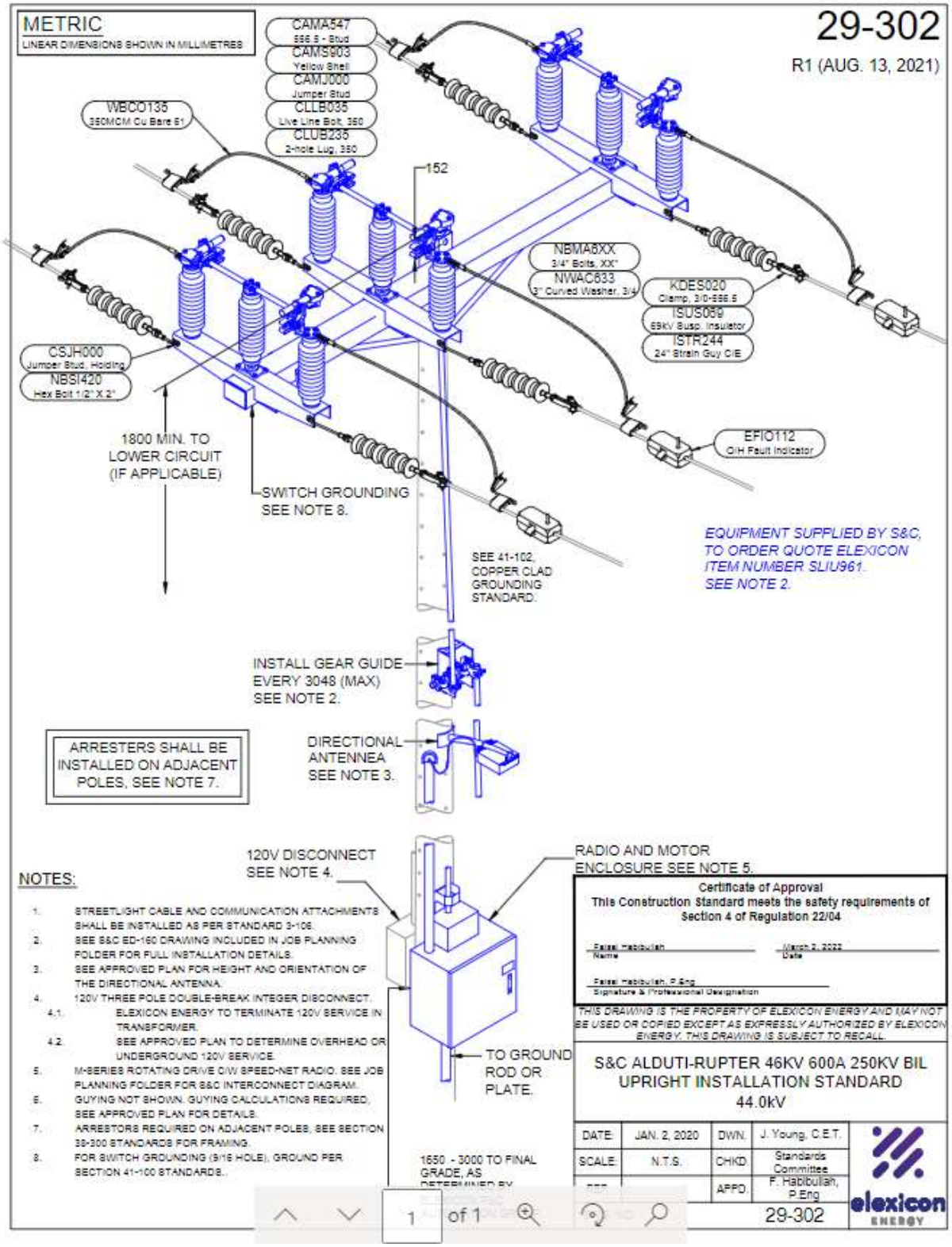
The location of the LIS’S are intended to reduce the number of prolonged outages to our customers, by dividing the feeder into 2MW sections this reduces the number of customers affected by one fault on the feeder, as the control room can restore the supply to the parts of the feeder not affected by the fault, by using the SCADA controlled switches.

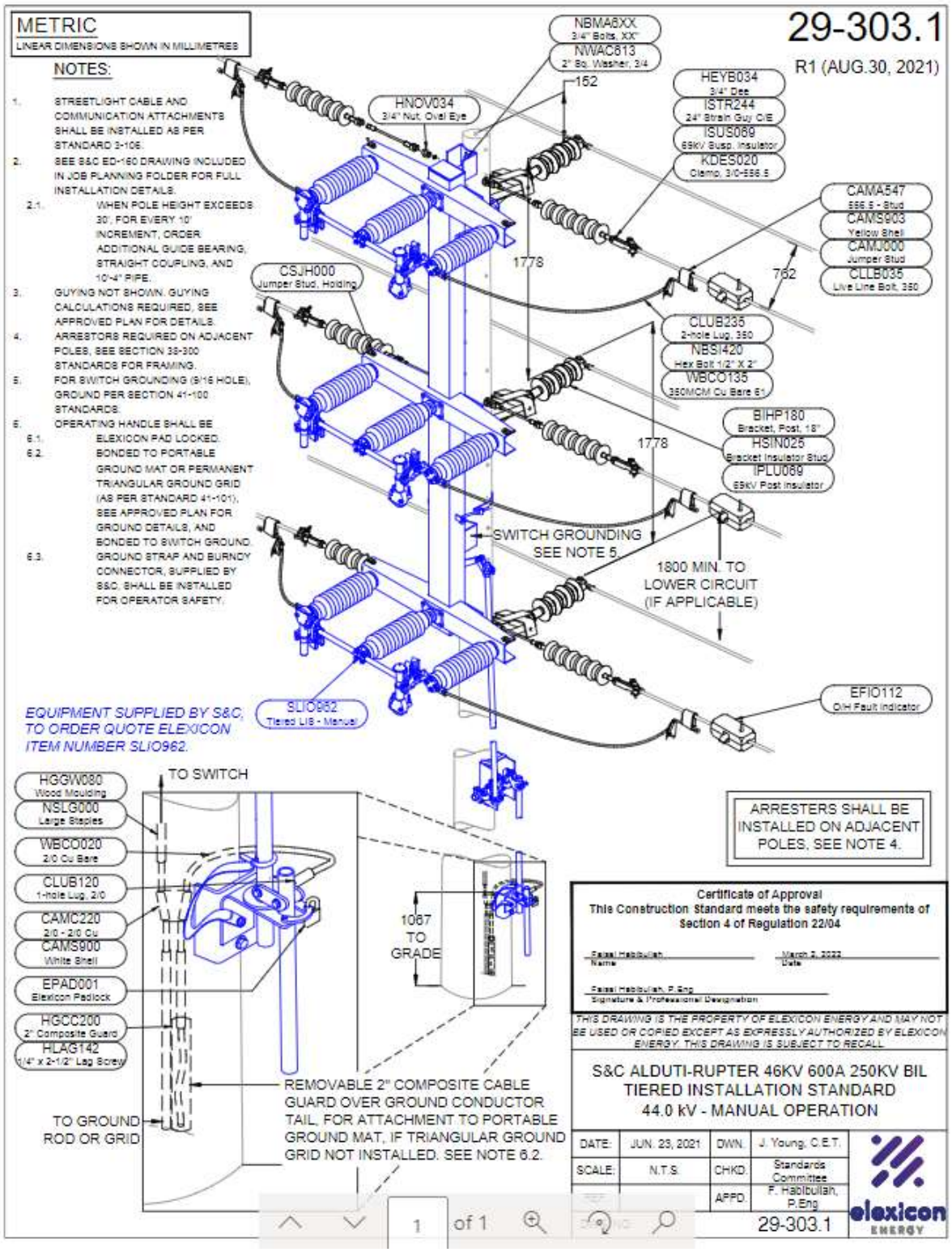
Appendix A: Typical Costs for SCADA Controlled, and Manual Switches.

Project	name	cost	LIS	Type	Material
ACA.14.0122	LIS 44-14L Replacement	$ 88,989.11	44-673L	SCADA	$36,109.75
ACA.14.0124	LIS 44-12L Replacement	$94,375.47	44-674L	SCADA	$34,537.10
ACA.14.0125	LIS 44-06L Replacement	$99,673.35	44-675L	SCADA	$34,527.33
ACA.15.0108	44-01L Replacement	$104,517.64	44-696L	SCADA	
BCA.14.0109	L.I.S. Replace. - Belleville - #117 Moira St East	$87,141.46	44-686L	SCADA	
CCA.14.0122	LIS 5006-1 Replacement	$62,856.56	44-688L	SCADA	
ACA.16.0136	LIS 44-43L Replacement	$87,378.67	44-43L	SCADA	
ACA.16.0213	610 Monarch Ave - LIS Removal & Installation	$83,843.01	44-742L	SCADA	$35,838.52
BCA.14.0113	L.I.S. Replace. - Belleville - 8M1-5 (44-689L)	$100,972.68	44-689L	SCADA	
CCA.15.0137	LIS 5019-3 Replacement	$71,465.21	44-720L	SCADA	$33,665.28
	Average	**$88,121.32**			**$34,935.60**
BCA.14.0107	L.I.S. Replace Belleville - #356/358 Moira St E.	$57,906.83	MS4-L	Manual	$16,713.00

Included in the SCADA controlled switches, should be fault current sensing devices to detect the passage of fault current, this is critical to the installation.

Elexicon Standards




METRIC
LINEAR DIMENSIONS SHOWN IN MILLIMETRES
29-303.1
R1 (AUG.30, 2021)
NOTES:
1. STREETLIGHT CABLE AND COMMUNICATION ATTACHMENTS SHALL BE INSTALLED AS PER STANDARD 3-106.
2. SEE S&C ED-160 DRAWING INCLUDED IN JOB PLANNING FOLDER FOR FULL INSTALLATION DETAILS.
2.1. WHEN POLE HEIGHT EXCEEDS 30', FOR EVERY 10' INCREMENT, ORDER ADDITIONAL GUIDE BEARING, STRAIGHT COUPLING, AND 10'-4" PIPE.
3. GUYING NOT SHOWN. GUYING CALCULATIONS REQUIRED, SEE APPROVED PLAN FOR DETAILS.
4. ARRESTORS REQUIRED ON ADJACENT POLES, SEE SECTION 38-300 STANDARDS FOR FRAMING.
5. FOR SWITCH GROUNDING (9/16 HOLE), GROUND PER SECTION 41-100 STANDARDS.
6. OPERATING HANDLE SHALL BE
6.1. ELEXICON PAD LOCKED.
6.2. BONDED TO PORTABLE GROUND MAT OR PERMANENT TRIANGULAR GROUND GRID (AS PER STANDARD 41-101), SEE APPROVED PLAN FOR GROUND DETAILS, AND BONDED TO SWITCH GROUND.
6.3. GROUND STRAP AND BURNDY CONNECTOR, SUPPLIED BY S&C, SHALL BE INSTALLED FOR OPERATOR SAFETY.
NBMA6XX
3/4" Bolts, XX"
NWAC813
2" Sq. Washer, 3/4
152
HEYB034
3/4" Dee
ISTR244
24" Strain Guy C/E
ISUS089
69kV Susp. Insulator
KDES020
Clamp, 3/0-556.5
HNOV034
3/4" Nut, Oval Eye
CAMA547
556.5 - Stud
CAMS903
Yellow Shell
CAMJ000
Jumper Stud
CLLB035
Live Line Bolt, 350
1778
762
CSJH000
Jumper Stud, Holding
CLUB235
2-hole Lug, 350
NBSI420
Hex Bolt 1/2" X 2"
WBCO135
350MCM Cu Bare 61
BIHP180
Bracket, Post, 18"
HSIN025
Bracket Insulator Stud
IPLU089
69kV Post Insulator
1778
SWITCH GROUNDING
SEE NOTE 5.
1800 MIN. TO
LOWER CIRCUIT
(IF APPLICABLE)
EFIO112
O/H Fault Indicator
EQUIPMENT SUPPLIED BY S&C, TO ORDER QUOTE ELEXICON ITEM NUMBER SLIO962.
SLIO962
Tiered LIB - Manual
TO SWITCH
HGGW080
Wood Moulding
NSLG000
Large Staples
WBCO020
2/0 Cu Bare
CLUB120
1-hole Lug, 2/0
CAMC220
2/0 - 2/0 Cu
CAMS900
White Shell
EPAD001
Elexicon Padlock
HGCC200
2" Composite Guard
HLAG142
1/4" x 2-1/2" Lag Screw
1067
TO
GRADE
TO GROUND
ROD OR GRID
REMOVABLE 2" COMPOSITE CABLE GUARD OVER GROUND CONDUCTOR TAIL, FOR ATTACHMENT TO PORTABLE GROUND MAT, IF TRIANGULAR GROUND GRID NOT INSTALLED. SEE NOTE 6.2.
ARRESTERS SHALL BE INSTALLED ON ADJACENT POLES, SEE NOTE 4.
Certificate of Approval
This Construction Standard meets the safety requirements of Section 4 of Regulation 22/04
Faisal Habibullah
Name
March 8, 2022
Date
Faisal Habibullah, P.Eng
Signature & Professional Designation
THIS DRAWING IS THE PROPERTY OF ELEXICON ENERGY AND MAY NOT BE USED OR COPIED EXCEPT AS EXPRESSLY AUTHORIZED BY ELEXICON ENERGY. THIS DRAWING IS SUBJECT TO RECALL
S&C ALDUTI-RUPTER 46KV 600A 250KV BIL
TIERED INSTALLATION STANDARD
44.0 kV - MANUAL OPERATION
DATE: JUN. 23, 2021
DWN. J. Young, C.E.T.
SCALE: N.T.S.
CHKD. Standards Committee
APPD. F. Habibullah, P.Eng
29-303.1
elexicon ENERGY
1 of 1

OEB PANEL – 3

ATTACHMENT 2

UNDERGROUND DISTRIBUTION EXPANSION FOR RESIDENTIAL DEVELOPMENT

TECHNICAL SPECIFICATION FOR

UNDERGROUND DISTRIBUTION EXPANSION FOR RESIDENTIAL DEVELOPEMENT

SPECIFICATION No. - EETS-0_

October 1, 2022

Revision History

Name	Date	Revision	Ver.	P.Eng Approval

DISCLAIMER

This specification is authored by Elexicon Energy Inc., specifically for their use. Use of this specification is at the user's own discretion. No warranties or representations are made concerning this specification, and the user is to satisfy itself that this specification is adequate and appropriate for its own use.

Any exceptions to these specifications must be stated by the manufacturer when submitting the proposal.

TABLE OF CONTENTS

1.0 SCOPE

This specification outlines Elexicon Energy's broad requirements for underground subdivision work and is organized into multiple sections with different target audiences.

1) Requirements of The Customer
    a. Customer oriented.
    b. Informs the customer, and the customer's team of consultants (architects, civil, survey, etc.), of Elexicon Energy's administrative processes and requirements to initiate underground expansion projects in Elexicon Energy's service area.
2) Construction Methods
    a. Contractor oriented.
    b. Supplemental to good utility practice and existing Elexicon Energy Standards, this section describes niche construction methods and practices to be followed at the request of Elexicon Energy, in a non-exhaustive format.
3) Underground Distribution System Design
    a. Engineering oriented.
    b. Outlines Elexicon Energy design philosophy, available design options and methods, and material considerations and specifications.
4) Equipment Specification Tables
    a. Engineering technician oriented.
    b. Provides quick-reference charts for material specifications and information relevant to project design.
5) AutoCAD
    a. Engineering technician oriented.
    b. Describes Elexicon Energy drafting methods and practices, symbology, line types, tool palettes, and drawing template.

The definitions and terminology employed in this document are as defined in Elexicon Energy Conditions of Service or Distribution System Code.

These policies and standards have been migrated from legacy utilities (Veridian Connections and Whitby Hydro).

2.0 DEFINITIONS

"***Development***" means all parcels of land that have been approved by the municipality as a Subdivision or Townhomes site.

"***Customer***" means a generator or consumer whose facilities are connected to or are intended to be connected to a distributor's distribution system. This includes developers of residential or commercial subdivisions.

"***Consulting Engineer***" means the person or persons, registered with the Association of Professional Engineers of Ontario, who for the time being, are employed to provide engineering services on behalf of the Owner.

"***Electrical Plant***" means the total electrical distribution system, and appurtenances owned and maintained by Elexicon Energy, from its designated point(s) of supply to the ownership demarcation point(s).

"***Inspector***" means the person appointed by Elexicon Energy to inspect and/or approve the owner's installations in the subdivision.

"***Contractor***" means a person, or a group of persons or companies, hired by the Owner or his Consultant to carry out the construction of Electrical Plant as 'Constructors'.

"**Contract**" unless stated otherwise shall mean an agreement between Elexicon and the Customer for the supply of electricity or any other commodity or service that Elexicon will provide. The supply and consumption of electrical energy shall be construed as acceptance of such contract.

3.0 GENERAL

This specification is supplemental to the developers/builders' Agreements with the municipality and/or Road authority, as well as Elexicon Energy Conditions of Service and Standards and is intended to cover underground service(s) to detached, semi-detached, row or mixed-used units on blocks of land designated as development lands.

The supply point(s) of power will be from Elexicon Energy's designated source(s). All facilities beyond this (these) point(s) towards the load, including lines, will be installed, and paid for by the Developer through a capital contribution calculated by the economic evaluation model as prescribed in Appendix B of the Distribution System Code (DSC).

The Customer or their representative must contact Elexicon Energy's engineering department regarding any other specific requirements. In the case of a conflict between this specification and approved drawings, the approved drawing will prevail, unless advised otherwise by Elexicon Energy.

4.0 REQUIREMENTS OF THE CUSTOMER

4.1 Initial Offer To Connect

Elexicon Energy treats all subdivision developments as "expansions" as defined by in the Distribution Services Code (DSC).

"Expansion Project Economic Evaluation Data Inputs Form from Customer" (EPEEDIFFC) form to be completed by the Customer.

Elexicon Energy shall use this form to complete an Initial Offer to Connect Agreement at no cost for the proposed expansion. The initial offer to connect will be based on the number of connections only and may not reflect unique site conditions that may alter the actual service costs. The initial offer to connect will not include a servicing design drawing, and the project will be considered parked until the Customer indicates they wish to proceed with a full design by signing Signature Blocks A or B from the Initial Offer to Connect Agreement. Elexicon Energy may terminate this Agreement if this Agreement is not executed by all Parties (Elexicon Energy and the Customer) within 60 days.

4.1.1 Project Initiation and Required Documents

The Customer may initiate the hydro distribution design by:

1) Completing and submitting the EPEEDIFFC form and proposed site plan to Elexicon Energy; and
2) Requesting preliminary design drawings; or
3) Engaging their Consulting Engineer to produce the design under Offer To Connection Option B, by signing Signature Block B from the "Initial Offer to Connect Agreement".
4) Providing an engineering deposit in the amount of 10% of the Initial Offer To Connect or $5,000.00, whichever is greater.

An Elexicon Energy Technical Representative shall review and confirm receipt of the following required documents within fifteen (15) business days:

Expansion Project Economic Evaluation Data Inputs Form From Customer (EPEEDIFFC)
This form is divided into the following sections:

1) Customer Information
2) Legal Description of Lands & Pin Number(s)
3) Civil Drawings Summary
4) Forecasted Connections, by lot type (5-year)

This information will allow Elexicon Energy to identify easements and calculate its contribution towards the project, if applicable.

AutoCAD Files
All electronic plans must be submitted to Elexicon Energy in AutoCAD DWG format. All drawing will be professionally prepared, to scale, and make reasonable use of AutoCAD layers to facilitate formatting of the drawings for the distribution design.

Typical examples of rejected documents: All AutoCAD entities on Layer 0; Drawing units not equal to 1 unit = 1 meter.

The following documents must be submitted electronically via e-mail or internet cloud storage service ("drop box") to the Elexicon Energy Technical Representative:

1) Survey Plan:
The following must be specified in the survey plan, as a minimum:
a) To scale (1unit = 1 meter)
b) Property limits
c) Registered plan
d) New or existing buildings
e) All above grade plant (hydrants, pedestals, poles, mailboxes, etc.) with ownership, including Elexicon Energy plant.
f) Trees
g) Easements (if any), including ownership.

2) Site Plan
The following must be specified in the site plan, as a minimum:
a) To scale (1 unit = 1 meter)
b) Property Limits
c) All existing and proposed below grade civil works and plant (storm sewer, sanitary sewer, water main, civil service laterals, water boxes, hydrants, foundations, gas mains, etc.)
d) All existing and proposed above grade civil works (hydrants, pedestals, streetlight poles, mailboxes etc.)
e) Grading
f) Existing and/or proposed building details (location, size, elevation, setbacks from adjacent property lines).
g) Proposed regional or municipal street widening.
h) Significant infrastructure such as railway tracks, major gas mains, hydro transmission lines, must be expressly noted if present on or adjacent to site.

3) Architect Drawings

a) Due to the meter base being constructed by the builder, and not the contractor, inspection is difficult to coordinate. To ensure the meter base enclosure meets Elexicon Energy's clearance requirements, the Elexicon Energy Technical Representative shall review the architect drawings prior to finalization of design.
b) If the Customer fails to provide architect drawings complete with meter base details and locations, the meter bases may need to be rebuilt in the field, at the Customer's expense.

4.1.2 Early Coordination for Equipment Lead Times

The Customer must contact Elexicon Energy and provide the required documents a minimum of **seven (7) months** in advance of the target in service date.

Elexicon Energy will prepare an Initial Offer To Connect Agreement within **sixty (60) days** of receipt of required documents.

Upon execution of the Initial Offer To Connect Agreement, if the Customer chooses Option A, a **sixteen (16) week** minimum lead time is required to order and procure the transformer(s) but is not guaranteed **(see note below)**. Elexicon Energy is not liable for costs or loss of profit incurred due to transformer lead times.

Lead times may be extended or reset, if any of the required documents are revised after being resubmitted to Elexicon Energy, at the discretion of the Elexicon Energy Technical Representative.

Note: The lead times shown above reflect our conditions of service and typical lead times, however due to the global supply chain crisis the lead times can exceed 24 months. See Appendix B. Early coordination for materials is highly recommended.

4.2 Offer To Connect

1) Offer to Connect shall be provided by Elexicon Energy, within sixty (60) days of receiving all required documents.
   a) The sixty (60) day period will not commence until all required information is received and all documents are fully completed and formatted to the satisfaction of the Elexicon Energy Technical Representative.
   b) Any Customer driven changes that result in a revision to the Engineering Design Drawing will reset the sixty (60) day period from the time that the change is communicated to the Elexicon Energy Technical Representative.
   c) The Total Project Costs in the Offer to Connect are divided into Ineligible and Eligible for Alternate Bid categories, in compliance with the DSC:
      i) Ineligible for Alternative Bid Work:
         (1) Distribution System Planning
         (2) Development of specifications for design, engineering, and layout of expansion.
         (3) Work that requires direct contact with the existing distribution system, including switching.
         (4) Cost to terminate existing energized equipment.
         (5) Review and acceptance of design, engineering, and layout of the expansion.
         (6) Supply and install riser materials, splices, terminations in existing equipment.
         (7) Temporary de-energization of any portion of the existing distribution system as decided solely by Elexicon Energy.
         (8) Inspection
         (9) Cable testing
         (10) Equipment verification and data collection
         (11) Energization
      ii) Eligible for Alternative Bid Work (Option B):
         (1) Design, engineering, and layout of an expansion.
         (2) Supply and install of new distribution equipment to Elexicon Energy's specifications, including pad-mounted equipment, cables, splices, and terminations.
         (3) Supply and install low voltage cables to the lot line for municipal subdivision projects.
         (4) Supply and install low voltage cables to the meter base for privately owned condominium townhouse block projects where there is only one construction from points of power supply to meter bases.
   d) Street light assets are owned by the municipality and/or Road Authority. As such costs associated with Streetlight beyond Elexicon Energy ownership demarcation point, are NOT included in the Offer to Connect. The Customer must enter into a separate agreement with the local authorities.
   e) Low voltage service cables from the property line/marker to the meter base are NOT included in the Offer to Connect including the private condominium townhouse blocks where there is one construction from the points of power supply to the meter base. The Customer or Builder must enter into a separate agreement with Elexicon Energy.
   f) The Customer will choose either Option A or Option B in the Offer to Connect.
   g) Elexicon Energy shall carry out an Economic Evaluation of the project and make an investment in accordance with the DSC guidelines.
   h) The Customer must provide a payment for the Capital Contribution in a form of a certified cheque, bank draft, or wire transfer. The Customer may provide a Letter of Credit for the Expansion Deposit.

4.2.1 Offer To Connect, Option A

Elexicon Energy shall prepare an estimate including work eligible for Alternative Bid Work.

1) Eligible for Alternative Bid Work will be estimated by Elexicon Energy using unit pricing.
2) The site will be assumed by Elexicon Energy upon completion of construction.

4.2.2 Offer To Connect, Option B

The Customer, only after reviewing Option A, may elect to pursue Alternative Bid Work (Option B) and to hire their own contractor(s) to complete all Alternative Bid Work.

1) The Customer must provide the Eligible for Alternative Bid Work quotes to Elexicon Energy (minimum 3 quotes).
2) The Customer's contractor must submit all materials' specifications to be installed for review and approval by Elexicon Energy.
3) The Customer shall provide proof of insurance.
4) Elexicon Energy shall retain a security deposit of 10% of the Expansion Deposit for a period of two years and will draw on the deposit for any final inspection and remedial costs incurred during this period.
5) Contractor(s) costs estimates must follow the Ontario Energy Board Accounting Procedures Handbook for Electricity Distributions Article 210 account descriptions, with labour (engineering, design, construction) and equipment (overhead and underground) applied to each appropriate account number listed in the handbook's Uniform System of Accounts, Chart of Accounts.

4.2.3 Composite Utility Drawings

Elexicon Energy (Option A) or the Consulting Engineer (Option B) shall provide preliminary and final drawings to the Customer's consultant. The Customer's consultant must receive all plans from 3rd parties and compile a composite utility plan (CUP), regardless of if it is a municipal requirement or not. The Customer's consultant is responsible to maintain these drawings under on-going revisions until all Elexicon Energy and 3rd Party drawings are finalized.

The CUP drawing must show the following applicable information as a minimum:

1) Road crossing locations, duct quantity, and ownership
2) 3rd Party pedestals
3) Streetlights
4) Streetlight pedestals or in-pole disconnect locations
5) Typical trench profile (Typically Joint-Use Trench)
6) Offset dimension of main trench from Right of Way in meters.
7) Elexicon pad-mounted equipment locations
8) 3rd Party pad-mounted equipment locations
9) Bus stops
10) Community mailboxes
11) Hydrants
12) Driveways
13) Civil service laterals crossing at Right of Way line
14) Any major underground structure or large gas mains
15) Hydro One transmission towers and associated easements
16) Trees

The final CUP drawing will be signed off by all parties to confirm lack of conflict. The Elexicon Energy or the Consulting Engineer shall review the drawing to verify adequate available service attachment points at each transformer.

4.2.4 5-Year Customer Connection Horizon

Where the Customer is required to pay the capital expansion costs, the Customer will receive compensation from other connections benefiting from the installation for a period of five (5) years from the energization date.

Capital expansion costs will be included in the Offer to Connect.

5-Year Customer Connection Horizon, Payor

As per the Distribution Service Code, if the Customer is benefiting from a customer driven expansion built within the past five (5) years, the Customer will be required to pay a contribution cost. The original customer that covered the costs of the expansion is then issued a rebate from Elexicon Energy.

5-Year Customer Connection Horizon, Payee

Where the Customer is required to pay the capital expansion costs, the Customer will receive compensation from other connections benefiting from the installation for a period of five (5) years from the energization date.

Capital expansion costs will be included in the Offer to Connect.

4.2.5 Embedded Generation (If Applicable)

If a Distributed Energy Resource (DER) is planned to be installed within the development lands as part of the Sub-division, the Owner of this DER will be required to enter into an Embedded Generation Connection Agreement with Elexicon Energy.

Refer to the “Elexicon Energy – Conditions of Service” for more information.

4.2.6 Ownership

Upon completion and energization of plant, Elexicon Energy shall retain (Option A) or assume (Option B) ownership of the residential or condominium hydro distribution system and provide for ongoing care and replacement at the end of the maintenance period, 2-years after the last low voltage connection or the economic evaluation five-year forecast period expires.

4.2.7 Easements

The legal fees associated with easements will be included in the Offer to Connect.

General Easements

1) Any required easements will be identified by Elexicon Energy and put in place (registered) by the Customer prior to energization.
2) Elexicon Energy easements are typically required where;
   a) Elexicon Energy owned assets are located on or trespass onto private property (including municipal parks or school properties).
   b) In Laneways or other areas where the Right of Way is reduced, to accommodate transformers.
   c) Over low voltage cables for grouped or ganged metering arrangements on municipal property.

Condominium Easements

1) Condominium Site – A blanket easement over the site is required.
2) Freehold Condominium Site – A blanket easement over all common elements is required. A blanket easement over the entire site is preferred.
3) The Customer is responsible for the expense, preparation, and registration of all necessary easement documents.

4.2.8 Approved Contractor Equipment Document

If the customer selects Option B, alternative bid, the contractor must complete the "Contractor Supplied Equipment" approval sheet prior ordering any equipment. The Engineering Representative shall review this equipment for accuracy with respect to system voltage and equipment ratings and then forward to Planning & Standards for final review and approval. It is recommended to submit this form early in the project to avoid delays due to long lead times.

This form will be verified on site by the Elexicon Energy inspector prior to construction.

See section "Ordering and Handling Material" for more information.

4.2.9 Issued For Construction Drawing

1) The residential subdivision hydro distribution design drawings will be created by Elexicon Energy, or a consultant selected by Elexicon Energy. If the customer selects Option B (Alternative Bid Work as defined in the DSC), they must engage their own consultant to create the residential subdivision, or condominium, hydro distribution design drawing.
2) Prior to receiving an approved engineering design drawing, the Customers civil consultant will confirm drawings are absent of civil conflicts at the following stages:
   a) 1st Circulation (transformer locations only)
   b) 2nd Circulation (full design)
3) Elexicon Energy Technical representative shall review and redline or approve the composite utility plan, as it pertains only to Elexicon Energy plant.
4) Drawing Approval for Construction:
   a) If the customer selects Option A (Ineligible for Alternative Bid Work and Alternative Bid Work by Elexicon Energy), Elexicon Energy shall provide an approved engineering design drawing, sealed by a Professional Engineer.
   b) If the customer selects Option B (Ineligible for Alternative Bid Work by Elexicon Energy, and Alternative Bid Work by Customer) the hydro distribution design drawing will be reviewed by Elexicon Energy prior to authorizing the Consulting Engineer to approve the drawings by applying their seal as a Professional Engineer.

5.0 CONSTRUCTION METHODS

The contractor information presented in the following sections is not exhaustive or complete, in the event of a conflict between the following sections and approved Elexicon Energy standards or approved for construction drawings, the standards and drawings take precedent, and the contractor must bring the deviation to the attention of the Elexicon Energy Inspector or Representative.

All construction must meet or exceed, where specified by Elexicon Energy, CSA C22.3 No. 7. Underground Systems requirements.

5.1 Pre-Requisites Prior to Construction

If the Customer proceeds with construction prior to receiving all required approvals from Elexicon Energy, the Customer is liable for all costs to rework the project to meet Elexicon Energy design standards.

Work in the public Right of Way must only be carried out by Elexicon Energy approved contractor.

The following must be completed and executed prior to Construction:

5.1.1 Permits for Work in the Right of Way

Municipal and/or regional consent, or any other relevant approvals (Hydro One, Metrolinx, Canadian Pacific Rail, Government Ministries etc.) will be obtained by Elexicon Energy (Option A) or the Consulting Engineer (Option B), for any work directly in or relation to the lands under the respective authority's jurisdiction.

Work on-site must not proceed without all applicable consent and approvals are in place, unless otherwise advised by Elexicon Energy.

The contractor will arrange for any required road occupancy permits prior to construction.

5.1.2 Approved Engineering Design Drawing

Elexicon Energy shall prepare and apply a 22/04 Certificate of Approval, signed by a Professional Engineer, to the engineering design drawing. Any drawings received by the Customer shall not be construed as approved for construction unless the 22/04 Certificate of Approval is present and signed. Where the customer has chosen Option B, the customers consultant will complete the 22/04 Certificate of Approval.

5.1.3 Approved Qualified Contractor

All work within the public boulevard will be carried out by Elexicon Energy approved contractor. The approval is a one-time process per contractor. Elexicon Energy shall review and file the contractor's commercial vehicle operator's registration (CVOR), Form 1000, Health and Safety Policy, insurance, training, Workplace Injury Summary Report(s), and Workplace Safety and Insurance Board (WSIB) certificate.

5.1.4 Pre-Construction Meeting

The Customer will hold a pre-construction meeting with Elexicon Energy and any other utilities or contractors working on the site prior to commencing construction.

The Elexicon Energy Representative(s) shall attend the pre-construction meeting.

Typical Pre-construction agenda meeting items:

1) Provide any approved drawings to contractor.
2) Confirm road occupancy permits are in place.
3) Confirm locates are in place, as required.
4) Confirm joint-use-trench profile.
5) Review inspection requirements, expectations, and construction schedule with contractor.
6) Inform the contractor of any relevant or recent changes to Elexicon Energy design standards.
7) Proposed servicing date.
8) Elexicon Energy Equipment Approval status for materials provided by contractor.
9) Confirmation water boxes are on field side of main trench.
10) Meter base locations, types, construction.
    a) Enclosed meters are not permitted.
    b) Recessed meters must meet Elexicon Energy standards.
11) Gas meter locations. Inspection schedule, arrangements, and expectations.
    a) Including early inspection of meters installed by builder
12) Locations of major gas pipelines, hydro one corridor, or 3rd party significant underground structures.
13) 3rd party coordination for connections, pedestal locations, streetlights, etc.

5.1.5 Design Deviations and As-Built Requirements

The Customer or their representative must notify and coordinate with Elexicon Energy Technical Representative for any deviations from the approved engineering design drawing before proceeding to implement them in the construction.

If the Customer or their representative fails to notify or coordinate deviations with Elexicon Energy Technical Representative, they are responsible to remedy the construction works on site to conform to the original approved engineering design drawing, at their cost.

Where the Expansion is built by the Customers' contractor, they must record all approved deviations from the approved drawings, in red pen, on copies of the approved engineering design drawing, which will then be coordinated with Elexicon Energy's inspector and marked up on the original approved for engineering design drawings, referred to as the "As-Built Drawing". The As-Built Drawing must be submitted to Elexicon Energy Technical Representative.

5.1.6 Pre-Requisites Prior to Construction (Alternative Bid Work)

Additionally, prior to the construction of Electrical Plant built under Option B of the OTC, the Customer or their Consulting Engineer will submit all final engineering drawings, designs, and specifications for the Electrical Plant, prepared in accordance with Elexicon Energy standards for review and approval.

The following items must be submitted to Elexicon Energy Technical Representative at least fifteen (15) working days prior to construction of any part of the plant:

1) A proposed schedule of construction for the Electrical Plant. Elexicon Energy shall provide a written confirmation of this approval to the Consultant or their agent. Once approved, this schedule will only be modified with prior consent from Elexicon Energy.
2) Proof of adequate insurance coverage as set out in the Subdivision / Town home Agreements with the municipality.
3) Upon request, proof of security of performance, labour and material payment bond and any cash deposit for the estimated charges as specified in the relevant Agreements with the municipality
4) Any request for access to Elexicon Energy existing energized plant along with an estimated date and duration this access is required.

5.1.7 Builder Coordination

1) Meter base locations and designs must be approved by Elexicon Energy prior to construction.
    a. Enclosed Meter Bases is not permitted.
    b. Meter Base installations must follow approved Elexicon Energy meter base standards included in the Issued For Construction drawings. Reduced clearances or other design deviations are not permitted without coordination with Elexicon Energy technical representative.
    c. The builder must contact Elexicon Energy to coordinate a review and inspection of their initial metering installations to avoid costly rebuilds.

5.2 Inspection

An Inspector shall be appointed by Elexicon Energy to oversee that approved materials and standards are installed and followed and that the installation of the Electrical Plant is in accordance with good utility practices. An Inspector may stop the work entirely if there are safety concerns, non-compliance with any of Elexicon Energy's requirements, shortage of personnel or materials, or any other reasonable cause.

Any work done in the absence of the Inspector will, upon request, be excavated or exposed for thorough examination and must be replaced or rebuilt, as directed by the Inspector, at the Customer's or the Contractor's sole expense. Approval by any inspector will not be taken as, or construed to be, an acceptance of improper work or material, which must, in every case, be removed and properly replaced whenever discovered at any stage of the work or warranty period, if applicable.

The Contractor must carry out instructions given by the Inspector immediately, but the Inspector does not have the authority to set out work or give any stakes, lines, gauges, levels, or grades.

Scheduling an appointment with Elexicon Energy Inspector must be arranged at least three (3) working days in advance by contacting Elexicon Energy's Technical Representative between the hours of 8:30am and 4:30pm, Monday to Friday. Access to energized plant will be confirmed and arranged with the inspector and Elexicon Energy's Operations staff.

5.2.1 On-Site Inspection and Testing

1) Contractor (Constructor) must provide full site access to Elexicon Energy Inspector and is responsible for his/her safety on site at all times.
   a) In all cases, the work will be inspected by the Inspector before being covered up and / or backfilled, unless otherwise directed by Elexicon Energy or its representative.
   b) All manholes, transformer vaults, foundations and duct structures will be inspected by the Inspector prior to pouring concrete or the Contractor committing any ducts or cables to them.
   c) All on-site testing of material and / or sub-systems of the Electrical Plant must be carried out only in the presence of the Inspector.
   d) Any or all testing or installation of Electrical Plant or material deemed necessary at any stage of the work and carried out by Elexicon Energy will be charged back to the Owner / Contractor.

Elexicon Energy shall inspect the site at various points during construction. The contractor is responsible for coordinating inspection in advance of the following items:

1) Pre-construction meeting.
2) Start of construction:
   a) Contractor will not proceed with construction without notifying the Elexicon Energy inspector 72 business hours in advance.
   b) Elexicon Energy inspector shall confirm equipment supplied by the contractor matches the equipment listed on the Planning & Standards approved contractor equipment document.
   c) Elexicon Energy shall confirm contractor construction methods comply with Elexicon Energy standards.
3) Elexicon Energy inspections are required prior to, and during:
   a) Trench excavation.
   b) Duct installation.
   c) Back filling road crossing installations.
   d) Pouring concrete encasement of duct, or installation of other types of mechanical protection, if applicable.
   e) Back filling duct bank.
   f) Mandrel test of cleaned ducts prior to cable installation.
   g) Concrete foundation installations.
   h) Cable pulling.
   i) Installing meter bases. If inspection can't be coordinated by the builder, then the customer is responsible for any necessary remedial work identified during final inspection. The main concern is compliance with meter base clearances when the meter base is recessed into the wall as per Elexicon Energy standard 25U-203.
   j) Pad-mounted equipment works, for conformance with Elexicon Energy standards, including:
      i) High voltage and low voltage terminations.
      ii) Grounding, including bleed wire terminations.
      iii) Underground lightning arrester scheme.
      iv) Faulted circuit indicators, complete with fibre optic leads.
   k) Energization, the site will only be energized under the direct supervision of the Elexicon Energy Inspector.
   l) Site assumption (For Option B, 2-years post construction pending final Elexicon Energy inspection).

4) If any of the required inspections are missed:
    a) The contractor is 100% responsible, and liable for all costs involved, including additional inspection and engineering charges related to corrective actions.
    b) The contractor will excavate works for inspection, at the contractor's expense, including restoration.
        i) This can include removal of concrete mechanical protection / concrete encasement if required.
5) Any proposed deviations from the Issued For Construction Drawing must be approved by Elexicon Energy prior to construction of the deviation.
    a) Failure to do so may result in the deviation being removed and works then installed per the Issued For Construction Drawing, at the contractor's expense, including additional inspection and engineering charges.
    b) Elexicon Energy engineering technician shall determine if a deviation is technical or non-technical.
        i) Technical deviations are subject to Elexicon Energy engineering manager review and professional engineer approval.
    c) Deviations will only be considered if they are a result of unknown or unforeseeable site conditions and will be at 100% the Customers cost.
        i) Deviations to reduce cost or ease construction are not permitted.
6) Clearances to gas
    a) Gas pipelines must not be installed in parallel, directly over the hydro distribution cables of any voltage.
        i) Minimum horizontal clearance to gas is 300 mm (12").
        ii) Minimum vertical clearance to gas pipeline crossing is 300 mm (12")
            (1) A sandbag will be installed between the gas pipeline and the hydro distribution cables, to achieve the minimum vertical clearance in the crossing where required.
    b) Locations where minimum separations from gas fall below these clearances must be immediately brought to the attend of Elexicon Energy Inspector or representative.

5.2.2 Remedial Work

The Contractor (Constructor) will take immediate corrective action to remedy any deficiencies noted by Elexicon Energy Inspector.

If the Contractor fails to remedy any deficiencies and complete such repairs within a reasonable time as stipulated by Elexicon Energy, Elexicon Energy reserves the right to remedy any such deficiencies and complete such repairs on its own and charge all costs to the Customer/Owner.

Any remedial work undertaken by Elexicon Energy personnel does not relieve the Customer/Owner or their representative of any obligations pursuant to the Agreements with the municipality and/or road authorities.

5.2.3 Electrical Safety Authority (ESA) Inspection

Elexicon Energy shall not energize the low voltage distribution system until the meter base(s) have passed an ESA inspection and a Connection Authorization has been sent to Elexicon Energy. The Customer is responsible to initiate and coordinate the ESA inspection.

5.3 Ordering and Handling Material

All material must conform to the approved equipment material submission signed off by Planning & Standards, requirements set out in this document including the associated standards, schematics and Issued For Construction Drawing. Any deviation from this must have written approval from Elexicon Energy, prior to ordering. Material installed, which is not approved by Elexicon Energy will be removed and replaced at the Customer/Owner's expense.

ESA requires that contractors install major equipment exactly to the specification of the local distribution company. Major equipment includes transformers, conductors, load break switches, reclosing switches, switchgears, insulators, protective devices and lightning arresters, poles, and station breakers.

Contractor supplied non-major equipment must be included on the equipment materials submission and will be examined by Elexicon Energy for equivalency with Elexicon Energy's approved equipment. All non-major equipment must meet industry standards (CSA preferred).

Work on any part of the Electrical Plant will not commence until all approved material necessary for the completion of that part, has reached and been safely stored at the construction site. The Contractor is responsible for the security of all said material on site.

The Contractor must always use proper material handling methods and equipment.

Where required, Elexicon Energy may supply, standard locks for equipment enclosures at the Owner's expense.

5.4 Trenching

5.4.1 Trench Excavations and Backfilling

All trench installations in municipal residential subdivisions must be in accordance with Elexicon Energy Standards and approved municipal right of way drawings. Deviation from this requirement requires the approval of Elexicon Energy, the local municipality or road authority, and other affected 3rd Parties. The Customer will follow directions given by the Elexicon Energy Technical Representative for any situation not covered in this specification.

Trench(es) must be excavated to sufficient depth to accommodate the designed number of ducts and cables. The Contractor will take note where underground sewer mains and services, storm drains, telephone or communications cables, gas lines, and other below ground utilities may exist near the work. Excavation around other utilities, pipes, culverts, and similar installations must be done with extreme care in accordance with the latest edition of Ontario Health and Safety Act.

It is the Contractor's responsibility to contact the Customer/operator of each utility encountered and obtain information relative to location and depth before excavating in the area. In the event of a conflict with the location of work, the encountered utilities must not be disturbed before approval is obtained from the utility's owner. Private utilities encountered will be brought to the attention of Elexicon Energy inspector. The Contractor will promptly notify the utility concerned in the event of damage occurred during construction, whether caused by him/her or others.

Unless otherwise specified, high voltage and low voltage cable runs in a trench will have 75 mm (3") of sand below and 150 mm (8") of sand above all direct buried cables/ducts, before regular backfill. The sand used will have no smooth stone over 13 mm (1/2") diameter and no crushed stone. The trench bottom will be kept as smooth as possible to permit laying of cable or duct. If in the opinion of the inspector, any part of the bottom of the trench is found unsound or in any way unsuitable, the Contractor will remove as much as may be required and replace accordingly.

See Elexicon Energy Standard 37U-600 Series "Standards for Concrete Encased duct structures and road crossings".

5.4.2 Joint-Use Trench

Unless otherwise specified, a minimum vertical separation of 300 mm (12") will be maintained between Elexicon Energy cables, and Bell Canada, Rogers and other communication cables together with a red warning tape on top of Elexicon Energy cables along the entire length of the joint use trench.

Above grade telephone and cable facilities will be located so as not to conflict with above grade Elexicon Energy plant. Pedestals will be placed clear of transformers so as not to interfere with access to the cable compartment. All pedestals placed within 1.0 m of transformers will be effectively bonded to the transformer system ground.

See Elexicon Energy Standard 37U-801 Joint Use Trench Profile, Municipal Residential Subdivision.

See Elexicon Energy Standard 37U-810 Joint Use Trench Profile, Condominium Development (Concrete Encased).

5.4.3 Road Crossings

Changes to approved crossings or crossings at an angle with respect to the boulevard must not be carried out without written consent from Elexicon Energy's representative.

Concrete envelopes under roadways must extend at least 300 mm (12") beyond the proposed curbs and be a minimum 760 mm (30") below proposed boulevard grade. In all cases, the concrete envelope below the roadway must be at a minimum depth of 1000 mm (40"). The duct ends must terminate at the main trench.

Concrete road crossings must be perpendicular to the road alignment, at a minimum depth of 1200 mm (47") and where possible, placed across from the pad-mounted transformer or switchgear and the ducts carrying utility cables will extend and terminate into the vault. All other services ducts (eg. Bell, cable etc.) will terminate before the vault, or be routed around it.

Where crossings terminate at a structure (vault, etc.) the structure will be placed first and the crossing will be poured against the wall of the structure to the other side of the street.

Hydro "red" electronic ball markers must be utilized at the start and end of all road crossings.

See Elexicon Energy standard 37U-610 "Road Crossing (1.2 m Cover)".

See Elexicon Energy standard 37U-611 "Road Crossing (1.5 m Cover)".

5.4.4 Directional Bored Duct Bank

Directionally boring is permitted except where open cut road crossings are explicitly stated on the Issued For Construction Drawing.

See Elexicon Energy standard 37U-400 "Directional Bored Duct Bank Requirements".

5.4.5 Installation of Direct Buried Ducts

The duct(s) must be laid end-to-end in as straight a line as possible to facilitate pulling in of the cable. Maximum number and radii of bends between pull points (i.e., manholes, hand holes, transformer bases/vaults etc.) will be based on pull calculations. The duct lengths must be joined together with approved couplings and bonded with PVC glue.

Where tie-ins are made to ducts left for future plant these ducts must be continued to the next structure except where required for services. These will be properly sealed using an approved duct seal once services are installed to prevent migration of silt.

All ducts that are to terminate within a structure must terminate with a bell end placed flush with the inside wall of the structure. Where these ducts enter the vault care should be taken to maintain a seal that will not allow sediment into the structure.

All ducts must be supported on a solid bed of undisturbed earth or disturbed earth compressed earth to 95% standard proctor.

Ducts terminating in soil must be plugged with plastic caps and marked by a Hydro “red” electronic ball marker.

Where two or more ducts are installed direct buried in a trench, each duct must be separated from the other by at least 90 mm (3.5").

Spacers must be installed at regular intervals, the ducts must be secured to the spacers using twine, non-conductive zip ties, or other non-conductive material.

The ends of all buried ducts and any change in the direction of the ducts will be tied down in the field and shown on the ‘As-Built’ plans.

5.4.6 Installation of Concrete Encased Ducts

Ducts shall be concrete encased where:

1) Where phases from another circuit are introduced to the high voltage section of the trench profile.
   a) four (4) phases or more.
   b) two (2) or more phases from different supply points of different feeder circuits.
2) Daylight Corners and duct bends of 45 degrees or more to a maximum of 90 degrees.
3) Road Crossings.
4) Where the main trench travels parallel to the curb under the road instead of the boulevard.

Hydro “red” electronic ball markers must be utilized at the start and end of all concrete encasement.

5.4.7 Polypropylene Pull Rope

A continuous 10 mm (3/8”) dia. polypropylene pull rope must be installed throughout the entire length of all spare ducts. This rope is to be tied off within the structure wherever possible, at the discretion of Elexicon Energy Inspector.

5.5 Cables

5.5.1 High Voltage Cables

Installation

200 A High voltage cable shall be 1/0 AWG of the appropriate voltage and insulation class as specified and approved by Elexicon Energy. No splices are permitted in the high voltage cables unless necessitated and approved by Elexicon Energy based on site specific installation requirements. High voltage cables must be labelled as per Elexicon Energy approved standards.

Termination

High voltage cables are generally be connected by Elexicon Energy; however, the Contractor is responsible to prepare cables terminations for final connection. Only trained electricians or linepersons experienced in high voltage cable terminations and approved by Elexicon Energy shall install high voltage terminations. Only Elexicon Energy approved cable terminations for high voltage cable are acceptable.

Unless otherwise specified, the high voltage cables are terminated with Elexicon Energy approved 200 Amp load break elbows. The load break elbows may be left on de-energized transformer bushings to aid in storage of elbows.

High voltage dead-end caps, plugs, standoff bushings are to be as specified in the list of Elexicon Energy approved materials.

All pole-top cable terminations will be supplied by the Contractor, for connection by Elexicon Energy. The conductor must be terminated with either a pin-type or a two-hole lug, as per Elexicon Energy standards. Overhead switches and phase terminations must be identified as required by Elexicon Energy.

For underground terminations, a fault indicator must be installed on the test point of the load side load break elbow at each transformer, switch, or junction location other than at a normally open point.

For overhead terminations, with a line tap switch, Elexicon Energy shall supply and install a fault indicator on the conductor feeding the subdivision.

5.5.2 Low Voltage Cables

Installation

Each dwelling unit on a single-family or semi-detached lot will have its own individual service cable from the transformer, low voltage junction box to the meter base. Townhouses may be similarly serviced, or two (2) or three (3) units can be energized from a single service, utilizing ganged meter bases.

The cables shall be installed direct buried on the boulevard, from the Transformer up 1.0 m beyond the service entrance point at the property line. The service shall be staked and coiled on a cable marker complete with yellow caution tag and a “back-fill note” tag.

Back-fill must be clean sand, photo records of the splice installation must be provided to Elexicon Energy as indicated on the “back-fill note” tag.

For condominium developments all services are concrete encased and individually ducted from the transformer or low voltage bus to the meter base.

Low voltage service cables are initially labelled with the lot number, then the municipal address when available. Cables are to be labelled inside the transformer or inside the flush to grade box if a low voltage bus is used. Where ganged metering is used (max. 3 position), the individual meters are labelled with the unit #.

See Elexicon Energy standards 25U-100 Series “Underground Residential Metering”

See Elexicon Energy standard 25U-209 “Typical Residential Low Voltage Service Stub and Service Trench Details”.

Termination

Cables must be ‘looped’ at the transformer and low voltage junction box (if applicable) with sufficient cable left to ensure ease of installation. Low voltage connections at transformer are made using Elexicon Energy approved connectors as specified. The cable must be slack in the meter base to allow for movement of the expansion joint in addition to the foundation loop.

Low voltage neutral cables can be connected to transformer by the Contractor prior to any cable testing. Once testing is complete, low voltage connections (other than neutral) at the transformer must be made by the contractor’s qualified personnel. Where cables are left unconnected or exposed, they must be capped with bonding cement and PVC cap, or sealed, with rubber tape and made waterproof as follows:

1) The first layer consists of two (02) wraps of self-amalgamating tape, half lapped to provide the necessary electrical characteristics for 600V and sealed against ingress of moisture.
2) The second layer consists of two (02) wraps of vinyl tape, applied half lapped to enclose the first layer of tape. It shall be made and installed in a manner to eliminate unravelling (i.e., last two lengths of wraps around the circumference of the cable, are not to be stretched).

IMPORTANT: See Elexicon Energy standard 25U-209 “Service Stub and Service Trench Details”

5.5.3 Cable Lubricant and Pulling Pits

Only Polywater J or Polywater NN cable lubricant must be used in Elexicon Energy service area, and winter or summer grade as applicable. The co-efficient of friction used in cable pulling calculations is based on this product and is very low compared to other products. Permanent pulling pits are determined during the engineering design and shown on the Issued for Construction drawings. Pulling pits not included on the plans need to be approved by Elexicon Energy prior to installation.

5.5.4 Splices

600 A high voltage feeder cable must be continuous without splices.

200 A high voltage distribution cable must be continuous without splices unless otherwise indicated on the Issued For Construction Drawing. Where splices are required to accommodate cable pulling, the splices are installed in a permanent pre-cast concrete underground structure.

The exact location of any splice must be noted on the Issued For Construction Drawing and a “3M” marker placed at the location, 300 mm (12”) below grade. All cable ends must be properly capped with a bonding cement and PVC cap or taped and identified at each termination location.

See Elexicon Energy standard 37U-200 “Splice Installation and Plant Separation of Direct Buried High Voltage Cables in Duct”.

5.5.5 Handling

The Contractor will use care in storing, handling, and installing the cables to prevent scuffing or otherwise damaging the protective covering. All direct buried cables in a common trench must be separated from adjacent cables of the same voltage class and supported at the bottom using sand bedding with minimum depth of 75 mm (3”) and a sand cover of 200 mm (8”) above.

The cables will be handled and reeled off in such a manner as to prevent kinking or bending beyond the minimum radius. The conductor must be laid as straight as possible.

Cables are trained into ducts with bell-end terminations in smooth bends and looped to a length generally equal to the vault perimeter, which is left inside the vault for connection.

5.6 Foundation Knock-outs

5.6.1 Duct Seal

All ducts will enter the foundation through existing knock-outs. Unused knock-outs will be left with knock-out cover intact. All removed knock-outs must be filled with duct seal around the incoming or duct.

5.6.2 Low Voltage Cable Entering Foundations

All low voltage direct buried cables entering a foundation must enter through a 1.5 m (min.) length of duct complete with a bell end. The duct must be sealed around the circumference of the foundation entrance using approved duct seal.

5.6.3 Grounding Conductors

Grounding and bonding cables will enter the foundation through the existing foundation lifting holes, and an approved seal must be made around these to prevent silt migration.

5.7 Construction Site Protection

During construction, Elexicon Energy is not responsible for any costs associated with the removal or resulting damage to any objects within 3.0 m of the transformer. The developer assumes all responsibility for encroaching within this area.

A protective wood structure must be built around the transformer and will remain in place until the Elexicon Energy Inspector instructed the builder to remove it. Removal by builder only.

The transformer must not be used as a table or to stack construction materials on. The transformer lid is convex and failure to maintain this feature will rust the transformer prematurely. Any transformers with damaged enclosures will be replaced at the Customers cost.

See Elexicon Energy standard 19U-106 “Transformers – Pad-mounted Construction Site Protection”.

5.8 Metering Requirements

All individual meters must be CSA approved, 4-jaw S-Base type complete with metal screw type sealing ring.

All external installations must have unobstructed clearance, as per Ontario Building Code, from the meter or gang meter installations. Meter bases must be permanently labelled with unit and/or house numbers.

No meters are to be installed by Elexicon Energy, on meter bases where the structure is not adequate to provide proper support for the meters or poses unsafe installation conditions for Elexicon Energy personnel.

5.8.1 Locations

The meter base must be located on the same side of the residence where the low voltage service enters the property line. If the meter base is on the opposite side of the property, the builder will:

1) Relocate the meter base to the same side of the residence where the low voltage service enters the property line; or
2) Relocated the low voltage service entrance to the property to the same side of the residence where the meter base is located.
    a. The service must be extended or shortened in the main trench located in the boulevard and cannot run in a separate trench located on private property for this purpose.
    b. Coordination with Elexicon Energy or the Engineering Consultant is required for pre-approval of this deviation.
    c. Deviation must be recorded on the as-built drawings.

5.8.2 Ganged or Grouped Metering Requirements

The stand-alone meter wall must be constructed by the developer’s contractor in compliance with applicable building codes. Meter walls may be incorporated into the end wall(s) of townhouse blocks.

Meter walls must be built with one row of meters placed horizontally at height of 1.65 m (5’5”) to meter from final grade.

See Elexicon Energy standards 25U-204.1“Multiple Meters Installation, Ganged”.

See Elexicon Energy standards 25U-300 “Multiple Meters Installation, Meter Wall”.

See Elexicon Energy standards 25U-300.1 “Multiple Meters Installation, Grouped”.

5.8.3 Stacked (Vertical) Metering

Stacked metering is not preferred but may be required to service high-density condo blocks where there is inadequate room or greenspace for ganged or grouped meters.

Approval from Elexicon Energy is required before proceeding with a stacked metering design.

The area in front of the enclosure doors must be kept free and clear of all obstructions, sufficient to allow the door(s) to fully open. The enclosure must be adjacent a pedestrian path that is kept free of debris and snow year-round and is accessible to Elexicon Energy.

See Elexicon Energy standards 25U-301 “Stacked Meters Installation, Condominium”.

5.8.4 Services and Transformer Size

For 50kVA transformer, the maximum customers allowed per meter wall is eleven (11). This meter wall is typically 3.9 m wide.

For 100kVA transformer, the maximum customers allowed per meter wall is twenty-one (21). This meter wall is typically 6.9 m wide.

5.8.5 Meter Labels

For the case of grouped meters, the corresponding unit numbers must be affixed to the meter. The label will be permanent and vandal resistant.

5.8.6 Third Party Equipment Metering

Unless there is an existing agreement for flat rate metering. All communication services are metered. This can be achieved using a pole mounted meter where the service is supplied from a low voltage riser pole or a low voltage metered pedestal.

See Elexicon Energy standard 25U-201 “Low Voltage Termination Pole (Customer Owned)”.

See Elexicon Energy standard 25U-210 “Low Voltage Metered Pedestal”.

5.8.7 Net Metering

Where net metering is required to accommodate solar, wind, or other generation, the customer will provide a customer disconnect complete with visible break window.

See Elexicon Energy Standard 25U-211 “Residential Underground Service Net Metering Service Mounting Location”.

6.0 UNDERGROUND DISTRIBUTION SYSTEM DESIGN

6.1 Section Scope

The remainder of this specification covers 15 kV and 28 kV insulation rated equipment and their application and configuration to meet Elexicon Energy requirements for underground distribution system design. All approved equipment conforms to industry standards (CSA, IEEE, ASTM, etc) and/or approved in compliance with Electrical Safety Authority (ESA) requirements.

While this document covers many topics, specifications, standards, and equipment approval it is not intended to replace those documents. Always refer to the final approved standard, equipment approval sheet, or specification for design purposes, accessible through the Elexicon Energy Remote Access Portal.

6.2 Elexicon Energy Remote Access Portal

All standards, equipment approval sheets, specifications, and forms referenced in this document are available to consultants working for Elexicon Energy or the Customer. To access this information, the Consultant Engineer must enter into a non-disclosure agreement with Elexicon Energy.

Contractors are provided relevant standards included as the back pages of the Issued For Construction Plan. Under no circumstances will contractors maintain their own library of Elexicon Energy Standards as they may become outdated or otherwise used for unauthorized work.

Standards are only valid for construction when included in an issued for construction set of drawings.

6.3 Clearances

All clearances must meet Elexicon Energy requirements. Reduction to CSA minimum clearance requirements must be negotiated with Elexicon Energy. Reduction to clearances less than CSA requirements is not permitted under any circumstances.

Ownership of the latest edition of CSA C22.3 No. 7 “Underground Systems” is a prerequisite for any Consulting Engineer engaged in work in Elexicon Energy’s service area.

6.4 Ampacity

Where more than one high voltage 3-phase circuit is installed in a duct structure (i.e., RWB phases plus 1 or more phases from another circuit) and/or clearances between high voltage ducts are required to be reduced to less than the clearances indicated on approved Elexicon Energy standards, The Engineering Representative or Engineering Consultant (Option B) shall engage with Elexicon Energy Planning & Standards for an ampacity assessment.

6.5 Distribution Voltages

Elexicon Energy has a wide divided service area in ten municipalities across east central Ontario. This diverse service area operates under a mix of five different system voltages, which are categorized into two equipment categories:

1) 28 kV rated equipment for 16.0/27.6 kV system voltage.
2) 15 kV rated equipment for 8.0/13.8 kV system voltage and lower which include 2.4/4.16, 4.8/8.3, 7.2/12.47 kV system voltages.

6.6 Underground High Voltage Cable

High voltage cables must be manufactured to CSA C68.5 “Shielded And Concentric Neutral Power Cable For Distribution Utilities” and marked “100%” to indicate that the cable is certified to carry its ampere rating continuously. Maximum design temperature of 90°C.

Typical high voltage cable composition:

Jacket: Poly-ethylene encapsulated jacket (PEEJ) also referred to as low linear density polyethylene (LLDPE) jacket, offering the benefits of an encapsulated concentric neutral which negate water migration along the CN.

Insulation Shield: Black semiconducting crosslinked polyolefin (SC XLPO)

Insulation: Natural electrical tree retardant crosslinked polyethylene (TRXLPE)

Conductor Shield: Black semiconducting crosslinked polyolefin (SC XLPO)

Conductor: Class B soft (annealed) unilay compressed conductor.

Includes water swellable powder to prevent longitudinal migration of water.

See Table 4, Underground High Voltage Cables.

6.7 Important Note about Mixed Equipment Ratings

Many legacy systems in Elexicon Energy service are designed using 28 kV class components and cable even though the system voltage is 13.8 kV or lower.

It is required for all new construction that the voltage class is appropriate for the system voltage, however due diligence and coordination is required with Elexicon Energy when connecting to existing high voltage cable to determine the appropriate voltage class for separable connectors and underground arresters.

New construction on 13.8 kV or lower system voltage should utilize 15 kV class components unless there is specific direction from Elexicon Energy to upgrade to 28 kV class components as part of a planned system conversion project.

6.8 200 A Separable Connectors

All separable connectors utilized by Elexicon Energy comply with IEEE 386 Standard for Separable Insulated Connector Systems for Power Distribution Systems Above 600V” meaning they are fully shielded, insulated, and submersible.

Elexicon Energy uses elbows that include capacitive test point and insulating caps complete with conductive cuffs. All 28 kV rated connectors must have blue terminals and yellow cuff indicators for vented, arc-reducing design.

All bleed wires are to be utilized.

See Table 9.

See Elexicon Energy standard 37U-501 “200A Load-break Separable Connectors Selection Chart Up to 27.6 kV”.

6.9 Trenching

6.9.1 Joint-Use Trench

Joint-Use trenches are typical and preferred.

Reasonably adequate time must be provided for Streetlights and other 3rd Parties (Bell Canada, Rogers, and other communication service providers) to prepare for the installation of their plant.

6.9.2 Road Crossings

Unless otherwise specified, road crossings must not terminate under driveways. A minimum clearance of 1m will be maintained from the edge of driveway to the road crossing. The location of the road crossings with reference to a fixed point (eg. Property line, transformer etc.) must be indicated on construction drawings.

When it is unavoidable to cross underneath a driveway, the concrete structure of the road crossing will be extended under the driveway, to follow the main trench, until 1.0m beyond the edge of the driveway.

Road crossings must not conflict with street furniture including hydrants and streetlights, a minimum clearance of 1.0m is required.

6.9.3 Ducts

All ducts installed in Elexicon Energy service area must be certified by CSA and have a copy of the CSA certificate filed with Elexicon Energy.

All ducts are to be 100 mm (4”) rigid polyvinyl chloride (PVC) duct DB2, built to CSA C22.2 No. 211.1 “Rigid Types EB1 and DB2/ES2 PVC Conduit” and spaced 90 mm (3 ½”) apart typically.

Note: Due to supply chain issues, other, not preferred, ducts, may be allowed by Elexicon Energy on a case-by-case basis, these include black or grey ducts and HDPE ducts, however these alternate ducts must also have copy of the CSA certificate filed with Elexicon Energy. Any deviations must be pre-approved by Planning & Standard and indicated on the approved contractor equipment document.

Configurations not covered by Elexicon Energy standards 37U-800 series will be arranged in a similar manner to these standards and subject to Elexicon Energy approval. The Customer will follow directions given by the Elexicon Energy Technical Representative for any situation not covered in this specification.

Spare ducts must be installed to provide future servicing to blocks of land (including parks for park lighting) and future extensions to the Development.

All low voltage service cables in privately owned condo/town home sites must be in concreted encased ducts / duct banks. Low voltage services under private driveways, porches, or any above ground structures, will be in ducts.

See Elexicon Energy standard 37U-801 for municipal residential subdivision duct bank requirements.

See Elexicon Energy standard 37U-810 for condominium duct bank requirements.

6.9.4 Concrete Encased Ducts

Ducts will be concrete encased where:

1) Where phases from another circuit are introduced to the high voltage section of the trench profile.
   a) four (4) phases or more.
   b) two (2) or more phases from different supply points of different feeder circuits.
2) Daylight Corners and duct bends of 45 degrees or more to a maximum of 90 degrees.
3) Road Crossings.
4) Where the main trench travels parallel to the curb under the road instead of the boulevard.

Hydro “red” electronic ball markers will be utilized at the start and end of all concrete encasement.

6.9.5 Cable In Duct Installation Capacity

Where Elexicon Energy standards are followed regarding duct separations, duct banks of any size may be constructed. The following notes apply:

1) Road crossings
   a. A maximum of two (2) x 3/0 services per 100 mm (4”) duct is permitted.
   b. For larger service sizes, one service per duct is permitted.
2) Low Voltage Cables in continuously concrete encased duct:
   a. 1 service per duct.
   b. For road crossings on private property (condominium), 1 service per duct.
3) Mixed Voltages:
   a. Different voltage cables must <u>not</u> be installed in the same duct.
4) Duct banks carrying three high voltage phases from 1 circuit and 1 more phase from another circuit require coordination with Elexicon Energy Planning & Standards to evaluate if an ampacity study is required.

6.9.6 Cable Pulling Calculations and Pull Pits

From CSA C22.3 No. 7:20 "Underground Systems":

"*The design of underground cable systems shall be such that maximum pulling tensions and maximum sidewall bearing pressures for the cables being installed are not exceeded during installation. These maximum values shall be determined by calculations specific to the duct system design, which is dictated by the physical limitations of the cable, the method of cable attachment, and the design of the duct structure.*

Note: To facilitate future cable removal, considerations should be made to design the cable pull to work without the aid of lubricants, and where practical, the duct structure should be designed so that the computed pulling tension and sidewall bearing pressure values are within allowable limits for pulls from either direction."

Pulling calculations must be included as a table on the P. Eng. approved Issued For Construction Drawing.

Generally, no more than 4 bends are permitted per installed cable. Bends made after the cable has been pulled, such as in a transformer foundation, meter base, or to the riser; do not count towards this maximum.

Temporary or permanent pull-pits will be considered during the design stage.

Recommended typical cable bend radius for cable pulling purposes are 1.5 m for 1/0 and 3.0 m for 500 to 1000 MCM.

6.10 600 A Feeder System Overview

A 600A underground expansion of the high voltage distribution system may be required, depending on the site size, lot fabric, and over all planning requirements for the distribution system in the subdivision area. Typically, 600A underground expansions are not required for condominium sites. The 600A underground expansion typically consists of high voltage cable in concrete encased ducts, switchgear, and connections to existing underground or overhead distribution systems. Easements are typically required for switchgear installations.

The "feeder" circuit is the backbone of the distribution system and operates at a typical looped design ampacity of 300 A with a maximum radial design ampacity of 600 A. During trouble calls or as part of planned switching operations the feeder normal open point may be moved for a radial supply to the unaffected branches while the trouble is resolved.

Looped feeder circuits typically run from riser to switchgear(s) to a riser on a different (preferred) or same overhead circuit with a normal open point in the middle.

There is no load on the feeder circuit and the risers and switchgears have solid blade switches.

6.11 600 A Riser Poles

Feeder riser poles should be considered where the future quantity of transformers in an area can exceed the amount supported by a single distribution loop relative to the system voltage. For example, green field construction in areas of municipal development should be considered for feeder system expansion, where-as in-fill projects may not require an expansion of the feeder system. Planning will determine the requirements for each project in this regard.

Refer to standard 37-104 when reviewing this section.

6.11.1 Drop Leads

Feeder drop leads comply with ASTM B3 and ASTM B8 standard specifications for copper wire.

The drop leads, regardless of system voltage, are connected to the overhead line using compression connectors (“Ampacts”) and terminated on the solid blade switch using lugs. The drop leads connect directly to the switch. Drop leads are flexible 61 strand 350 MCM copper conductor, for ease of handling.

6.11.2 Switch

A set of three 28 kV 900 A solid blade switches will be utilized for individual hot-stick operation for system voltages 4.16 kV through 27.6 kV.

See Table 1, 600A Overhead Switch Ratings.

6.11.3 Switch Bracket

The switch bracket will be three-phase heavy duty class specified to support 600A terminations and disconnecting devices. Switch mounts are inclined 20 degrees to allow easier hot-stick operation. Although the switch bracket may have provision for mounting line side intermediate and distribution type arresters, the arresters will be mounted on a separate load side arrester bracket. The bracket will be attached to the pole using ¾” bolts.

6.11.4 Arrester Bracket

The arrester bracket is identical to the switch bracket; however, the switch mounts are removed. This bracket is the attachment point for distribution class arresters and is also the attachment point for cable support wraps.

6.11.5 Faulted Circuit Indicators

Overhead faulted circuit indicators comply with IEEE 495 “IEEE Guide for Testing Faulted Circuit Indicators”.

Overhead style fault circuit indicators will be clamped over the cable (including concentric neutrals) above the cable support wrap and arrester bracket. The FCI accepts cable sizes 0.3” to 1.25”. The “load memory” feature of the FCI allows it to self-calibrate to the system voltage (2.4 through 69 kV). Current withstand is 25,000 A / 1 second symmetrical RMS. The FCI is configured in a dual reset mode either manually reset or resets after 4 hours, with 4 red LEDS and 2 Yellow LEDS indicators. The minimum trip rating is 100A at 200 ms.

6.11.6 Cable Terminations

Riser cable terminations comply with IEEE 48 “Standard for Test Procedures and Requirements for Alternating-Current Cable Terminations Used on Shielded Cables Having Laminated Insulation Rated 2.5 kV through 765 kV or Extruded Insulation Rated 2.5 kV through 500 kV”.

Riser cable terminations are cold shrink type with lugged terminations.

The cold shrink terminations are 28 kV rated, 150 kV BIL. There are multiple cold shrink termination kits available, and each kit has different cable size ranges for 15 kV vs. 28 kV rated cable.

6.11.7 Separate Neutral and Concentric Neutral

Unless specifically directed by Planning, all feeder installations will utilize the cable’s concentric neutral for the purpose of a multi-grounded system neutral.

Planning may direct the installation of a grounded-floating concentric neutral and separate neutral conductor scheme in areas operating at higher-than-normal ampacity levels.

The concentric neutrals will be bonded to the overhead system neutral using 2/0 copper conductor

See Table 5, Concentric Neutrals.

6.11.8 Grounding

Ground conductors comply with ASTM B3 and ASTM B8 standard specifications for copper wire.

Arresters and bracket ground leads will be #4 cu, bare. The individual ground leads are individually amped to a 2/0 Cu ground lead which then transitions to 2/0 Cu Clad above the neutral, before terminating into an enhanced ground disc installed on the butt of the pole.

6.12 600 A Pad-Mounted Switchgear

Switchgear complies with ANSI C37 series standards for switchgears.

Only dead front switchgear is permitted to be installed new.

Live front may be installed for like-for-like only.

SCADA control is limited to 27.6 system voltage and only as directed by Planning & Standards.

All switchgear must offer visible break of all three phases.

See Elexicon Energy standard 37U-307 “SF6 Switchgear Termination with Separate Neutral, 27.6 kV”.

See Elexicon Energy standard 37U-310 “S&C PME Switchgear Termination, 13.8 kV or Lower”.

See Elexicon Energy standard 37U-311 “G&W Solid Dielectric Switchgear Termination, 27.6 kV”.

See Table 7, Switchgear Selection.

See Table 8, Switchgear Compartment Ratings.

6.12.1 SF6 Switchgear

The only deciding factor to utilize SF6 switchgear is that it is the only switchgear technology currently that has fault current handling capacity up to 18 kA. It utilizes vacuum technology and is therefore otherwise maintenance free other than required inspection of the SF6 pressure gauge.

Sulphur hexafluoride (SF6) is considered the world’s worst greenhouse gas, 23,500 times more potent than CO2, with an atmospheric lifetime of over 1,000 years.

6.12.2 Solid Dielectric Switchgear

Solid dielectric switchgear also utilizes vacuum technology allowing for all components to be encapsulated in an epoxy moulding, which is therefore completely maintenance free. This style of switchgear is typically rated for 2,000 load break operations. The vacuum technology is flexible with regards to single or three phase trip and resettable fault interrupting mechanisms replace fuses. There are a variety of options for actuators: spring, motor, and high-speed magnetic.

6.12.3 Air Insulated Switchgear

Air insulated switchgear are an economical choice. The switchgears need to be inspected every 5 years (max.) for proper performance and alignment of components. Condensation issues were found to be associated with 27.6 kV system voltages and therefore air insulated switchgears are limited to 13.8 kV system voltages or lower. Air insulated gear are typically rated for 400 load break operations.

6.12.4 Dead Front Terminations

All separable connectors utilized by Elexicon Energy comply with “IEEE 386 Standard for Separable Insulated Connector Systems for Power Distribution Systems Above 600V”

The following separable connectors schemes are common to all dead front switchgear:

600 A T-Body Kits

T-Body kits are used to terminate the feeder cable in the switched compartments of the switchgear.

T-Body Kit Components:

Cable Adapter	The cable adapter is sized according to the feeder cables insulation, it creates a seal between the cable and the T-body
Compression Lug	The compression lug is sized according to the feeder cables core, the lug and stud are used to join the reducing tap plug to the bushing insert, housed in the T-Body.
Symmetrical Stud	The symmetrical stud is threaded into the reducing tap plug and bushing insert and supports the compression lug.
Reducing Tap Plug	A 600A to 200A reducing tap plug is the back end of the T-Body allowing for Lines to ground and otherwise troubleshoot the switchgear.
Insulating Cap	The 200A insulating cap is placed over the 200A reducing tap plug as required in a dead front installation.
T-Body	The T-Body is universal sized for system voltages and encloses the other comp

See Elexicon Energy standard 37U-502 “Switchgear T-Body Kit Detail 1/0 – 1000 MCM, 15 kV, 28 kV, 600 A”.

See Table 9, T-Body, Feeder Cable Diameter Over Insulation for Cable Adapter Sizing.

200 A Elbows

The 200 A local circuit fused compartments of the switchgear will utilize standard bushing inserts and elbow connectors.

See Elexicon Energy standard 37U-501 “200A Load-break Separable Connectors Selection Chart Up to 27.6 kV”.

See Table 10, Underground Separable Connectors.

6.12.5 Feeder Duct Bank

The feeder duct bank will be concrete encased. Provisions for a spare duct are required.

See Elexicon Energy standard 37U-600 Series for “Concrete Encased Duct Bank Requirements”.

See Elexicon Energy standard 37U-800 Series for “Joint-use Trench Duct Bank Requirements”.

6.13 200 A Distribution Overview

A 200A underground expansion of the high voltage distribution system to service the residential subdivision is required for all subdivisions and condominium sites.

The 200A underground expansion typically consists of 1/0 Cu cable in duct, 50kVA transformers, and connections to existing underground or overhead distribution systems. High voltage underground cables will be protected using an underground lightning arrester arrangement as designed Elexicon Energy.

The “local” circuit operates at a typical looped design ampacity of 100 A with a maximum radial design ampacity of 200 A. During trouble calls or as part of planned switching operations the normal open point may be moved for a radial supply to unaffected customers while the trouble is resolved.

Looped local circuits typically run from switchgear to switchgear and/or directly to riser poles on a different or same overhead circuit with a normal open point in the middle.

There is load on the local circuit and the connected risers and switchgears have fused switches.

Single-phase loop phase will be determined in coordination with Elexicon Energy Planning & Standards.

Load across each phase of a three-phase loop will be balanced as much as practicable.

See Table 13, 50 kVA Transformer Quantities Per Phase, Loop Design

See Table 14, (Future, EV Preparedness) 75 kVA Transformer Quantities Per Phase, Loop Design

See Table 16, Municipal Subdivisions Vs. Condominium Development

6.14 200 A Riser Poles

Local circuit riser poles should be considered where the future quantity of transformers in an area are unlikely to exceed the amount supported by a single distribution loop relative to the system voltage. For example, in-fill projects may not require an expansion of the feeder system and can be adequately serviced by 1 or 3 phase underground loop. Planning will determine the requirements for each project in this regard.

6.14.1 Drop Leads

Local circuit drop leads comply with CSA C61089 “Round Wire Concentric Lay Overhead Electrical Stranded Conductors”.

The drop leads are connected to the overhead line using compression connectors (“Ampacts”) and terminated below the lowest conductor attachment point, transitioning to a stirrup termination. For conductors at the lowest attachment point, drop leads are not required and stirrup terminations can be applied directly to the overhead line. Drop leads are rigid 556.5 aluminium conductor typically, minimum requirement is that they have the same ampacity as the overhead conductor. From the stirrup’s live line clamp, #4 covered copper conductor is then used to terminate to the top of the cut-out bracket.

6.14.2 Fuses

Built to IEEE C37.41 “Standard Design Tests for High-Voltage (>1000 V) Fuses, Fuse and Disconnecting Cut-outs, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches, and Fuse Links and Accessories Used with These Devices”.

A single (1-phase) or set of three fuses (3-phase) are installed in hot-stick operable cut-outs.

200 A Power Fuses for 27.6 kV. Power fuses utilize a strain wire and spring-loaded mechanism to manage the arc energy challenges unique to 27.6 kV system voltage.

100 A Fuse Links for 13.8 kV or lower. The link fuses utilize a strain wire and fuse wire composition suitable for the required ampacity, with a removable buttonhead (arc shortening rods not required).

Fuse selection is to be coordinated with the Planning & Standards Department. Fuse size is based on time-current coordination curves to ensure equipment is adequately protected.

See Table 6, Fuse Ratings.

6.14.3 Fused Cut-Out Bracket

Built to CSA 310 “Distribution Class Polymeric Cut-outs”

The fuse bracket will be single, or three-phase type, specified to support 200A terminations and disconnecting devices. Fuse attachment points are located at the end of 2” diameter fiberglass rods elevated 15 degrees to allow for easier hot-stick operation. 2” arrester clamp(s) will be provisioned with the bracket (1 per arm) to allow arrester to be installed in an underslung configuration for attachment to the load side of the cut-out. The bracket will be attached to the pole using ¾” bolts.

6.14.4 Cable Terminations

Riser cable terminations are cold shrink type with pin terminations.

The cold shrink terminations are 28 kV rated, 150 kV BIL. There are multiple cold shrink termination kits available, and each kit has different cable size ranges for 15 kV vs. 28 kV rated cable.

6.14.5 Concentric Neutral

All 200 A local circuit cable installations will utilize the cable’s concentric neutral for the purpose of a multi-grounded system neutral.

Concentric neutrals will be bundled and grounded in every 200A riser installation.

The concentric neutrals will be bonded to the overhead system neutral. For single phase, use a compression connector compatible with the #2 and system neutral conductor. For three phase join each phase to a 2/0 copper horseshoe loop and run a 2/0 copper lead to the system neutral conductor.

See Table 4.

6.14.6 Grounding

Arresters and bracket ground leads are #4 copper, bare. The individual ground leads are individually amped to a #4 copper ground lead which then transitions to #2 Cu Clad above the neutral, before terminating into an enhanced ground disc installed on the butt of the pole.

6.15 200 A Pad-Mounted Transformers

A pad-mounted transformer is the Elexicon Energy standard for new service(s) and service upgrade(s). Unless otherwise specified in the design, for residential services, these transformers are single-phase and are typically rated at 50 kVA at the supply voltage.

See Elexicon Energy Standards 19U-100 series “Pad-Mounted Transformers”.

6.15.1 Transformer Locations

The pad-mounted transformer locations on site are determined by Elexicon Energy in coordination with the Customer’s consultants and local municipality/road authority.

6.15.2 Transformer Clearances

Pad-mounted transformer include internal current-limiting fuse(s) and are equipped with a pressure relief device allowing for reduced clearances on non-access sides to combustible equipment as per OESC rule 26-242 2) b).

Minimum Clearances on door side:

1) 3.0 m working space clearance shall be maintained.

Minimum Clearances on all other sides:

1) 1.0 m from combustible surface or material on a building.
2) 1.0 m from any window, door, or ventilation inlet or outlet on a building.
3) 1.0 m from any building exterior.
4) 1.5 m from driveway curbs.
5) 3.0 m from other utilities preferred.
6) 3.0 m from landscaping (shrubs, bushes, fences, etc.), door side only.
7) 1.5 m from landscaping (shrubs, bushes, fences, etc.), sides and back.

The transformer must not be enclosed by any means, even if the enclosure exceeds the minimum clearances listed above.

In condominium developments, the transformer must be in a location specifically designated for the transformer and not intended for snow pile, garbage, general storage, or other purposes. The transformer must be visibly and freely accessible from the common element roadway. Chain-link or otherwise conductive fence / fence posts are not permitted within 3.0 m of a pad mount transformer.

1) The transformer foundation must be located within the property limits, in an area protected from vehicular traffic but always permitting free and clear access for Elexicon Energy vehicles.
2) A finished grade within 3.0 m of the transformer access side, and 1.0 m on non-access sides, must be kept level and free of obstructions.
3) Any landscaping within 3.0 m of the transformer on any sides may be trampled, removed, or damaged, without notice by Elexicon Energy to access, maintain, repair, or replace the transformer. Landscaping to be restored at the customers cost
4) The Customer will install bollards in concrete, if required, as physical protection from traffic. Bollard requirement and layout to be determined by Elexicon Energy Technical Representative or inspector. Bollard type and installation method must conform to Elexicon Energy’s requirements.

See Elexicon Energy standard 19U-107 “Pad-Mounted Transformer Clearances”.

See Elexicon Energy standard 37U-700 “Typical Bollard Installation for Single Phase Transformer”.

See Elexicon Energy standard 37U-701 “Typical Bollard Installation for Three Phase Transformer”.

6.15.3 Transformer Specifications

Elexicon Energy has prepared the following manufacturer specifications for pad-mounted transformers, available upon request for reference:

1) EETS-01 “28 kV Single Phase Dead-Front Pad-Mounted Distribution Transformers”
2) EETS-03 “15 & 28 kV Three-Phase Pad-Mounted Distribution Transformers”
3) EETS-04 “15 & 28 kV Single-Phase Vault-Type Distribution Transformers”
4) EETS-05 “15 kV Single Phase Pad-Mounted Distribution Transformers”

The main distinction between 28 kV and 15 kV single phase-padmount transformers is the inclusion of individual bushing under-oil load break switches for 28 kV transformers.

6.15.4 High Voltage Configurations

Elexicon Energy typically permits contractors to install new single voltage transformers sized to the area system voltage.

In areas with planned voltage conversion projects, Elexicon Energy requires all transformers to be dual voltage where one voltage is the current voltage and the other is the future voltage. For example, an area converting from 13.8 kV to 27.6 kV will require a dual voltage transformer rated for 8.0 x 16.0 kV.

Elexicon Energy only stocks dual voltage transformers, intended as spare inventory for trouble calls.

6.15.5 Low Voltage Bus Bar Types and Maximum Connections

Elexicon Energy will design for a maximum of ten (10) customers per 50kVA pad-mounted transformers. 3rd party pedestal locations and streetlight supply points must be accounted for, before exceeding ten services to a maximum of thirteen services, to ensure sufficient connection points for all services.

For condominium sites, this may be increased to twenty (20) customers per 100kVA pad-mounted transformer, to accommodate more than thirteen services, a ganged meter bases or low voltage bus scheme may be employed in coordination with Elexicon Energy.

6.15.6 Transformer Foundations

The transformer foundation consists of three parts:

1) The base slab (bottom)
2) The foundation (center)
3) The lid (top) (three phase only)

The transformer foundation must be sized to suit the transformer dimensions and weight.

Contact Elexicon Energy Technical Representative for listing of approved foundation manufacturers and part numbers.

All pad mounted foundation parts must have lifting lugs or similar means to maneuver the part on site.

6.15.7 Bonding of 3rd Party Equipment and Structures

Any above ground metal structure such as fence, bollards, junction boxes etc., which are located within 3.0 m (118”) of a pad-mounted transformer or switchgear, will be bonded to the ground grid of pad-mounted equipment in at least two (2) locations, separated by 0.5 m (20”) minimum.

If the 3rd party equipment is energized and located within 1.0 m (39”) - 3.0 m (118”) of a pad-mounted transformer or switchgear it must have its own ground grid complete with ground rods, which will be bonded with the ground grid of the transformer or switchgear in at least two (2) locations, using 2/0 bare Copper conductor.

All 3rd part installations must meet OESC and ESA requirements and are subject to ESA inspection.

6.16 Three-Phase Loads Included in Subdivision Designs

Three phase loads (schools typically) included in a residential subdivision application will be installed on private property and isolated from the single-phase looped design of the subdivision by either:

a) switchgear, installed in an easement on private property adjacent the Right of Way.
b) Directly connected to riser where practicable (looped).

6.17 Equipment Protection

6.17.1 Overhead Arresters

Underground arresters are built to IEC 6099-4 “Metal Oxide Surge Arresters Without Gaps for AC Systems” and IEEE C62.11 “Metal Oxide Surge Arresters for AC Power Circuits (>1kV)”.

Overhead type arresters will be gapless, polymer, heavy duty distribution class, and sized to the system voltage. Arresters must be sized to the system voltage, do not undersize or oversize the arresters.

Arrester leads are #4 Cu, covered “Transformer Drop” which is a manufacturer developed specification.

See Table 2, Overhead Distribution Arrester Ratings.

6.17.2 Underground Arresters

Dead-front underground arresters are built to IEEE C62.11 “Metal Oxide Surge Arresters for AC Power Circuits (>1kV)” and IEEE 386 “Standard for Separable Insulated Connector Systems for Power Distribution Systems Rated 2.5 kV through 35 kV”.

Underground arresters are not utilized on the 600 A Feeder System. For the 200 A looped distribution system design, the following arrester scheme is utilized.

The normal open point transformer is at the center of the loop (typically) and is supplied through H1A while H1B is not utilized, the cable intended for H1B is parked in the parking stand.

The adjacent transformers are transformers on either side of this normal open point.

1) A bushing arrester is installed on the cable connected to H1B of the adjacent transformer where H1B of the adjacent transformer is connected to H1A of the normal open point transformer.
2) A parking stand arrester shall be installed on the cable parked in the normal open point transformer.
3) An elbow arrester is installed in the unoccupied H1B bushing of the normal open point transformer.
4) A bushing arrester is installed on the cable connected to H1A of the adjacent transformer (not the same transformer as 1)) where HIA of the adjacent transformer is connected to the parking stand of the normal open point transformer.

Similar to overhead arresters, underground arresters must be sized to the system voltage, do not undersize or oversize the arresters.

Underground arresters have a separate insulation rating not related to the system voltage that must be accounted for. Overall, the cable, separable connectors, and arresters are all 15 kV or 28 kV class. It is not recommended to mix classes of connectors as this can lead to issues in the field during future remedial works for trouble calls.

See Table 3, Underground Distribution Arrester Ratings.

6.17.3 Pad-Mounted Equipment Grounding

1) Ground Rods
   a) 3/4" diameter copper-clad ground rod, 10’ in length.
   b) Note, galvanized steel ground rods are not permitted.
2) Compression Connections
   a) 2/0 Cu to 3/4" ground rod compression or mechanical connectors.
3) Lugs
   a) 1-Hole 2/0 tinned, manufactured to CSA and/or ANSI specifications.
4) Ground Conductor
   a) 2/0 Copper, 19 strand, compressed, bare, manufactured to ASTM B8.
   b) Continuous, without splices.

See Elexicon Energy standard 41U-100 “Distribution Grounding installation Underground System”.

6.17.4 Faulted Circuit Indicators

Faulted circuit indicators are placed on high voltage cables, starting at the riser pole and then on Bushing B or outgoing switchgear compartment on every pad-mounted equipment up to the normal open point.

6.18 Low Voltage Cable

For 200 A services, the standard cable size is 3 x 3/0 aluminum USEI-90.

For 400 A services, 250 MCM, or 500 MCM USEI-90 aluminum cables may be used depending on voltage drop calculations. The Customer shall retain an engineer to calculate the required cable size and coordinate with the Elexicon Energy Customers Technical Representative.

Low voltage cables must be type USEI-90 for direct buried and ducted applications.

ACWU90 armoured cables may be used for direct buried rural applications and/or applications with reduced cover in coordination with Elexicon Energy.

RWU90 cables are utilized as required for streetlight and pedestal services.

RW90 cables are not permitted to be installed underground in Elexicon Energy service area.

6.18.1 Direct Buried

For residential municipal subdivisions, the low voltage cables will run continuously, and direct buried, from the pad-mounted transformer to the property line, where the cables are staked and coiled above grade.

6.18.2 In Duct

Low voltage cable will be installed in-duct when:

1) on private property
2) in an easement
3) in concrete encased road crossings
4) when passing underneath above or below grade structures, porches, or private driveways.

See Elexicon Energy standard 25U-209 “Typical Residential Low Voltage Service Stub and Service Trench Details”.

For condominium sites, the low voltage cables will run continuously, and fully ducted and concrete encased, from Elexicon Energy pad-mounted transformer supply transformer to the meter base.

All low voltage services will be supplied by an underground distribution system only.

See Elexicon Energy engineering guideline ENG-002 “Engineering Guideline for Low Voltage Service Sizing”.

6.18.3 Installation of Flush to Grade, Traffic Rated, Low Voltage Junction Box

Installation of low voltage junction boxes is subject to Elexicon Energy review and approval.

Low Voltage Junction Boxes may be utilized where:

1) Service runs exceed 90 m at the rated capacity.
2) There is insufficient green space to install additional transformers or high voltage cable.
3) Any other reasons where individual services directly from the transformer is not practicable.

A low voltage junction box may be installed at or near the load centre to facilitate connection of low voltage services. In this instance, the services from the service entrance at lot lines will be terminated at this Junction Box using ANSI C119.1 compliant multi-port type connectors to a suitably sized low voltage bus. The other end of the low voltage bus is terminated at the Transformer. All low voltage cables are installed in individual ducts that are direct buried on municipal property or concrete encased on private property, as per Elexicon Energy approved installation standards.

See Elexicon Energy standard 25U-208 “Flush to Grade Low Voltage Multi-port Enclosure for Grouped Meter Wall or High-Density Sites, Condo (Typ.)”

6.18.4 Low Voltage Riser Pole

Elexicon energy uses composite cable guards on the riser poles. Low voltage services do not require a weather-head.

See Elexicon Energy standard 25U-100 “Low Voltage Termination Pole”.

6.19 Residential Metering

6.19.1 Individual Metering

All meter bases are generally located on the same side of the house where the low voltage service enters the property line, and the following criteria is considered:

1) If the residence/unit has no garage, then the meter location is on the side opposite to the driveway.
2) If the residence/unit has a garage and the low voltage service enters the property line on the driveway side, then the meter is located on the side of the garage.
3) Row Townhouses:
    a. For townhouse or row housing, the meter base is typically located on the porch either facing the street or rotated 90 degrees. Where such arrangements cannot be made, a specific location and installation detail must be verified from Elexicon Energy prior to installation. The meters may also be located in a ‘ganged’ or ‘grouped’ metering location where the low voltage service enters the property line at the end of a block of attached units where the meters are located.

See Elexicon Energy standards 25U-200 series for meter base standards and low voltage service arrangements.

6.19.2 Grouped or Ganged Metering

Grouped or ganged metering can be located on one or both sides of a townhouse or row housing structure, or on a free-standing meter wall.

Grouped meters are individually supplied directly from the transformer or low voltage junction box using 3/0 Al. USEI90 triplex cable.

Ganged meters must be 2 or 3 position type (maximum) and serviced directly from the transformer or low voltage junction using 3/0 Al. USEI90 triplex cable.

Due consideration shall be taken if electric charger stations are included with the residences to ensure adequate service sizes. Requirements for service sizes larger than 3/0 aluminum USEI90 triplex must be communicated to Elexicon Energy by the Customer.

6.19.3 Stacked (Vertical) Metering

Stacked metering is not preferred but may be required to service high-density condo blocks where there is inadequate room or greenspace for ganged or grouped meters, or free-standing meter wall.

The Customer must retain an engineer to calculate the required cable size to service the stacked meter.

Selection of stacked meter make and model, enclosure, and door design, and locking mechanism, will be coordinated with Elexicon Energy.

6.20 Pre-Cast Concrete foundations

All concrete foundations shall be built to CSA A23.1 “Concrete Materials and Methods of Concrete Construction.”

See Elexicon Energy standard 19U-302 “Three-Phase Transformer Foundation & Ground Grid Installation”.

See Elexicon Energy standard 19U-303 “1 MVA – 3 MVA Transformer or 24+ Low voltage Cables Foundation & Ground Grid installation”.

See Elexicon Energy standard 37U-101 “Pre-cast Concrete Product Requirements”.

See Elexicon Energy standards 37U-300 series for pre-cast concrete pad-mounted equipment foundations.

See Table 11, Pre-Cast Concrete Foundation Dimensions.

6.21 Multiplex Junction Units

Multiplex junction units are temporary open point installations where the high voltage cable can be safely parked until the next phase of construction begins. The main benefit of a multiplex junction unit is that it can be used to create a temporary looped circuit, where the current phase of construction would otherwise be a radial feed.

Where the high voltage cable in the current phase of construction can be looped without a multiplex junction unit, then it is recommended to install empty spare ducts to the limit of the construction phase from the last transformer(s) instead.

These dead front load break units are available in 15 or 28 kV ratings, 200A, and 1 phase 3 ways, 1 phase 4 ways, 3 phase 3 ways, and 3 phase 4 ways.

Due to the inconsistent footprint of multiplex junction units, the selection of the make and model of foundation must be coordinated with the contractor at the design stage to facilitate the correct selection of the concrete pre-cast foundation. The pre-cast foundation will be reviewed during the contractor equipment approval submission by Planning & Standards.

6.22 Remote Locations

Due to the unique geography in remote locations, such as Gravenhurst, special consideration towards methods of construction is required. Note, in developed areas of the remote locations, regular construction rules apply.

Known deviations from standards for rural construction include:

1) The use of 15kV overhead insulators instead of 27.6kV through wooded areas.
2) Use of smaller overhead conductor instead of 556.5 through wooded areas.
3) Height restriction of poles due to limited vehicular access.
4) Prohibition of concrete poles due to transport issues.
5) Coordination with Ministry of Environment for:
    a. Submarine cable crossings and landings.
    b. Pole proximity to water (preservative leeching).
6) Pole cribbing in swamp or marsh lands.
7) Reduced cover of underground cable and equipment, requiring additional means to satisfy CSA's requirement for mechanical protection.
8) Alternate grounding schemes where rods cannot be installed, such as utilization of enhanced ground plates and enhanced conductive cement.
9) Use of fibre-glass pad-mounted equipment foundations.

See Elexicon Energy Standard 19U-501 "Typical Distribution Transformer Foundation Ground Grid for Rock or Low Bury Depth".

See Elexicon Energy Standard 37U-609 "Shallow Trench Installation Remote Locations".

6.22.1 Submarine Cable Landing

Installation of submarine cables are subject to provincial and federal requirements. Coordination with the Ministry of Environment and Central Lake Ontario Conservation Authority is required for all installations. The submarine cable is encased in helical armour rods from the littoral zone to the high watermark before switching to concrete encasement.

See Elexicon Energy Standard 37U-901 "1-Phase Submarine Cable Landing".

7.0 AUTOCAD DRAFTING GUIDELINE

7.1 Setup

Elexicon Energy's AutoCAD customization includes a tool palette, which allows for the insertion of dynamic blocks and approved line types, and project drawing templates.

7.1.1 Tool Palette Installation

Installation Instructions for Employee's

Load and apply the latest Elexicon Energy AutoCAD Profile.

CTRL-3 shortcut opens and closes the tool palette window.

Installation Instructions for Consultants

Change the tool palette path under AutoCAD options to match the path to where you have installed (downloaded and copied) the Elexicon Energy tool palette.

In the tool palette window, multi-select all block insertion tools and update the path of the source file "LDC Blocks Library.dwg" to where you have saved it to.

Tool palette line type insertion tools work as intended and do not need to be updated.

For assistance with this process contact the Elexicon Energy Standards Technician.

The consultant may choose to forgo the use of the tool palette and access blocks directly from the blocks library file at their discretion.

7.1.2 Tool Palette Visual Customization

Due to technical limitations, the order of blocks on each tab of the tool palette may not appear in a rational order. These steps only to be completed once per user.

Tabs

Category tabs can be re-ordered by right-clicking on the tab and selecting "Customize Palettes.."

Commands In Tabs

Blocks and/or line-types can be re-ordered by dragging and dropping the commands in the preferred order.

7.1.3 AutoCAD LISP Routines

A few of the tool palette commands require LISP (AutoCAD programming language) routines. These are loaded using "Load Application…" from the Tools drop-down menu, then selecting "Contents.." and adding the LSP file extension files from the Elexicon Energy drawing standard files.

7.1.4 Drawing Templates

Elexicon Energy drawing templates are available for capital, general service, residential, and schematic type projects.

Revisions to the drawing templates will be posted in the Elexicon Energy Remote Access portal.

7.2 Civil Base Insertion and Formatting

Confirm that the civil base meets all the requirements laid out previously in this document.

Do not scale or rotate the meter base, adjust your AutoCAD universal coordinates system (UCS) until the desired orientation of the civil base is achieved.

By following this method, when the revised civil base block is inserted into your drawing, it will be exactly in place of the existing civil base, allowing for greater expediency to update the design. The obsolete existing civil base should be deleted before exploding the new civil base block. There are also benefits to the GIS technician by using this technique. Also, by following this method, there should be no issues with text embedded in line types being generated upside down.

Property lines, curbs, driveways, and above ground plant are to be recoloured white. The remainder of the civil base is reformatted to grey (AutoCAD colour 8).

All text and line art present in the civil base irrelevant to the hydro distribution design should be removed, however when in doubt, left in.

Examples of information that can be deleted are typography lines (provided the gradient changes have been accounted for in the hydro distribution design), over land water flow details, text around civil features such as manholes, etc.

Overall, the goal is to provide a clean and easy to read drawing without compromising the engineering.

7.3 Line Types

For line types that include dashes or text, it is recommended to convert the lines to continuous poly-lines, with line type generation enabled to ensure the text is properly represented on the drawing.

7.3.1 Colour Schemes

Elexicon Energy uses line types and colours to convey the intention of the drawing. This is also supported by a colour independent lettering scheme.

State	Colour	Letters
Existing	Black	N/A
Proposed	Red	P
To Be Removed	Blue	X
To Be Abandoned	Green	A

7.3.2 Conductors and Cables

Overhead Conductors are continuous line type and include text to indicate the system voltage or rms voltage line-to-ground and phase colour.

Underground Cables are dashed line type and include text to indicate the system voltage or rms voltage line-to-ground and phase colour.

7.3.3 Trenching

Trenching follows the same conventions listed above, without the system voltage text. The trench must be a polyline with a width equivalent to the trench and drafted to its actual physical location.

7.4 Dynamic Blocks

Dynamic blocks are symbols that can be scaled or have their state (proposed, existing, to be removed, to be abandoned) updated using grips directly attached to the block. These blocks also include attributes that are linked to the drawing template layers for proper representation on the Issued For Construction Drawings.

Some dynamic blocks also include grips to allow the block to be lengthened, flipped, rotated, etc.

Blocks have civil and general arrangement components that only appear through the associated viewports in paper space. In model space, the block can be viewed in its entirety.

7.4.1 Colours and Line Types

Equipment blocks follow the same convention as line types with a few minor changes. If the equipment is proposed and the symbol has an internal shape, it is typically filled with a solid hatch to indicate it is new (in addition to red continuous line type). Where there is no internal shape, an internal line type may appear thicker than the existing version.

State	Colour	Line type	Hatch
Existing	Black	Dashed	None
Proposed	Red	Continuous	Solid
To Be Removed	Blue with Red “X”	Dashed	None

7.5 Drafting Rules

7.5.1 Drawing Orientation

The drawing should be orientated so that the North Arrow faces “up” and at least one major road on the plan travelling across the length of the sheet is “flat”. For large projects, the orientation should be the same on all sheets regardless of the road orientations for spatial clarity.

7.5.2 Scales

Drawing units shall be 1 unit = 1.0 m

Drawing Scale	AutoCAD Viewport Scale
1:250	4
1:500	2
1:1000	1

7.5.3 Text

It is preferred that text be rotated either flat (90°) or up to -90°, readable left to right or bottom to top. If there is a technical issue with the drawing where this cannot be achieved, then upside down text may be permitted only where it is embedded in a line type. All text outside of line types may be manually rotated to the preferred orientation.

1) All text must be the arial font.
2) Natural features, if named shall be black arial-italic font.
3) Lakes and rivers, if named shall be blue arial-italic font.
4) Yellow text is not permitted.
5) Line art shall not overlap the text.
    a. Turn on the background mask of the multi-line text (mtext).
    b. Manually break the line art over the text and delete any remaining pieces of line.

7.6 Sheet Sets

It is recommended to review existing approved drawings, and exam the templates in the layer manager to understand the requirements of each sheet.

The following is a non-exhaustive summary of the drawing template components.

7.6.1 Layers

Each sheet has a specific collection of layers enabled for that sheet. This enables the dynamic blocks to render properly on each sheet. When adding new sheets, it is therefore important to duplicate an existing sheet of the same type.

7.6.2 Certification Blocks

Certification blocks are completed by Elexicon Energy under Option A.

Certification blocks are signed and stamped by the Consulting Engineer, under Option B, only after express permission has been granted by Elexicon Energy to proceed with final approval of the construction drawings.

7.6.3 Title Block, Cover Page, Revision History

There are several tables located on the cover page and the title blocks for each sheet. These must be completed with the indicated required information.

Revisions prior to approval follow a lettering scheme (A, B, C..).

Revisions after the drawings have been issued for construction follow a numeric scheme (0, 1, 2..).

7.6.4 Schematic Sheet

The schematic sheet is drafted for legibility only without emphasis on real world coordinates.

The entire project schematic is represented on this single sheet, when possible.

7.6.5 Electrical Arrangement Sheet

The electrical arrangement can be considered a schematic overlaid on the civil base. Dynamic blocks with a civil component (such as a foundation) must be placed to real world coordinates, however cable types may be represented schematically for easy reading. General design notes should be included on these pages.

7.6.6 Civil Arrangement Sheet

The civil arrangement is entirely drafted to real world coordinates.

Equipment must be dimensioned when offset from a property line.

Trenches are dimensioned from the ROW line.

Civil notes, duct profile drawings, etc, should be included on these pages.

7.6.7 Standards Sheet

The Standards sheets are located at the back of the drawing set and include all relevant standards for the proposed construction work.

Up to fifteen (15) PDFs of the latest Elexicon Energy approved standards maybe inserted on to each Standards Sheet.

Elexicon Energy does not issue loose standards to contractors, the approved standards sheets included in the IFC drawing package are the only way to obtain the latest and correct standards for the project.

The Consulting Engineer (if applicable) is responsible to download Elexicon Energy standards from Elexicon Energy SharePoint Remote Access for each job.

8.0 EQUIPMENT SPECIFICATION TABLES

Table 1, 600A Overhead Switch Ratings

Rated Voltage (kV)	Current (A) Rated / Momentary	Nominal BIL (kV)	Flashover 60 Hz (kV) Dry / Wet	Leakage Distance (“)	Dry Arc Distance (“)
28	900 / 40,000	150 kV	160 / 65	17.2	7.6

Table 2, Overhead Distribution Arrester Ratings

System Voltage (kV)	Duty Cycle (kV)	Maximum Continuous Operating Voltage “MCOV” (kV)	Maximum Switching Surge Protective Level @ 500 A (kV)
2.4/4.16	3	2.55	7.3
4.8/8.3	6	5.1	14.7
7.2/12.47	8	7.65	21.5
8.0/13.8	10	8.4	23.4
16.0/27.6	21	17	47.0

Table 3, Underground Distribution Arrester Ratings

System Voltage (kV)	Separable Connectors Class Interface (kV)	Duty Cycle (kV)	Maximum Continuous Operating Voltage “MCOV” (kV)	Maximum Switching Surge Protective Level @ 500 A (kV)
2.4/4.16	15	3	2.55	8.5
4.8/8.3	15	6	5.1	17.0
7.2/12.47	15	9	7.65	23.0
8.0/13.8	15	10	8.4	24.0
16.0/27.6	28	21	17	49.0

Table 4, Underground High Voltage Cables

System Voltage (kV)	Cable Voltage Class (kV)	Application	Cable Size (MCM or AWG)	CSA Cable
27.6	28	600 A Feeder	1000 or 500[1]	EXCN
13.8 or lower	15	600 A Feeder	500	EXCN
27.6	28	200 A Local Circuit	1/0	EXCN
13.8 or lower	15	200 A Local Circuit	1/0	EXCN

[1] *- as directed by Planning & Standards*

Table 5, Concentric Neutrals

System Voltage (kV)	Cable Size (MCM)	1/3 Concentric Neutral (CN)	CN Bundled Diameter	Separate Neutral Cable[1]
27.6	1000	30 x 0.105”	330 MCM	1000 V 500 MCM RWU90 CU
27.6	500	26 x #12	3/0	1000 V 500 MCM RWU90 CU
27.6 or lower	1/0	16 x #14	#2	N/A

[1] *- separate neutrals not normally required, only install as directed by Planning & Standards*

Table 6, Fuse Ratings

System Voltage (kV)	Cut-out Rating (kV)	Fuse Type (K Speed)	BIL (kV)	Maximum A (K Speed)	Interrupting (A, RMS, Symmetrical, 60 Hz)
16.0 / 27.6	25	Power Fuse	150	200	12,500
8.0 / 13.8 or lower	15	Fuse Link	110	200 or 100	12,000 @ 200 10,000 @ 100

Table 7, Switchgear Selection

System Voltage (kV)	Max. Fault Current (kA Sym.)	Switchgear Type
27.6	18.0	SF6
27.6	12.5	Solid Dielectric (SD)
13.8 or lower	14.0	Air Insulated (PME)

Table 8, Switchgear Compartment Ratings

Switchgear Compartments / Ratings	SF6 600 A	SF6 200 A	Solid Dielectric 600 A	Solid Dielectric 200 A	Air Insulated 600 A	Air Insulated 200 A
Max Design Voltage (kV)	29.3	29.3	29.3	29.3	17	17
Impulse Level (BIL) (kV)	125	125	125	125	95	95
AC 1 Min. Withstand (kV)	40	40	40	40	35	35
DC 15 Min. Withstand (kV)	78	78	78	78	53	53
Continuous Current (A)	630	630	630	630	600	600
Interrupting Current Sym. (kA)	630	18	630	12.5	600	14
Momentary Current, RMS Asym. (kA)	40	-	20	-	36.4 sym.	-
Making Current, RMS Asym. (kA)	40	-	20	-	36.4 sym.	-
1 Sec Rating, RMS Sym. (kA)	25	-	12.5	-	14	-

Table 9, T-Body, Feeder Cable Diameter Over Insulation for Cable Adapter Sizing

System Voltage (kV)	Feeder Cable Size (MCM)	Cable Adapter Sizing (Dia. over Insulation)
27.6	1000[1]	1.73”
27.6	500	1.37”
13.8 or lower	500	1.19”

[1] – as directed by Planning & Standards

Table 10, Underground Separable Connectors

System Voltage (kV)	Underground Separable Connector Type	Separable Connector Class (kV)	Current Rating (A)	AC Withstand Voltage (kV)	BIL (kV)	Corona Extinction (kV)
27.6	Elbow	28	200	45	125	21
	Bushing insert	28	200	40	125	19
	Insulating Cap	28	200	40	125	19
13.8 or lower	Elbow	15	200	34	95	11
	Bushing insert	15	200	34	95	11
	Insulating Cap	215ICC	200	34	95	11

Table 11, Typical Pre-Cast Concrete Foundation Dimensions

Pad-Mounted Equipment	Base (L x W x H) (mm [“])	Foundation (L x W x H) (mm [“])	Lid (L x W x H) (mm [“])
1-Ph Transformer	1626 x 1168 x 152 [40 x 58 x 6]	1473 x 1016 x 1067 [40 x 58 x 42]	N/A
3-Phase Transformer	1829 x 1829 x 152 [72 x 72 x 6]	1829 x 1829 x 1219 [72 x 72 x 48]	1829 x 1829 x 152 [72 x 72 x 6]
3-Phase Transformer 24+ Service Cables or MVA category	N/A (Clam-Shell)	3353 x 2154 x 1370 [132 x 85 x 54]	3353 x 2154 x 229 [132 x 85 x 9]
Switchgear (SF6, Solid Dielectric, and Air Insulated)	2337 x 2159 x 152 [92” x 85” x 6”]	2337 x 2159 x 1219 [92” x 85” x 48”]	2337 x 2159 x 152 [92” x 85” x 6”]

Table 12, Meter Base Examples

METER TYPE	CUTLER HAMMER	HYDEL	MICROLECTRIC	MURRAY JENSON
200 A, GANGED	2K2	HC22R	BDA2 (OH), BDC2-5V (UG)	
400 A, GANGED	2K4	HC42R	BS42-V	
200 A, INDIVIDUAL	LM2		BS2-TCV	EK400R0
400 A, INDIVIDUAL	TCC5-3	CT4-3	JS4B-300/5	

*ANY CSA APPROVED, 4 or 5 JAW, WEATHERPROOF TYPE 3R ENCLOSURE, TUNNEL TYPE, SCREW TYPE RING MAY BE INSTALLED BY THE BUILDER PROVIDED THEY ARE EQUIVALENT TO THESE EXAMPLES. CO-ORDINATE WITH ELEXICON ENERGY INSPECTOR FOR METER BASE SELECTION.

9.0 UNDERGROUND DISTRIBUTION DESIGN TABLES

Table 13, 50 kVA Transformer Quantities Per Phase, Loop Design

1-Ph. System Voltage (kV)	Transformer Qty.	Transformer Size (kVA)	Total kVA	Amps[1] (50%)	Cable (200A)
16.0	34	50	1700	106	1/0 Cu.
8.0	17	50	850	106	1/0 Cu.
7.2	15	50	750	104	1/0 Cu.
4.8	10	50	500	104	1/0 Cu.
2.4	5	50	250	104	1/0 Cu.

*Total kVA = Transformer Qty. * Transformer Size*
Amps = Total kVA / 1-Ph. System Voltage (kV)
[1]Cable has been derated to ~50% ampacity to accommodate future electric vehicle initiatives

Table 14, (Future, EV Preparedness) 75 kVA Transformer Quantities Per Phase, Loop Design

1-Ph. System Voltage (kV)	Transformer Qty.	Transformer Size (kVA)	Total kVA	Amps[1] (80%)	Cable (200A)
16.0	34	75	2250	159	1/0 Cu.
8.0	17	75	1275	159	1/0 Cu.
7.2	15	75	1125	156	1/0 Cu.
4.8	10	75	750	156	1/0 Cu.
2.4	5	75	375	156	1/0 Cu.

*Total kVA = Transformer Qty. * Transformer Size*
Amps = Total kVA / 1-Ph. System Voltage (kV)
[1]200A Cable derated 80% per OESC.

Table 15, Municipal Subdivision Vs. Condominium Development

Item	Municipal Subdivision	Condominium Development
Easement	Only for plant on private property	Blanket Easement
Primary Metering	Not Required	Required if owner elects to own installation
High voltage Trenching	Direct buried in duct	Concrete encased in duct
Low voltage Trenching	Direct buried in boulevard, in duct on private property	Concrete encased in duct
Trench Profile	Joint Use Trench	Concrete encased joint use trench
Low voltage Distribution	Transformer to meter	Transformer to meter; or Transformer to LV junction box
Over Underground Parking	Not Permitted.	Not Permitted unless the owner installs a primary meter and assumes ownership of the distribution system.
Metering	Individually serviced meters	Individually serviced meters preferred. Application for stacked metering to be reviewed on a case-by-case basis.

APPENDIX A: REFERENCE STANDARDS (TYPICAL)

19u-101 Single Phase Padmount Transformer (Up To 167kva)

19u-102 Single Phase Padmount Transformer Foundation And Ground Grid Typical Installation

19u-103 Single Phase Padmount Transformer Open Point Arrester Configuration

19u-104 Single Phase Padmount Transformer Adjacent To Open Point Arrester Configuration

19u-105 Typical Installation Of Underground Faulted Circuit Indicator (Fci) For Single Phase Transformer

19u-106 Padmount Transformer Construction Site Protection

19u-107 Padmount Transformer Clearances

25u-203 Low Voltage Residential Underground Service Recessed Meter Base

25u-203.1 Low Voltage Residential Underground Service Recessed “Milk Box” Meter Base

25u-204 Low Voltage Residential Underground Service Non-Recessed Meter Base

25u-204.1 Low Voltage Residential Condo Underground Service Non-recessed Meter Base

25u-205 Residential Low Voltage Service Arrangement Detached Houses

25u-206 Residential Low Voltage Service Arrangement Corner Detached Houses

25u-207 Residential Low Voltage Service Arrangement Semi-Detached Houses

25u-208 Low Voltage Bus, Multi-Port Enclosure

25u-300 Grouped Metering, Condominium

25u-300.1 Multiple Meters Installation Residential – Townhouses Only

25u-301 Stacked Metering

37u-200 Splice – Installation And Plant Separation Of Direct Buried Primary Cables In Ducts

37u-301 Switchgear (1981 X 2159) Foundation & Ground Grid Installation

37u-302 Switchgear (2159 X 2337) Foundation & Ground Grid Installation

37u-303 Switchgear (3353 X 2159) Foundation & Ground Grid Installation

37u-304 Vista Switchgear (3353 X 2159) Foundation & Ground Grid Installation

37u-307 Distribution Feeder, Sf6 Switchgear Termination 1000mcm /W 500mcm Separate Neutral, 27.6kv, 600a

37u-501 Loadbreak Separable Connectors Elexicon Energy Selection Chart

37u-502 Distribution Feeder Termination, Switchgear, T-Body Kit Detail 1/0 – 1000mcm, 600A

37u-503 Elbow And T-Body Arrangement For Temporary Energization Pending Switchgear Installation, 600A

37u-700 Typical Guard Post (Bollard) Installation For Single Phase Transformers

37u-701 Typical Guard Post (Bollard) Installation For Switchgear Or Three Phase Transformer

37u-800 Joint-Use Duct Bank Requirements

37u-801 Joint-Use Trench Profile Residential Development, Municipal

37u-802 Typical Joint Use Trench, Municipal Subdivision, 1-Circuit

37u-810 Joint-Use Trench Profile, Residential Development, Private Condominium

37u-811 Typical Joint Use Trench, Private Condominium, 1-Phase

APPENDIX B: PANDEMIC RELATED SUPPLY CHAIN ISSUES

This temporary appendix is intended to address known pandemic related supply chain issues and will be removed once the supply chain is restored to normal.

Ducts

Only CSA certified ducts continue to be permitted for installation. Permissible ducts, in order of preference are:

1. RED RIGID PVC DB2 DUCT
2. BLACK RIGID PVC DB2 DUCT
3. GREY RIGID PVC DB2 DUCT
4. RED HDPE DUCT
5. BLACK HDPE DUCT
6. 6. GREY HDPE DUCT

Non-Rigid Ducts are not permitted except with express permission for rural applications.

Transformers

Transformer lead times vary and can be 24 months or more.

APPENDIX C: EXPANSION PROJECT ECONOMIC EVALUATION DATA INPUTS FORM FROM CUSTOMER

Job Name: Job Number:

elexicon ENERGY

Expansion Project
Economic Evaluation Data Inputs Form from Customer

This form must be completed by Customer for Elexicon to prepare an initial Offer to Connect /a final Offer to Connect (pick one)

1.0 Customer Information			
Name of Project:			
Project Location/Address:			
Customer Legal Name:			
Customer Contact:		Telephone #:	
Customer Contact Email:		Facsimile #:	
Customer Officer:		Who has authority to bind the Customer	
Customer Officer Title:		Email:	
Mailing Address:			
Customer HST Number:			
Customer Legal Counsel:			
Civil Consultant:			
Civil Consultant Contact:		Telephone #:	
Email:		Facsimile #:	

2.0 Legal Description of Lands & PIN Number(s)	
Legal Description of Lands:	
PIN Number(s):	

3.0 Description with Revision & Date of Drawings Including Site Plan, Grading Plan & Single Line Diagram					
Name of Drawing(s):		Revision:		Date:	
Name of Drawing(s):		Revision:		Date:	
Name of Drawing(s):		Revision:		Date:	
Name of Drawing(s):		Revision:		Date:	
Name of Drawing(s):		Revision:		Date:	
Name of Drawing(s):		Revision:		Date:	

4.0 Forecasted Connections (for Residential Developments)

Number of Connections	Year 1 (20)	Year 2 (20)	Year 3 (20)	Year 4 (20)	Year 5 (20)	Totals
Estate-Style	0	0	0	0	0	0
Single Detached	0	0	0	0	0	0
Semi-Detached	0	0	0	0	0	0
Townhouses	0	0	0	0	0	0
Other	0	0	0	0	0	0

Customer EE Data Inputs Form V.0 2022-03-10 Page 1 of 2

Job Name: Job Number:

5.0 Forecasted Demand (for General Service)						
	Year 1 (20____)	Year 2 (20____)	Year 3 (20____)	Year 4 (20____)	Year 5 (20____)	Totals
Number of Connections	0	0	0	0	0	0
Demand (kW)	0	0	0	0	0	0
6.0 Forecasted Demand (for Larger User)						
	Year 1 (20____)	Year 2 (20____)	Year 3 (20____)	Year 4 (20____)	Year 5 (20____)	Totals
Number of Connections	0	0	0	0	0	0
Demand (MW)	0	0	0	0	0	0

Customer Approval:			
Approved By:			
Signature of Customer/Customer's Authorized Agent			
Print Name:		**Print Title:**	
Name of Customer:		**Date:**	

APPENDIX D: RATING OF 1/0 COPPER CABLE IN DUCT PER ESA

Table D10B
Allowable copper conductor ampacities for the installation configuration of Diagram B4-2

(See Appendix B Note to Rule 4-004.)

Size, AWG or kcmil	1/Phase Detail 1		2/Phase Detail 2		4/Phase Detail 3	6/Phase Detail 4
	100%	80%	100%	80%	—	—
1/0	208	172	201	172	159	146
2/0	242	200	228	200	180	164
3/0	280	231	260	231	204	186
4/0	327	270	296	270	231	211
250	361	298	325	298	252	230
350	450	371	391	371	303	275
500	561	462	475	462	364	330
600	621	518	521	518	404	365
750	706	592	589		448	406
1000	823	700	682		526	474
1250	920	791	759		571	515
1500	1004	882	824		618	556
1750	1077	959	880		659	592
2000	1139	1029	928		692	622

Notes:

(1) *This Table gives the allowable current for 90 °C rated single copper conductors with spacings installed in non-metallic underground raceways, subject to Rule 4-004(16) and (17), where*
- *(a) the load is continuous; and*
- *(b) either end of the cable terminates at a fusible switch or circuit breaker.*

(2) *The columns with the heading "80%" indicate that the equipment identified in Note (1)(b) is not marked as certified to carry its ampere rating continuously.*

(3) *The columns with the heading "100%" indicate that the equipment identified in Note (1)(b) is marked as certified to carry its ampere rating continuously.*

(4) *The ampacities provided in this Table are the lesser of*
- *(a) the value obtained in accordance with Rule 4-004(1)(d); or*
- *(b) the value obtained in accordance with Rule 8-104(7).*

Elexicon Energy Inc.

Answer to OEB Commissioner's Questions

OEB Panel-4

Ref 1: Technical Conference 1 – Transcript pages 54-55, 134

Ref 2: Reminder of Distributor Discretion to Extend Customer Connection Horizon for System Expansions, December 22, 2022 (https://www.oeb.ca/sites/default/files/OEB-staff-Letter-Customer-Connection-Horizon-20221222.pdf)

Ref 3: Appendix B-2, pages 5, 6 and 10.

Preamble:

Reference 1, pages 54-55 of the technical conference transcript day 1, Elexicon Energy stated that for the purpose of the DCF Elexicon Energy considered the Brooklin Development Group as one customer for Phase 1 and for Phase 2 it would treat different customers connecting to the feeders at different times. For Phase 1, Elexicon Energy also stated that because of the way Phase 1 is defined, it does not expect any revenue from the Brooklin Development Group.

Reference 1, page 134, Elexicon Energy implies the developers, its customer, staged the project and the phasing of this application.

Reference 2 is a letter issued by OEB staff reminding electricity distributors of OEB staff's view that under the Distribution System Code electricity distributors have the discretion to extend the customer connection horizon that is used in distribution system expansions. Appendix B of the Distribution System Code includes a statement that for customer connection periods of greater than 5-years, an explanation of the extension of the period must be provided to the OEB.

Reference 3 indicates that the Brooklin Development Group, which account for 60% of the landowners in the area and 87% of the housing, are planning on building between 10,081 to 11,217 new homes by 2041 at a pace of 700 DER/EV-ready homes a year for the next 20-years.

a) Why is Phase 1 a discrete project as required by the OEB's ICM funding criteria? Please explain.

b) Has Elexicon Energy or the Brooklin Landowners developed an estimate of the residential level distribution build out for (Phase 2) over 20-years. If yes, please provide the annual estimated cost.

c) Please provide a DCF calculation in accordance with Appendix B of the Distribution System Code together with the live excel model considering Phase 1 (option 1) and Phase 2 on a combined basis. Please include the Brooklin Landowner's minimum and maximum annual

customer connections and the associated annual Phase 2 cost from the projected date of energization over a 5-year, 10-year, 15-year, and 20-year time horizon. Please include all assumptions.

d) Please provide a DCF calculation in accordance with Appendix B of the Distribution System Code in a live excel model considering both Phase 1 and Phase 2 on a combined basis assuming the cost for a single 27.6 kV pole line design. Please include the Brooklin Landowners minimum and maximum annual customer connections and the associated annual Phase 2 costs from the projected date of energization over a 5-year, 10-year, 15-year, and 20-year time horizon. Please include all assumptions.

Response:

a) The Phase 1 project is a one-time, system extension triggered in response to customer demand and is not part of typical annual capital programs. The amounts are outside of the base upon which the rates were derived.[1] As such, Elexicon believes it meets the Incremental Capital Module ("ICM") criteria of a "discrete" project.

For clarity, and to aid all stakeholders in this proceeding, Elexicon provides the following explanation about the use of Phase 1 and Phase 2 with respect to connecting the North Brooklin homes to the Elexicon distribution grid. The Brooklin Landowners Group anticipates that the construction of new homes in North Brooklin area will occur in several phases over the next 20 years.[2] Therefore, power supply is being constructed in two phases as electricity demand increases over time when: (i) the Brooklin Landowners Group constructs new homes; and (ii) other real estate developers build residential and commercial properties in the North Brooklin area.

Phase 1 involves the construction of two new 27.6 kV looped main feeders from Whitby TS to a demarcation point on Columbus Road in the North Brooklin area. Phase 2 involves the construction of feeder(s) from the demarcation point, or other points along the Brooklin Line, to each subdivision in the North Brooklin area. The nomenclature "Phase 1" and "Phase 2" is intended to represent the required sequencing of a series of discrete projects. None of the Phase 2 projects can proceed without the North Brooklin Line.

- **Phase 1:** A portion of the ICM application pertains to Phase 1 construction for the Brooklin Line. As detailed in Appendix B and B-2 of the Application, Phase 1 encompasses a discrete capital project and associated Distribution System Code ("DSC") exemption

[1] See also section 3.2.2 of Appendix B – Incremental Capital Module Whitby Smart Grid & Sustainable Brooklin.
[2] Brooklin Landowners Group interrogatory response to STAFF-12(a).

request. Phase 1 of the Brooklin Line is colloquially referred to as an extension cord from the Whitby TS to a demarcation point on Columbus Road.

While the initial build-out of the Brooklin Line will only incorporate a single looped circuit from the Whitby TS to accommodate the capacity requirements of initial development phases, the poles installed for the Brooklin Line have been designed to accommodate three circuits to serve future phases of growth in North Brooklin. Please see Figure 1 in Appendix B-2 Sustainable Brooklin Business Case for the distribution infrastructure layout.

The customer for the Phase 1 Brooklin Line under the DSC is the Brooklin Landowner Group, who has intervened in this proceeding and for which the OEB has received evidence via the Brooklin Landowner Group interrogatory responses filed on January 9, 2023. Absent the Brooklin Line, none of the Phase 2 projects could proceed because there would be no proximate source of supply from which to draw. All of the landowners and developers in North Brooklin stand to benefit from the Brooklin Line, unlike the discrete projects for each individual landowner and/or developer in Phase 2.

- **Phase 2:** Phase 2 projects are a series of discrete connections of newly constructed North Brooklin subdivisions that will each "plug-in" to the end of the extension cord constructed in Phase 1. Each North Brooklin developer subdivision is being considered as a separate distinct customer connection project which will have its own Discounted Cash Flow ("DCF") Economic Evaluation model. None of the Phase 2 projects can occur without Phase 1 being placed in-service.

  Phase 2 represents a sequence of discrete projects that will span years to connect individual subdivisions and two additional circuits that may be potentially added to the Brooklin Line as a result of this growth. At this time, Elexicon is dealing with 30 discrete customers constructing subdivisions, as detailed in the Brooklin Landowners Group response to STAFF-12(d). Each of the customers in this response have a different forecasted construction schedule for subdivision development, including when electricity service is required.

  Finally, the Brooklin Landowners Group response to STAFF-15(c) states: "The Phase 2 project should not be confused with the individual connections from the street to individual dwellings which would, in any event, need to be constructed pursuant to individual "Offers to Connect" made by Elexicon, to the owners of such dwellings."

  In summary, Phase 1 is a discrete project because it is a looped circuit supplying electricity to facilitate development in the North Brooklin area for all landowners and/or developers, whereas Phase 2 is anticipated to be a series of discrete projects supplying electricity from

the Brooklin Line to discrete subdivisions within the North Brooklin area for individual landowners and/or developers.

b) Elexicon did not develop an estimate of the residential level distribution build out for Phase 2. As explained by Mr. Corey during the Technical Conference, each of the different developers that together constitute the Brooklin Landowner Group are at varying stages of subdivision draft plan approval[3] (also shown in Attachment 3 to Staff-12 in the Brooklin Landowners Group supplemental responses).

It is difficult to predict what these individual developers will do, as it will depend on when they get all necessary permits and approvals as well as the market and economics at the time of such approvals. Rather, Elexicon and the developers have been working from an assumption of 700 new houses per year during Phase 2 at Elexicon's estimated average subdivision extension cost of $5,000 per new home.

c) Elexicon has included the requested DCF calculations below and filed live Excel versions with this response. For the purpose of producing the requested DCF calculations, Elexicon has made the following assumptions (in addition to the scope of work discussed in this response to OEB Panel-4):

- 5 years, 10 years, 15 years, and 20 years models were completed which consider the combined Phase 1 and Phase 2 costs.
- A 25-year customer revenue horizon was used in all DCF calculations.
- The Phase 1 (i.e., North Brooklin Line) cost is $26.6M, which is consistent with Elexicon's ICM funding request.[4]
- The cost of Phase 2 is assumed to be $14.4M. This assumption is based on the taking the difference between the Brooklin Landowners Group evidence that the capital cost for securing electricity supply to the subdivisions will cost $41M[5] and the Phase 1 cost noted above.
- The cost to connect 700 individual homes to supply loops consistent with the attachments 2 to 6 in Undertaking JT1.19 is assumed to be $3.5M (i.e., $5,000 X 700 individual homes).
- The Brooklin Developers are assumed to build approximately 700 DER/EV-ready homes per year up to a total of 11,200 homes, commencing in 2023.

Elexicon identifies that the results below have a high probability of inaccuracy, particularly in relation to Phase 2 cost estimates, given the potential range of values in the assumptions used

[3] Technical Conference Transcript Day 2, page 118
[4] Appendix B – Incremental Capital Module Whitby Smart Grid & Sustainable Brooklin, Page 6 of 56
[5] Brooklin Landowners Group interrogatory response to STAFF-20(a)

to generate these results. Significant changes to any one of these assumptions can materially impact the economic analysis. The following tables summarize each of the DCF model calculations:

Table 1 – 5-Yr DCF Model Calculation Results

Total Cost of Project	$58,500,000
Capital Contribution by Customer	$43,970,871
Elexicon's Contribution	$14,529,128
Capital Contribution Recovery Rate (CCRR) (% of Project Total)	75%

Table 2 – 10-Yr DCF Model Calculation Results

Total Cost of Project	$76,000,000
Capital Contribution by Customer	$49,334,523
Elexicon's Contribution	$26,665,476
Capital Contribution Recovery Rate (CCRR) (% of Project Total)	65%

Table 3 – 15-Yr DCF Model Calculation Results

Total Cost of Project	$93,500,000
Capital Contribution by Customer	$53,196,257
Elexicon's Contribution	$40,303,742
Capital Contribution Recovery Rate (CCRR) (% of Project Total)	57%

Table 4 – 20-Yr DCF Model Calculation Results

Total Cost of Project	$97,000,000
Capital Contribution by Customer	$54,187,413
Elexicon's Contribution	$42,812,586
Capital Contribution Recovery Rate (CCRR) (% of Project Total)	56%

With respect to the scenario(s) requested in this additional question, Elexicon does not believe that an extension of the connection horizon is warranted or appropriate in these circumstances. Elexicon identifies that a substantial capital contribution would be required from developers in all scenarios provided.

Elexicon is also of the view that it is not appropriate to combine Phase 1 (option 1) and Phase 2 into a single DCF calculation under Appendix B of the DSC, which states:

"The discounted cash flow (DCF) calculation **for individual projects** will be based on a set of common elements and related assumptions listed below." [Emphasis added]

As discussed in the response to OEB Panel-4(a) above, each of Phase 1 and Phase 2 are individual projects. Phase 1 is intended to be the backbone feeder for development in the Brooklin Area, whereas Phase 2 projects are comprised of a series of connections from the Brooklin Line to newly constructed subdivisions. All of the developers in North Brooklin stand to benefit from the Brooklin Line, unlike the discrete subdivision connection projects in Phase 2 that will only benefit the landowner.

As detailed in the Brooklin Landowners Group response to STAFF-12(a) and (d), there are currently 30 landowners at various stages of the approval process. Combining Phase 1 and 2 together is not customer friendly. For example, combining the phases would require a developer for a subdivision in 2035 to pay for their subdivision extension in 2023.

d) Elexicon has included the requested DCF calculations below and filed live Excel versions with this response. For the purpose of producing the requested DCF calculations, Elexicon has made the same assumptions noted in part c) of this response, with one exception. An estimated cost of $13.9M is used for Phase 1, assuming the cost for a single 27.6 kV pole line design (not a looped circuit).

Elexicon identifies that the results below are speculative, particularly in relation to Phase 2 cost estimates, and that many assumptions have been made to generate these results. Significant changes to any one of these assumptions will materially impact the economic analysis.

Table 5 - 5-Yr DCF Model Calculation Results - Single 27.6 kV Pole Design

Total Cost of Project	$45,800,000
Capital Contribution by Customer	$32,900,347
Elexicon's Contribution	$12,899,652
Capital Contribution Recovery Rate (CCRR) (% of Project Total)	72%

Table 6 - 10-Yr DCF Model Calculation Results - Single 27.6 kV Pole Design

Total Cost of Project	$63,300,000
Capital Contribution by Customer	$38,441,564
Elexicon's Contribution	$24,858,435
Capital Contribution Recovery Rate (CCRR) (% of Project Total)	61%

Table 7 - 15-Yr DCF Model Calculation Results - Single 27.6 kV Pole Design

Total Cost of Project	$80,800,000
Capital Contribution by Customer	$44,115,677
Elexicon's Contribution	$36,684,322
Capital Contribution Recovery Rate (CCRR) (% of Project Total)	55%

Table 8 - 20-Yr DCF Model Calculation Results - Single 27.6 kV Pole Design

Total Cost of Project	$84,300,000
Capital Contribution by Customer	$45,273,781
Elexicon's Contribution	$39,026,218
Capital Contribution Recovery Rate (CCRR) (% of Project Total)	54%

As provided in response to OEB Panel-2(e), Elexicon determined that building one 27.6kV circuit would not be sufficient to supply the required power to the North Brooklin development and allow Elexicon to meet its obligations to maintain the safety, reliability and quality of supply to customers in the North Brooklin community.

If the OEB elects to only fund one of the two pole lines with an ICM, Elexicon will require the Brooklin Landowners to fund the second pole line as an expansion to its distribution system to ensure that the system continues to be designed and constructed in accordance with its engineering standards to satisfy its legal obligations regarding safety and reliability as set out in its conditions of licence and DSC[6].

[6] Throughout the DSC there are numerous references to the distributor's obligations to maintain the reliability and quality of electricity service. The DSC defines "good utility practice" as:

> "..the practices, methods and acts engaged in or approved by a significant portion of the electric utility industry in North America during the relevant time period, or any of the practices, methods and acts which, in the exercise of reasonable judgment in light of the facts known at the time the decision was made, **could have been expected to accomplish the desired result at a reasonable cost consistent with good practices, reliability, safety and expedition.** Good utility practice is not intended to be limited to the optimum practice, method, or act to the exclusion of all others, but rather to be acceptable practices, methods, or acts generally accepted in North America;" [emphasis added]

Elexicon cites the following sections of the DSC: Section 3.2.28 A Connections and Expansions, Section 4.1.1 Quality of Supply