

E16. INSTALLATION OF STREET LIGHTING AND ASSOCIATED WORKS

DESCRIPTION

- E16.1 The Work shall consist of the supply of all supervision, labour, materials (except as indicated in E16.8) insurance, tools and equipment (and their maintenance), transportation, fuel, oil, meals and lodging, mobilization and de-mobilization, and warranty of workmanship as required to remove existing street light poles and install new street light poles and associated underground cables/conduits, all in accordance the requirements specified in the tender documents.
- E16.2 The proposed street light installation and removals are shown on Drawing 1-04707-DE-50000-0137 and are as follows:
- (a) Victor Street from St. Matthews Avenue to Ellice Avenue
 - (b) Markham Road from Chancellor Drive to the CNR Tracks
 - (c) Chancellor Drive from Augusta Drive to Markham Road
- E16.3 The work shall be conducted in a manner to ensure street lighting is maintained for the duration of the work. See Manitoba Hydro Drawing 1-04707-DE-50000-0137 for the proposed work sequence.
- E16.4 Prior to the proposed works The Contractor's crew foremen, electricians, and other key personnel shall attend one (1) day of training provided by Manitoba Hydro for various operations such as cable handling, cable splicing, installation of street light poles, concrete bases, luminaires and various other construction standards and procedures. The Contractor will be responsible for all costs associated with personnel salaries, travel, sustenance and overheads, etc., during training. The Contractor personnel being trained are responsible to bring Contractor equipment for training purposes. The Contractor personnel will be certified on the equipment that they will be using in the field.
- E16.5 Licensed journeyman electricians, and/or, apprentices under the supervision of licensed electricians, are required to connect, terminate and splice. The Contractor shall be prepared to provide proof of licenses to the Contract Administrator upon request.
- E16.6 Referenced Standard Construction Specifications
- E16.6.1 In addition to these Specifications, the Work to be performed by the Contractor relative to the installation and/or replacement of street lighting poles and concrete bases shall be in accordance with the following:
- (a) Manitoba Hydro 66kV and Below Standards
 - (b) CSA C22.3 No. 7 (latest edition)
 - (c) Canadian Electrical Code (CEC) Part 1 (latest edition)
 - (d) Any other applicable codes
- E16.6.2 Revisions and updates to the Manitoba Hydro 66kV are issued periodically and the latest issued version of the standard will apply. For the convenience of the Contractor for bidding purposes, excerpts of the Manitoba Hydro 66kV have been included as Appendix B.
- E16.6.3 In some cases, Municipal, Provincial or Federal laws or this Technical Specification may be more stringent than the CSA Standards. Whenever conflict exists, the Contractor shall comply with the most stringent requirements applicable at the place of the Work
- E16.7 Experienced and Trained Contractors
- E16.7.1 The following contractors are experienced and trained vendors to complete all associated works for the proposed installation of street light standards :

- (a) Tri-Star Traffic Inc.
 Attention: Mr. Joey Hydrochuk
 101 - 356 Furby Street
 Winnipeg, Manitoba
 R3B 2V5

- (b) Lohr Underground Construction
 Attention: Mr. Charles Lohr
 PO Box 27
 Ile Des Chene, Manitoba
 R0A 0T0
 Phone: (204) 799-3581

TOOLS, EQUIPMENT AND MATERIALS

E16.8 The Contractor will be required to provide all tools and equipment as required for performing the specified tasks. Equipment shall be in good operating condition, shall be properly maintained using original equipment manufacturer replacement parts and shall be provided with letters of testing/inspection from the manufacturer when requested. Where the equipment is provided as a kit with multiple parts and tools, the kit shall be complete with all parts required to perform the designed task. Contractor fabricated tools or equipment will not be accepted for use.

E16.9 The Contractor shall obtain the following specific Electrical Equipment including but not limited to:

E16.9.1 Compression tool or tools and associated dies to perform compressions to a maximum size of 1/0 Al (MD-6 compression tools shall not be used).

E16.9.2 Approved compression tools are:

Manufacture	Type	Model No.	Range
Bundy	In-line, battery	PATMD68-14V	350 coil AL
Camber	In-line, battery	B54Y (06V081E)	4/0 AWG AL
Bundy	Pistol, battery	BUR PAT60018V	350 coil AL

E16.9.3 Dies shall be of the type shown in Standard CD210-21 and CD 210-24 only, must have identical markings, and compression tool die must match die number stamped on connector.

- (a) Midyear Model #4444 or Fluke 1AC-II Volt Alert potential
- (b) Indicator
- (c) Voltage meter – Fluke model #T3C
- (d) Insulated wire cutters – used for cutting cable ends square.

E16.10 Alternative equipment manufactures shall be considered upon request by the Contractor and shall be approved for use by the Contract Administrator prior to use.

E16.11 The Contract Administrator will reject any tools or equipment that do not appear to be in good condition or fail to successfully provide the required function.

E16.12 Manitoba Hydro shall supply all street light poles, concrete bases, breakaway bases, luminaires, street light arms, ground rods, compression sleeves, grommets, nuts, electrical cables, conduits, relays, cable guards and all other materials noted in the Standards. The Contractor shall sign receipts indicating the part of the project on which the materials are to be used from the following locations which the materials are to be picked up from:

- E16.12.1 Manitoba Hydro's Waverley Service Centre - 1840 Chevrier Blvd - Winnipeg, Manitoba
Contact:
- E16.12.2 Manitoba Hydro Stores - 1315 Notre Dame Avenue- Winnipeg, Manitoba (contact
personnel will be provided to the successful contractor).
- E16.13 Materials requested will be supplied to the Contractor by Manitoba Hydro upon presentation of
Manitoba Hydro's Stores Material Order Form signed by Manitoba Hydro. The Contractor shall
assume all responsibilities for the loading, transportation, proper handling, secure storage and
working of the materials and shall make replacements at its own expense in case any material
is damaged, stolen or lost due to improper handling, storage or poor workmanship.
- E16.14 The Contractor shall, at the time of materials release, check and confirm the quantity of
materials. Shortages, discrepancies, or damages to materials shall be immediately reported in
writing to the Contract Administrator.
- E16.15 The Contractor will be responsible to furnish gravel, sand, $\frac{3}{4}$ down limestone, $\frac{1}{4}$ down
limestone, and pit-run material for backfilling around street light poles and around cables as
required. The cost of furnishing materials shall be incorporated into the unit prices for the work.
- E16.16 Upon completion of the Work, the Contractor shall, at its own expense, deliver to the delivery
point(s), depots, storage lots or warehouses designated by the Contract Administrator, all
materials furnished by Manitoba Hydro and not used in the Work, regardless of the location of
said material at that time.
- E16.17 In addition, the Contractor shall, at its own expense, deliver to the delivery point(s), depots,
storage lots, storage lots or warehouses designated by the Contract Administrator, all reclaim
materials from the Work including but not limited to concrete bases, steel poles, power installed
bases and wire.
- E16.18 Reclaim material shall be sorted into the following categories and returned to:
- E16.18.1 Manitoba Hydro, 1840 Chevrier Blvd, Winnipeg, Manitoba
- (a) copper - poly covered
 - (b) copper - bare (ground wire)
 - (c) control cable (2C - 12, #4 AL C/N)
 - (d) steel (street light poles, power installed screw bases)
- E16.18.2 Rocky Road Recycling, 4154 McGillvary Blvd, Winnipeg, Manitoba Contact:
- (a) concrete (precast, poured in place)
- E16.19 Reclaimed street light poles shall be disassembled by removing the davit arm and at all tenon
joints. If street light poles cannot be disassembled at the tenon joints, the Contractor shall cut
the street light poles apart at the tenon joints prior to returning to the depot at 1840 Chevrier
Boulevard, Winnipeg, Manitoba.

CONSTRUCTION METHODS

- E16.20 Electric Cables and Conduits
- E16.20.1 The Contractor shall use diligent care and proper equipment in handling of all cables, so as
not to injure the jacket and avoid gouging, kinking, scratching or abrading the cables. If any
material is damaged to any extent, the Contractor shall repair the damages at its own
expense, in a manner approved by the Contract Administrator or will be charged the full
cost of the damaged items.
- E16.20.2 Cable reels shall not be dropped and must be handled and placed/stored in an upright
position at all times and shall not be laid flat for any purpose or reason. Cable reels shall
be adequately supported on hard surface to prevent the reel from sinking into the ground
that can cause undue stress on the cables. Cable reels should be inspected for damages

prior to use. If a cable reel is found to be defective, such defect shall be reported immediately to the Contract Administrator.

E16.20.3 The Contractor shall place all material and string the cables in such a manner as to cause the least interference with normal use of the land, street or roadway. All material shall be unloaded in a manner to preserve its condition, prevent loss and/or theft and permit easy access for Purchaser's inspection.

E16.21 Precast Concrete Bases

E16.21.1 The Contractor shall handle, store and transport the precast concrete bases in a manner to prevent damage to the threaded bolts and conduit casing.

E16.21.2 Precast Concrete Bases are extremely heavy. Approximate weight of pre-cast concrete base for 25'/35' pole is 680 kg. The Contractor shall only use equipment rated for such weight.

E16.22 Street Light Poles and Arms

E16.22.1 The Contractor shall handle, store and transport the poles and arms in a manner to prevent damage.

E16.23 Luminaires

E16.23.1 The Contractor shall handle, store and transport the luminaires in their original packaging and in a manner to prevent damage.

E16.24 Bulbs and Small Material

E16.24.1 Bulbs, photo electric cells, shorting caps, shims, nut covers and associated supplies shall be kept in a suitable warehouse provided by the Contractor at its own expense. Bulbs and photo electric cells shall be transported and stored in such a manner as to prevent breakage.

E16.25 Care of Materials

E16.25.1 The Contractor shall assume all responsibilities of all the materials and shall replace, at its own expense, any materials damaged, stolen or lost due to improper handling or poor workmanship.

E16.26 Wire and Cable Reel Storage

E16.26.1 Cable reels shall be stored with the flanges upright and resting on a hard surface. At temporary storage sites where the soil may be soft, preservative-treated plywood sheets may be used to keep the flanges from sinking into the ground.

E16.26.2 If cable reels must be pancaked or stored on their side in vertical racks, do not lift the reel by the top flange. Spacers (two 2 X 4s placed wide side up) should be placed under the bottom flange and between the reels in order to create a space to insert the forks and lift the reels without damaging the cable.

E16.27 Reel Handling

E16.27.1 When off-loading reels from a truck, reels shall be lowered using a hydraulic gate, hoist or forklift truck. When a reel is rolled from one point to another, care must be taken to see that the reel does not straddle objects such as rocks, pipes, curbs or wooden blocks which could damage the cable or protective covering. A reel should always be rolled on hard surfaces to avoid sinkage and in the opposite direction to the cable wraps to ensure that the reel is rolled in such a direction as to tighten the cable on the reel.

E16.27.2 When using a hoist, install a mandrel through the reel arbour hole and attach a sling. Use a spreader bar approximately 6 inches longer than the overall reel width placed between the sling ends just above the reel flanges. This will prevent bending of the reel flanges and damage to the cable.

- E16.27.3 If a forklift is used to move a reel, the reel is to be approached from the flange side. Position the forks such that the reel is lifted by both reel flanges. The lift forks shall not contact the cable.
- E16.28 Pressurized Water/Vacuum Excavation
- E16.28.1 Pressurized water/vacuum excavation (PW/VE) shall be used to daylight all buried utilities and structures where excavation by other mechanical means would be expected to provide a physical risk to that utility or structure
- E16.28.2 Work shall be performed in accordance with the requirements of the Manitoba Hydro safe excavation procedures and Manitoba Hydro Safety Circular 0065/07R included as Appendix C.
- E16.29 Removal Street Light Pole From Existing Base
- E16.29.1 This shall include all Work required to remove a street light pole from an existing base as set forth in this Technical Specification. The pole may be on an existing precast concrete base, steel power installed screw base or poured in place concrete base. The Contractor shall apply handling techniques in accordance with Workplace Health and Safety Regulation 217/2006
- E16.29.2 Prior to Commencement of Construction Manitoba Hydro's staff shall be responsible to disconnect and isolate the street light pole or poles to be replaced. Manitoba Hydro WORKER PROTECTION CODE (Lockout) - 0147/08R shall be followed prior to the start of any Work to remove a street light standard or base.
- E16.29.3 The Contractor shall employ its own lockout procedure in addition to that required by Manitoba Hydro WORKER PROTECTION CODE (Lockout) - 0147/08R to comply with the lockout program stipulated in Manitoba Regulation 217, part 16. 14-18 and part 38.14-15. The Contractor shall ensure that a potential (voltage) check is conducted on each and every service conductor prior to any Work taking place to ensure that the service cables are de-energized. Some street light poles may have been temporarily fed from overhead. This overhead feed will be removed by Manitoba Hydro prior to the Contractor commencing with the Work.
- E16.29.4 The Contractor shall furnish all labour and supplies necessary for the removal of the street light pole from the existing base. Care shall be taken to preserve the luminaire. The luminaire shall be reinstalled on the new street light pole or returned to Manitoba Hydro's stores as instructed by the Contract Administrator.
- E16.29.5 The Contractor shall be responsible to transport all salvaged poles, luminaires and appurtenances to a location specified by the Contract Administrator.
- E16.30 Removal of Concrete Base and Direct Buried Street Light Pole
- E16.30.1 This shall include all excavation, whether by auger, pressurized water/vacuum excavation, by hand, or by other methods which may be necessary to remove a concrete base or direct buried street light pole. The concrete base may be poured in place concrete, steel power installed screw-in or precast concrete. The Contractor shall apply handling techniques in accordance with Workplace Health and Safety Regulation 217/2006.
- E16.30.2 Prior to Commencement of Construction Manitoba Hydro's staff shall be responsible to disconnect and isolate the street light pole or poles to be replaced. Manitoba Hydro WORKER PROTECTION CODE (Lockout) - 0147/08R shall be followed prior to the start of any Work to remove a street light standard, concrete base or direct buried street light pole.
- E16.30.3 The Contractor may employ its own lockout procedure in addition to that required by Manitoba Hydro WORKER PROTECTION CODE (Lockout) - 0147/08R. The Contractor shall ensure that a potential (voltage) check is conducted on each and every service conductor prior to any Work taking place to ensure that the service cables are de-energized.

- E16.30.4 The Contractor shall be responsible to transport all salvaged concrete bases and poles to a location specified by the Contract Administrator.
- E16.30.5 All excavation practices must conform to Manitoba Hydro safe excavating procedures and Manitoba Workplace Safety and Health Regulation 217/2006.
- E16.31 Installation of Foundation - Concrete Base
- E16.31.1 This shall include all excavation, whether by auger, pressurized water/vacuum excavation, by hand, or by other methods which may be necessary to replace or install a concrete base as set forth in this Technical Specification. The Contractor shall apply handling techniques in accordance with Workplace Health and Safety Regulation 217/2006.
- E16.31.2 The Contractor shall furnish all labour and supplies necessary to install a new or replace a concrete base. Excavation for the precast concrete base shall be to a diameter and depth specified in Standard CD 300-6. All excess material is to be removed by the Contractor.
- E16.31.3 The concrete base shall be set on a bed of compacted gravel or $\frac{3}{4}$ down limestone. The concrete base backfill material shall be compacted in lifts of 150 mm. Backfill material may be spoil, pit run gravel or $\frac{3}{4}$ down limestone. Compacting of backfill material shall be done using a hydraulic tamper. Underground cables entering the concrete base shall be protected by a layer of sand surrounding the cables and protecting it from the limestone and/or use a section of fire hose for cable protection as directed by the Contract Administrator. The concrete base shall be installed level in all 4 directions. Final grade must be established prior to installing the concrete bases.
- E16.31.4 The completed backfill shall be at least equal in compaction to undisturbed soil or as required by Municipal authorities. Backfill material is to be placed and compacted in lifts not exceeding 150 mm. The Contractor shall level all excavations.
- E16.31.5 Should settlement occur in the excavation and cause a depression in the surface, the Contractor shall repair the surface. Placing of additional backfill material due to settlement shall be at no cost.
- E16.31.6 The concrete base shall be oriented in the proper direction to allow the easy entrance of the underground cables into the plastic pipe preinstalled in the concrete base. Care shall be taken to prevent damage to the insulation or jacket of the conductors. The cable shall be left long enough to extend one (1) metre beyond the top of the hand hole
- E16.32 Base Mounted Street Light Poles
- E16.32.1 This shall include all Work required to install the street light pole on the concrete base as set forth in this Technical Specification. The Contractor shall apply handling techniques in accordance with Workplace Health and Safety Regulation 217/2006
- E16.32.2 The Contractor shall furnish all labour and supplies necessary for the installation of the pole (straight shaft or davit) on the concrete base.
- E16.32.3 Unless otherwise specified on Drawing 1-04707-DE-50000-013, the Contractor shall orient the poles so that the hand hole is on the left side of the pole when viewed from the road. A worker should be able to see oncoming traffic when working in the hand hole.
- E16.32.4 The Contractor shall level the street light pole in all 4 directions. Leveling shims may be used.
- E16.32.5 Tightening of bolts should be performed in a manner that brings the surfaces up evenly. All nuts shall be tightened and torqued in accordance with Standard CD 300-9. The Contractor shall install the nut covers included with the pole. Nut covers are typically not supplied for the 55' and 65' street light poles.
- E16.32.6 Excess underground cable and 2C-12 wire shall be left inside the hand hole with the hand hole cover loosely installed for new street light pole installations in new areas.
- E16.32.7 Existing street light poles may have street signs attached. The Contractor shall remove the signs from the existing pole and temporarily reattach the signs to the new pole. The

Contractor shall notify the Contract Administrator of the location where the signs have been removed.

E16.33 Luminaires and Associated Wiring

- E16.33.1 The Contractor shall furnish labour and supplies necessary to install the luminaire and associated wiring. Unless otherwise specified, the luminaire shall be installed with a tilt of zero (0) degrees. The Contractor shall install a length of 2 conductor No. 12 gauge (2C-12) wire from the terminals of the luminaire, through the arm (if applicable), down the pole to the hand hole. One (1) metre of 2C-12 wire shall be left at the hand hole.
- E16.33.2 The Contractor shall verify luminaire voltage matches source voltage as shown on the drawings. If luminaire voltage does not match the source voltage, the Contractor shall re-wire the luminaire in accordance with the wiring diagram provided.
- E16.33.3 As specified in Drawing 1-04707-DE-50000-0137 the luminaire will require either a photo electric cell (PEC) or shorting cap installed. The Contractor shall also install the appropriate wattage bulb in the luminaire.

E16.34 Break Away Bases

- E16.34.1 Break away bases shall be installed in accordance with Standard CD 300-10. The height of the concrete base above grade should not exceed 50mm. The surface of the concrete base shall be flat and level. A reaction plate shall be installed between the concrete base and the break-away base.
- E16.34.2 The Contractor shall torque the couplers in accordance with Standard CD 300-10

E16.35 Splicing/Connecting Cables

- E16.35.1 The electric cable shall be spliced/connected as per Standards CD 215-12, CD 215-13, CD 310-4, CD 310-9 and CD 310-10
- E16.35.2 Prior to commencement of construction Manitoba Hydro's staff shall be responsible to disconnect and isolate the street light pole or poles to be replaced. Manitoba Hydro WORKER PROTECTION CODE (Lockout) - 0147/08R shall be followed prior to the start of any Work to splice/connect a cable.
- E16.35.3 The Contractor shall employ its own lockout procedure in addition to that required by Manitoba Hydro WORKER PROTECTION CODE (Lockout) - 0147/08R to comply with the lockout program stipulated in Manitoba Regulation 217, part 16. 14-18 and part 38.14-15. The Contractor shall ensure that a potential (voltage) check is conducted on each and every service conductor prior to any Work taking place to ensure that the service cables are de-energized. Some street light poles may have been temporarily fed from overhead. This overhead feed will be removed by Manitoba Hydro prior to the Contractor commencing with the Work
- E16.35.4 The Contractor shall furnish all labour and supplies necessary to splice/connect the street light conductor(s). Care shall be taken to ensure the conductors entering the street light from underground are not damaged

E16.36 Excavation

- E16.36.1 The Contractor shall furnish all materials and labour and supplies necessary for the completion and maintenance of grade and line of the street light cables and conduit including water control if found to be necessary. The trench shall be graded to conform to the bottom of the street light cables and conduit so that the street light cables and conduit rest firmly on a smooth surface in the bottom throughout its length. All stones or other objects which, in the opinion of the Contract Administrator might damage the street light cables jacket and conduit during its installation shall be removed. Where the presence of rock or other condition prevent a satisfactory bed for the cables, 150 mm of well-tamped, clean soil or ¼ down crushed limestone shall be placed in the bottom of the trench. The spoil bank from trenching operations shall not be allowed to fall on loose debris or foreign matter that might become mixed with the soil to be used in backfilling the trench, and the

spoil bank shall be placed so as not to hinder drainage, damage property, or obstruct traffic.

E16.36.2 Trenches shall be dug to such a depth as will provide a minimum cover of 600 mm from final grade in sodded areas and 1000 mm in roadways accordance with Standard CD 305-1.

E16.36.3 All excavation practices must conform to Manitoba Hydro safe excavating procedures and Manitoba Workplace Safety and Health Regulation 217/2006 ...

E16.37 Laying Cables

E16.37.1 Cables are to be lowered in the trench in an orderly fashion so as to maintain a consistent path and straight alignment. All cables shall be lowered in a continuous run (NO SPLICING) and in accordance to drawings; and shall maintain the necessary separation, where required. All cables shall be of continuous runs and capped and sealed if they are not be installed in the standard at that time. Cables shall not be dragged over paved surfaces.

E16.37.2 Once a cable is cut its ends must be sealed immediately with an approved and appropriately sized, heat shrink or cold shrink sealing cap to prevent moisture ingress unless the cable is being installed in the standard at that time.

E16.37.3 During the removal of the cable, the reels shall be placed on jacks, stands or trailers with a bar through the arbour holes which will allow the reel to be turned easily, and the cable to be paid out. Cables can be paid out from the bottom or the top of the reel. Cable in coils shall be handled in a similar manner. This can be achieved by supporting the coil in a vertical plane and rotating it by hand as the cable is carefully uncoiled. The cable shall never be pulled over the flange of a reel, or pulled off the side of a coil, since this will introduce a twist in the cable.

E16.37.4 During installation, under no circumstance is the cable to be subjected to a bending radius tighter than that detailed in the Standards. The minimum bending radius of #4CN street light cable is 125 mm per Electrical Standard CD210-15.

E16.38 Installing Conduit and Cable by Boring (Horizontal Directional Drilling)

E16.38.1 The Contractor shall dig the approaches and openings necessary to install boring equipment, and the boring equipment used shall be of such a nature as to minimize the opening size required. The boring equipment shall produce a straight hole without unnecessary dips or bends. The bore hole shall be only slightly larger than the outside diameter of the conduits or cables to minimize possible settlement. Cables and conduits shall be pulled in with pulling eyes or using a kelling grip in a manner so as to guard against damage.

E16.38.2 During construction as the drill bit crosses each existing facility a lookout shall be assigned by the Contractor to visually confirm the drill bit is maintaining a minimum 300 mm clearance from the existing facility. The minimum allowable clearance between the proposed cable or conduit installation and existing facilities is 300 mm or as otherwise specified by the Contract Administrator. The pull back tension on all cables shall not be allowed to exceed the maximum cable pulling tension.

E16.38.3 Drilling fluids and associated waste materials shall be disposed of in a manner that minimizes environmental effects.

E16.38.4 The Contractor shall properly compact the backfill material and will be responsible for placing additional material should settlement occur for the duration of the warranty period.

E16.39 Buried Utility Crossings

E16.39.1 All buried obstructions are not necessarily shown on the reference drawings and the locations of those indicated are approximate only. The Contractor shall determine the location of all buried obstructions and shall notify the appropriate authorities and obtain all necessary permits prior to excavating

- E16.39.2 The Contractor shall determine the location of all buried obstructions and shall notify the appropriate authorities and obtain all necessary permits prior to excavation, trenching and directional drilling near or across such obstructions. All buried obstructions where the buried cable route crosses gas, water, sewer, telephone and hydro lines, etc., shall be hand exposed by the Contractor, including the use of Pressurized Water/Vacuum Equipment (PW/VE) where necessary. Should any damage occur to such lines during the course of the Work, the Contractor shall be responsible for the damage and the costs of repairs to buried obstructions caused by its operations and shall fully indemnify the City of Winnipeg from and against all claims arising out of such damage. The requirements of the Directional Boring Guidelines included in Appendix D shall be followed when crossing natural gas pipelines and electrical cables by the directional boring method.
- E16.39.3 The PW/VE technique, used to expose underground plant in certain conditions, must be performed in accordance with each utility's requirements, including but not limited to Manitoba Hydro, Manitoba Telecom Services, Shaw Cable, etc. PW/VE costs that the Contractor will incur during the Work must be factored into the Tenderer's bid prices. The Contractor shall not be entitled to extra compensation for the use of PW/VE on the Work. At a minimum; the Contractor will be required to use PW/VE when excavating within 1m horizontal distance to polyethylene mains or services when 12 inches (or greater) of frost is present in the local ground conditions. The Contractor shall also be required to use PW/VE when excavating within 1 m horizontal distance to high pressure or transmission pressure steel mains or services when 12 inches (or greater) of frost is present in the local ground conditions. PW/VE is also required when digging within 1m horizontal distance of an energized primary regardless whether frost is present in local ground conditions or not. The Contractor shall be responsible to backfill, compact and level all excavations so as to be ready for topsoil and seed or sod.
- E16.40 Bending Cables and Installation Into Standards
- E16.40.1 It is desired to reduce to a minimum the required number of bends to lay the cables to conform to the contour of the ground and maintain a normal covering. This shall be accomplished by cutting the trench slightly deeper in approaches to road crossings and drainage ditches. It is intended that the Contractor shall eliminate unnecessary bending by operating the trenching machine at various depths rather than by finishing grading the trench by hand whenever practical.
- E16.40.2 Sharp bends of the cables shall be avoided at all times. All bends shall meet the requirements set out in this Technical Specification. If excessive bending was exerted on any cable, the cable shall be replaced at Contractor's cost. During installation, under no circumstance is the cable to be subjected to a bending radius tighter than that detailed in the Standards. The minimum bending radius of #4CN street light cable is 125 mm per Electrical Standard CD210-15.
- E16.40.3 At street light standards the Contractor shall install the ends of the cables into the plastic pipe preinstalled in the concrete base. Care shall be taken to prevent damage to the insulation or jacket of the conductors. Underground cables entering the concrete base shall be protected by a layer of sand surrounding the cables and protecting it from the limestone and/or use a section of fire hose for cable protection as directed by the Contract Administrator. The cable shall be left long enough to extend one (1) metre beyond the hand hole.
- E16.40.4 Excess underground cable and 2C-12 wire shall be left inside the hand hole with the hand hole cover loosely installed.
- E16.41 Backfill
- E16.41.1 All backfilling material within 300 mm of the cables shall be clean, free of sod, vegetation, organic material, stones or other debris, and of a consistency as to not create significant voids or air spaces around the cables. Other backfilling material shall be free of stones greater than 150 mm on their maximum dimension. Where cinders or very acid soil are encountered or where gravel or incompressible fill is required by Municipal authorities, ¼ down crushed limestone shall be placed all around the cables for a distance of at least

300 mm. The completed backfill shall be at least equal in compaction to undisturbed soil or as directed by the Contract Administrator. Backfill material is to be placed and compacted in lifts not exceeding 300 mm. All excess material is to be removed by the Contractor.

- E16.41.2 Tamping or flushing methods must be used where necessary to give the required compaction. Where tamping is used, hand tampers shall be used to at least 300 mm above the cable before machine tamping may be used. The Contractor shall level all excavations so as to be ready for topsoil and seed or sod. Should settlement occur in the excavation and cause a depression in the surface, the Contractor shall repair the surface to the satisfaction of the Contract Administrator.
- E16.41.3 Excavations remaining where standards have been removed shall be backfilled with spoil, pit run gravel or 3/4 down limestone and compacted in lifts of 150mm. The top 300 mm of the excavation shall be backfilled with topsoil.

E16.42 As-Built Drawing

- E16.42.1 The Contractor shall provide an as-built drawing or mark-up drawing to the Contract Administrator which accurately displays the "as-built" location of the buried street light cables, conduits and street light standards.

MEASUREMENT AND PAYMENT

E16.43 Removal and Salvage Street Light Pole and Base

- E16.43.1 Removal and Salvage Street Light Pole and Base will be measured on a unit basis and paid for at the Contract Unit Price per unit for "Removal of 25' to 35' street light pole and precast, poured in place concrete, steel power installed base or direct buried including davit arm, luminaire and appurtenances". The number of units to be paid for at the Contract Unit Price for the total number of 25' to 35' street light poles and precast, poured in place concrete, steel power installed base or direct buried including davit arm, luminaire, complete with pressurized water/vacuum excavation and appurtenances removed in accordance with this specification, accepted and measured by the Contract Administrator. The Price shall be payment in full for performing all operations herein described and all other items incidental to the work included in the specification.

E16.44 Installation of #4 AL C/N Streetlight Cable by Trench Method

- E16.44.1 Installation of #4 AL C/N streetlight cable by trench method will be measured on a linear metre basis and paid for at the Contract Unit Price per linear metre for "Installation of #4 AL C/N streetlight cable by trench method" as measured and accepted by the Contract Administrator." The Price shall be payment in full for performing all operations herein described complete with backfilling the trench, buried utility crossings and all other items incidental to the work included in the specification.

E16.45 Installation of 50 mm Conduit by Boring Method

- E16.45.1 Installation of 50 mm conduit by boring method will be measured on a linear metre basis and paid for at the Contract Unit Price per linear metre for "Installation of 50 mm conduit by boring method" as measured and accepted by the Contract Administrator. . The Price shall be payment in full for performing all operations herein described complete with inserting #4 AL C/N streetlight cable into conduit, buried utilities crossings and all other items incidental to the work included in the specification.

E16.46 Installation of 25'/35' Pole, Davit Arm and Precast Concrete Base Including Luminaire and Appurtenances

- E16.46.1 Installation of 25'/35' pole, davit arm and precast concrete base including luminaire and appurtenances will be measured on a unit basis and paid for at the Contract Unit Price per unit for "Installation of 25'/35' pole, davit arm and precast concrete base including luminaire and appurtenances." The number of units to be paid for at the contract price for the total number of 25' to 35' street light poles and precast, poured in place concrete, steel power installed base or direct buried including davit arm, luminaire complete with placing cable

ends into concrete bases, pressurized water/vacuum excavation, and appurtenances installed in accordance with this specification, accepted and measured by the Contract Administrator. The Price shall be payment in full for performing all operations herein described and all other items incidental to the work included in the specification.

- E16.47 Installation of One (1) 10' Ground Rod at End of Street Light Circuit. Trench #4 Ground Wire up to 1 m From Rod Location to New Street Light and Tape to Top of Ground Rod
- E16.47.1 Installation of one (1) 10' ground rod at end of street light circuit. Trench #4 ground wire up to 1 m from rod location to new street light and tape to top of the ground rod will be measured on a unit basis and paid for at the Contract Unit Price per unit for "Installation of one (1) 10' ground rod at end of street light circuit. Trench #4 ground wire up to 1 m from rod location to new street light and tape to top of the ground rod." The number of units to be paid for at the contract price for the total number of Installation of one (1) 10' ground rod at end of street light circuit. Trench #4 ground wire up to 1 m from rod location to new street light and tape to top of the ground rod installed in accordance with this specification, accepted and measured by the Contract Administrator. The Price shall be payment in full for performing all operations herein described and all other items incidental to the work included in the specification.
- E16.48 Install Lower 3 m of Cable Guard, Ground Lug, Cable Up Pole, and First 3 M Section of Ground Rod Per Standard CD 315-5
- E16.48.1 Install lower 3 m of Cable Guard, ground lug, cable up pole, and first 3 m section of ground rod per Standard CD 315-5 will be measured on a unit basis and paid for at the Contract Unit Price per unit for "Install lower 3 m of Cable Guard, ground lug, cable up pole, and first 3 m section of ground rod per Standard CD 315-5". The number of units to be paid for at the contract price for the total number of Installation of Install lower 3 m of Cable Guard, ground lug, cable up pole, and first 3 m section of ground rod per Standard CD 315-5 installed in accordance with this specification, accepted and measured by the Contract Administrator. The Price shall be payment in full for performing all operations herein described and all other items incidental to the work included in the specification.
- E16.49 Installation and Connection of Externally-Mounted Relay Per Standards CD 315-12 and CD 315-13
- E16.49.1 Installation and connection of externally-mounted relay per Standards CD 315-12 and CD 315-13 will be measured on a unit basis and paid for at the Contract Unit Price per unit for "Installation and connection of externally-mounted relay per Standards CD 315-12 and CD 315-13". The number of units to be paid for at the contract price for the total number of the externally-mounted relay per Standards CD 315-12 and CD 315-13 installed and connected in accordance with this specification, accepted and measured by the Contract Administrator. The Price shall be payment in full for performing all operations herein described and all other items incidental to the work included in the specification.
- E16.50 Splice/Connect 2/C #12 Copper Single Conductor Street Light Cables Per Standard CD310-4, CD310-9 or CD310-10
- E16.50.1 Splice/connect 2/C #12 copper single conductor street light cables per Standard CD310-4, CD310-9 or CD310-10 will be measured on a unit basis and paid for at the Contract Unit Price per unit for "Splice/connect 2/C #12 copper single conductor street light cables per Standard CD310-4, CD310-9 or CD310-10". The number of units to be paid for at the contract price for the total number of the Splice/connect 2/C #12 copper single conductor street light cables per Standard CD310-4, CD310-9 or CD310-10 in accordance with this specification, accepted and measured by the Contract Administrator. The Price shall be payment in full for performing all operations herein described and all other items incidental to the work included in the specification.
- E16.51 Splicing #4 Al C/N or 2 Single Conductor Street Light Cables
- E16.51.1 Splicing #4 Al C/N or 2 single conductor street light cables will be measured on a unit basis and paid for at the Contract Unit Price per unit for "Splicing #4 Al C/N or 2 single conductor

street light cables". The number of units to be paid for at the contract price for the total number of the Splicing #4 Al C/N or 2 single conductor street light cables in accordance with this specification, accepted and measured by the Contract Administrator. The Price shall be payment in full for performing all operations herein described and all other items incidental to the work included in the specification.

E16.52 Splicing 1/0 AL Triplex Cable or 3 Single Conductor Street Light Cables

E16.52.1 Splicing 1/0 AL triplex cable or 3 single conductor street light cables will be measured on a unit basis and paid for at the Contract Unit Price per unit for "Splicing 1/0 AL triplex cable or 3 single conductor street light cables". The number of units to be paid for at the contract price for the total number of the Splicing 1/0 AL triplex cable or 3 single conductor street light cables in accordance with this specification, accepted and measured by the Contract Administrator. The Price shall be payment in full for performing all operations herein described and all other items incidental to the work included in the specification.

E16.53 Installation of Break-Away Base and Reaction Plate on Base-Mounted Poles up to 35'

E16.53.1 Installation of break-away base and reaction plate on base mounted poles up to 35' will be measured on a unit basis and paid for at the Contract Unit Price per unit for "Installation of break-away base and reaction plate on base mounted poles up to 35'". The number of units to be paid for at the contract price for the total number of the Installation of break-away base and reaction plate on base mounted poles up to 35' in accordance with this specification, accepted and measured by the Contract Administrator. The Price shall be payment in full for performing all operations herein described and all other items incidental to the work included in the specification.