Town of Lyons
Electrical Distribution System Material and Design
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Section 6
Electrical Distribution System Design Standards

6.1 DESIGN CRITERIA

6.1.1 **SUBMISSIONS**: The electrical distribution system public improvement plans shall describe the proposed electrical distribution system in adequate detail so as to serve as construction drawings as well as satisfying the requirements of this section.

6.1.2 **METHOD**: The design of the electrical distribution system shall be based on standard design practices and design criteria contained in this section.

6.1.3 **CRITERIA**: The design of the electrical distribution system shall be based on the following:

1. In areas zoned for residential uses, the electrical distribution system and building services shall be installed underground with transformers, junction boxes, and pedestals surface mounted. Locations and general layout shall be as shown in Standards 6-1, 6-2 and 6-3.

2. In areas zoned for commercial and industrial uses, the electrical distribution system and building services may be installed underground or overhead. To be determined by Electrical Department.

3. The remainder of this section shall pertain to underground electrical distribution systems only. The design and construction of overhead electrical distribution systems and building services shall be coordinated with the Town administration prior to commencement.

4. Primary and secondary conductors will be placed in Schedule 40 PVC duct throughout the system. Conduit size to be determined by Town's Electric Engineer or Town staff. Minimum size duct shall be 2".

5. Town Electrical Engineer will determine wire sizes and system design at **Developer's** expense.

6. Joint Use Coordination:
    a. Whenever possible, construction will be coordinated with the telephone company and any authorized cable TV company so that they can install their facilities before final backfill.

b. Upon receipt of a copy of the proposed development from the developer, the telephone company or CATV will make a layout for their facilities. The Telephone Company or CATV will coordinate this layout with the town Electric Department for joint use trenches. The Telephone Company or CATV will coordinate this layout with the Town Electric Department for joint use trenches. The Telephone Company or CATV will then coordinate construction of their facilities directly with the developer.

6.2 **SPECIFICATIONS**

6.2.1 **SCOPE:** The work covered by these specifications concerns the furnishing of all labor, equipment, and materials and performing all operations for the construction of the electrical distribution system including primary and secondary lines, transformers, junction boxes, protective devices and other fittings and appurtenances in accordance with these specifications and the Standard Design Drawings in Paragraph 6.5.

6.2.2 **GENERAL REQUIREMENTS:** The electrical distribution system shall be constructed in accordance with engineered construction plans for the work prepared under the direction of a Town Engineer and approved by the Town Engineer.

6.2.3 **MATERIALS:** Will meet industry standards and be approved by the Electrical Department.

1. Conductor: All primary and secondary conductors will be new and on original factor reels marked with the manufacturer's name, address, type, date of manufacture and length of cable.

    a. Underground secondary cable shall be copper or aluminum, 600V, cross-linked polyethylene, triplexed UD cable. Cable size to be determined by Town's electrical Engineer.
    b. Under ground primary cable to be 25 Kv, XLPE, 220 mil Al. 1/3 neutral cable. Cable size to be determined by Town's Electrical Engineer.

2. Precast Concrete Underground Distribution Vaults:

    a. Vaults.

        (1) This Commercial specification covers the requirements for steel reinforced, precast concrete, underground distribution vaults. The structure described in this

specification shall be used in conjunction with underground primary cable for three phase installations.

(2) GENERAL. All vaults and components shall conform to this specification and associated drawings in all respects and be constructed using high quality materials in accordance with good industry practice. The Town Engineer will determine the dimensional requirements.

(3) COMPONENTS.

(a) PULLING EYES: All pulling eyes or irons shall be capable of withstanding a 15,000-pound force.

b. Vault Frame and Cover:

(1) SCOPE. This specification covers the requirements for steel reinforced, precast concrete, underground distribution vault lids. The structure described in this specification shall be used in conjunction with electrical concrete vaults for Underground Distribution Systems.

(2) GENERAL. All vault lid components shall conform to this specification and associated drawings in all respects and be constructed using high quality materials in accordance with good industry practice.

(3) DESIGN. The present vault lid shall be designed to resist all dead loads and live loads equivalent to an H-20 or S-16 loading as stated in the latest revision of the AASHTO Standard Specifications for highway bridges. The combination of loads that produces the maximum shear and moment shall be used to design the structure.

The vault lid shall be adequately reinforced to resist the stresses resulting from the above loading conditions. The supplier shall be responsible for the structural design.

(4) CONSTRUCTION. The minimum compressive strength in all concrete components of the precast vault lid shall not be less than 4000 psi after it has cured to reach its 28 day strength. The maximum nominal aggregate size shall be ¾" and shall not exceed 1/5 of the minimum dimension of cross section of any one concrete casting. Four "swift lift" lifting anchors (recessed lugs) or four ¾" standard SAE threaded inserts shall be provided. These shall be located on the top face of the vault lid. The vault lid shall be constructed to the dimensions indicated on the attached drawings with all appurtenances firmly fixed in the forms to prevent dislodgment during construction and future use.

(5) COMPONENTS.

(a) FRAME AND COVER: Frameco Fabricators' galvanized steel frame and cover assembly or approved equal. The lid shall have "Torsion Spring Assisted: access doors rated for H-20 (highway) traffic loading. The doors are either to be equipped with stops for latching in the open position or designed for removal by lift off. The access doors shall be secured by a recessed, captive pentahead bolt which threads into a nut with a blind hole. Frameco model #3' x 3' S.M.U.D. frame and cover shall be cast in all 5' x 5' O.D. vault lids for use with 4'x4'x4'x8" I.D. electric

vaults (Spec. 13-20). Frameco catalog #4272 frame and
cover shall be cast in all 5'x7' O.D. vault lids for use with
4'x 6'x 8" I.D. electric vaults (Spec. 13-30).

3. Transformer: All transformers shall be designed according to American National Standard Institute Type I design. Transformers will be pad-mounted, loop-feed, with load break primary bushings, 5/8 " brass stud, 2 primary taps 2 ½ % above and below normal and externally operable, primary load sensing fuse and isolation link. Manufacturer's metal nameplate with above data will be securely attached to the inside compartment of the transformer. Manufacturer will provide non-PCB label attached to transformer door. Manufacturer to provide along with other transformer information the type of insulating material used, i.e. petroleum products.

    a. All other major components of equipment shall have as a minimum the manufacturer's name, address, and catalog or style number on a nameplate securely attached to the item of equipment.

    b. All metallic materials shall be protected against corrosion. Aluminum shall not be used in contact with earth, and where connected to dissimilar metal, shall be protected by approved fittings and treatment. All ferrous metals such as anchors, bolts, braces, boxes, bodies, clamps, fittings, guards, nuts, pins, rods, shim, thimbles, washers and miscellaneous parts not of corrosion resistant steel, shall be hot-dip galvanized.

    c. Materials and equipment to be provided shall be essentially the standard cataloged products of a manufacturer regularly engaged in the manufacture of these products. Materials and equipment shall be installed in accordance with the approved recommendations of the manufacturer.

6.3 CONSTRUCTION

6.3.1 **GENERAL REQUIREMENTS:** Section 7, General Specifications, shall be followed except as modified in Paragraph 6.3.2.

6.3.2 **SPECIFIC REQUIREMENTS:** The following specific requirements shall apply in the construction of the electrical distribution system:

1. Trench Excavation Requirements:

a. The trench for direct-buried duct systems shall meet the following depth Requirements (see figures 6-5a and 6-5b).

(1) For residential applications all duct shall be a minimum of 36 inches below final sub-grade. The trench shall be no deeper than 42 inches below final sub-grade.

(2) For commercial application the trench shall be a minimum of 48
Inches below final sub-grade.

b. Trench backfill and Compaction Requirements:

(1) Single duct trench widths shall not exceed 24 inches.

(2) The Town shall not accept trenching outside of right-of-way or easement areas.

2. Trench Backfill and Compaction Requirements:

a. Backfill material shall be placed in uniform layers not exceeding 12 inches in un-compacted thickness and mechanically compacted using platform type tampers or other Town approved methods.

b. Backfill material shall be finely divided and free from debris and organic material. The first 12- inch lift shall contain no rocks larger than 3/4 inch in greatest dimension. Subsequent lifts shall contain no rocks larger than 3 inches in greatest dimension.

c. Trench backfill at all depths shall be compacted to not less than 95 percent of maximum density. Backfill for trenches traversing subgrades of roads, parking areas, underground piping, and other facilities subject to damage by settlement shall be compacted to not less than 95 percent of maximum density. ASTM Specification D698, otherwise known as Standard Proctor, shall define maximum density.

3. Duct Laying:

a. The duct shall be laid in a good workmanlike manner, with glued joints and smooth ends where duct requires cutting. The Town Inspector prior to concrete encasement when required will inspect the duct installation, ground rod locations and elbows up to surface apparatus.

b. When encasement is required, the duct run will be encased in four-sack mix concrete with ¾ inch aggregate. A minimum thickness of three inches will be maintained on top, bottom and sides of duct. Earth backfill will not be placed on concrete easement until concrete has set up enough to prevent displacement when earth fill is compacted. The earth backfill shall then be placed in lifts not to exceed a loose depth of 10 inches. The lift shall be well tamped. This procedure shall be followed until a minimum of one (1) foot of compacted backfill covers the encasement. The maximum thickness of each lift after the one-foot of cover has been reached shall be 18 inches. The backfill at all depths shall be compacted to at least ninety-five percent (95%) of the maximum density obtainable by the Standard Proctor Density Test. See standard 5-1 for trench detail concrete encased ducts.

4. Installation of conductor:

a. Pulling of conductors into duct runs shall be done with care to prevent damage. The reels shall be set up so there will be a minimum of bending into the cable entrance. Conduit shall have bell ends of guard protection at each end of the duct to protect the cable jacket. Where several wires or cables are to occupy one conduit, they will be pulled together. To facilitate the pulling of conductors, lubrication only as recommended by the cable manufacturer shall be used. Cable pulling tension and bending radius shall not exceed values as recommended by the cable manufacturer.

b. Cables shall be attached to the pulling lines by means of woven cable or basket grips. A swivel connection shall be used with all cable pulling operations. The Town Inspector shall be present during all pulling operations. The cable ends shall be sealed with a moisture-tight seal.

c. Conductors will be identified according to instructions from the Town Inspector.

5. Equipment Installation:

a. Transformers: Transformers will be installed and wiring connections made as shown in standard and details 6-1, 6-2, 6-6A through 6-6D. The transformer box pad will be placed on soil that has been compacted to 95% of Standard Proctor to provide a level and stable foundation.

b. Handholes or junction boxes: Handholes will be installed and wiring connections made as shown in Figures 6-7A and 6-7B on six to eight inches of ¾ inch crushed rock.

c. Pedestals: Pedestals will be installed as shown in Figure 6-8 on six to eight inches of ¾ inch crushed rock.

6.4 TESTING

6.4.1 COMPACTION TEST**:** Compaction tests to verify specified compaction shall be performed as required in Section 7 of this manual.

6.5 CONSTRUCTION STANDARDS AND DETAILS

5-1 Typical Trench for concrete encased ducts
6-1 Front lot line U.R.D. construction design
-2 Transformer box pad and conduit
6-3 Meter location
6-5A Typical trenches for direct buried ducts
6-5B Under ground street crossing
6-6 Loop system with radial tap showing lightning arrester locations
6-6A Ground assembly for pad-mounted single-phase transformers & enclosures
6-6B Typical primary connections on a grounded-front pad-mounted transformer
6-6C Bushing mounted lightning arrestor for a grounded-front pad-mounted transformer.
6-6D Single -phase pad-mounted transformer deferred unit, pedestal type.
6-6F Sectionalizing pedestal grounding.
6-6G Single-phase pad-mounted sectionalizing assembly
6-6H Three-phase pad-mounted sectionalizing assembly
6-6P URD service to typical apartment complex
6-7A Hand hole and secondary cable and duct
6-7B Front lot line hand hole, secondary cable and duct installation.
6-8 Below grade service pedestal
7-1 Three phase primary riser pole.
7-2 Three phase cable terminal pole with intermediate arresters and hook stick operated disconnect switches.
7-3 Single phase riser pole
7-4 Primary riser feeding single-phase transformer.

Specifications For Construction
For
Underground Distribution Systems

1. **General**

These specifications provide for the construction of underground distribution power facilities by the cable installed in conduit and trenching.

All construction work shall be done in a thorough and workmanlike manner in accordance with the staking sheets, plans and specifications, and the construction drawings.

The most current Edition of the National Electrical Safety Code (ANSI C2-1981) shall be followed, except where local regulations are more stringent, in which case local regulations shall govern.

2. **Handling of Cable**

Cable shall be handled carefully at all times to avoid damage, and shall not be dragged across the ground, fences or sharp projections. Care shall be exercised to avoid excessive bending of the cable. The ends of the cable shall be sealed at all times against moisture with suitable end caps. Where it is necessary to cut the cable, the ends shall be terminated or sealed immediately after the cutting operation.

3. Trenching

All trenching depths specified are minimum as measured from the final grade to the top surface of the conduit. The routing shall be as shown on the staking sheets and plans and specifications unless conditions encountered are such that changes are necessary to accomplish the work. In such event, the Engineer shall be notified

promptly. If rock or other difficult digging is involved, the contractor shall determine the nature and extent of the difficulty, and the Engineer will determine whether rerouting, rock trenching, or other changes are necessary. Loose soil or crumbly rock will not be considered as “difficult digging.” The trench widths specified are minimum and should be increased as necessary to obtain the required depths in loose soils.

4. Conduit

All exposed ends of conduit shall be plugged during construction to prevent the entrance of foreign matter and moisture into the conduit. Burrs or sharp projections, which might injure the cable, shall be removed. Riser shield or conduit shall extend at least 1.0 foot below grade at all riser poles. The minimum size of conduit, or riser guard with equivalent usable area is to be determined by the Town Engineer.

5. Installation in Conduit or Duct

Where cable must be pulled through conduit or duct, the operation shall be performed in such a way that the cable will not be damaged from strain or dragging. The cable shall be lubricated with a suitable cable lubricant prior to pulling into conduit or duct.

In placing primary cables, the stress applied while pulling into ducts or during other pulling operations shall not exceed the least of the following:

a. Where a pulling eye is attached to the conductor, the maximum pulling strain in pounds shall not exceed .006 times the circular mil area for aluminum or .008 times the circular mil area for copper.
b. Where a basket grip is placed over the cable, the pulling strain shall not exceed the lesser of (1) that calculated in an above or (2) 1000 pounds. The cable under the cable grip and 3.0 foot preceding it shall be severed and discarded after the pulling operation.
c. In no case shall the maximum pulling tension exceed that recommended by the specific cable manufacturer.
d. At bends the maximum sidewall pressure recommended by the cable manufacturer shall not be exceeded.

6. Tagging of Cables at Termination Points

As the cables are laid they shall be identified and tagged. The identification shall be a permanent type, such as that done with an

embossing type tape writer on plastic and colored cable tape. The tag shall be securely attached to the cable.

7. Secondary and Service Connections

A suitable inhibiting compound shall be used with all secondary and service connections.

All secondary cable connections located below grade or in secondary pedestals shall be made with pre-insulated secondary connector blocks. Diving bells with open terminals, insulating boots or moisture barriers that depend solely on tape are not acceptable.

All transformer secondary phase terminal connections shall be completely insulated. If the secondary phase terminals are threaded studs, the connection shall be made with a pre-insulated secondary transformer connection block. If the transformer secondary phase terminals are insulated cable leads, connection shall be made with a pre-insulated secondary connector block or with a secondary prefabricated splice when the transformer leads continue directly to the service.

If a transformer is so large that it must have secondary spades, the spades shall be taped or otherwise insulated. Boots used for insulation shall be taped so that they cannot be readily slipped off.

Secondary connections to terminals of pole-mounted transformers shall be made so that moisture cannot get inside the cable insulation. This may be accomplished by covering the terminals and bare conductor ends with an appropriate moisture sealant (item “es” in the List of Materials).

The secondary connections and insulation shall have accommodations for all future and existing services as shown on the plans and specifications.

8. Inspection and Inventory of Buried Units

Before any backfilling operations are begun, the contractor and Town shall jointly inspect all trenches, cable placement, risers, pedestal stakes, and other construction not accessible after backfilling, and an inventory of units shall be taken. If corrections

are required, a second inspection shall be made after completion of the changes.

9. Backfilling

The first 12 inches of trench backfill shall be free from rock, gravel larger than ¾"or other material, which might damage the conduit. In lieu of cleaning the trench, the contractor may, at his option, place a 4-inch bed of clean sand or soil under the conduit and twelve inches of clean soil above the conduit. Cleaned soil backfill when used shall contain no solid material larger than ¾". This soil layer shall be carefully compacted so that the conduit will not be damaged.

Backfilling shall be completed in such a manner that voids will be minimized. Excess soil shall be piled on top and shall be well tamped. All rock and debris shall be removed from the site, and any damage to the premises repaired immediately.

Pieces of scrap cable shall not be buried in the trench as a means of disposal.

10. Equipment Pads

The site for the pad shall be on undisturbed earth adjacent to but not over the trench. The site shall be cleared of all debris and excavated to the specified depth. Gravel, sand or other acceptable self-draining material shall be added to the site and thoroughly compacted. The pad shall be installed at the specified elevation. Poly pads, precast concrete, or cast-in-place concrete may be used.

11. Transformers

Transformers shall be handled carefully to avoid damage to the finish and shall be positioned in accordance with the staking sheets and the plans and specifications. Only qualified and experienced personnel shall be allowed to make connections and cable terminations.

12. Equipment Enclosures

Excavations for transformer hole liners and other below-grade enclosures shall be made so as to disturb the surrounding earth as little as practical. Enclosures shall be installed with sidewalls plumb or the top of enclosure level.. When enclosures are of fiber, plastic, or other semi flexible material, backfilling should be done with

covers in place and with careful tamping so as to avoid distortion of the enclosure. When installation is complete, the cover of the enclosure shall not be lower than and not more than two inches higher than the grade specified by the Town. Soil in the immediate vicinity shall be tamped and sloped away from the enclosure. At the Town's option the excess soil shall be removed from the site or spread evenly over the surface of the ground to the satisfaction of the Town.

Warning:

A hazardous voltage may exist on the cable after de-energizing. Therefore, before the handling the cable, the conductor shall be grounded to permit any charge to drain to earth.