

FirstEnergy

Underground Electrical Developer's Guide

January 2021



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UNDERGROUND ELECTRICAL DEVELOPER'S GUIDE

I. INTRODUCTION

This document is published to provide specifications, information, and guidance to assist developers in planning for and obtaining proper and prompt electric facilities to serve underground developments in the FirstEnergy Service territory. The requirements detailed in this document address conduit and other mechanical structures required for the installation of the underground primary and secondary cables, transformers, and other equipment necessary to serve the development. This document should be used in conjunction with the Company's "*Customer Guide to Electric Service*" for the state where the project will be constructed. That guide details the Company's requirements for service to individual locations including information on service laterals, meter installations, and customer equipment.

The information and exhibits contained herein convey general knowledge and do not provide every detail or every requirement. Furthermore, the information is supplementary to, and does not intentionally conflict with the National Electrical Code, the National Electrical Safety Code, the Company's current applicable tariffs, or such state and municipal laws, and ordinances as may be in force within the cities, towns, or communities in which the Company furnishes electric service. It is always necessary to comply with state statutes, local ordinances, and the Company's standard rules and regulations on file with the state agency that regulates public utilities. To the extent that any included information contradicts any terms in the Company's current applicable tariff, the tariff provision shall govern.

The Company reserves the right to make the final interpretation of this document and its specifications. The Company's interpretation shall be binding on the customer/developer.

The guidelines in this document pertain primarily to residential developments. However, the equipment, installation methods, and general system design philosophy shall also apply to commercial and industrial developments. Specific design requirements may vary for commercial and industrial developments based on the parameters of the development, state and local regulatory requirements, and the current applicable state tariff requirements. The Company engineering staff will provide specific details for these types of developments.

Mandatory rules of this document are those that identify actions that are specifically required or prohibited and are characterized by the terms **shall** and **shall not**.

Underground Residential Development Requirements by State:

- Maryland - Underground Residential Developments (URD) are mandatory for residential subdivisions of two or more building lots.
- New Jersey - Underground Residential Developments (URD) are mandatory for residential subdivisions consisting of three or more building lots.
- Pennsylvania - Underground Residential Developments (URD) are mandatory for residential subdivisions of five or more building lots.

- New York, Ohio, and West Virginia currently have no mandates for residential subdivisions that require the distribution lines, secondary mains, or service lines to be placed underground based on the number of building lots.

Refer to the tariff for each Operating Company for specific details and requirements for electric service required by the agency that regulates public utilities in the state where the project will be constructed.

II. DEFINITIONS

Terms frequently used in this Guide are as defined below (for additional definitions, refer to the latest edition of the National Electrical Code and the National Electrical Safety Code):

- **American National Standards Institute (ANSI):** ANSI is an independent administrator and coordinator of voluntary industry standards (www.ansi.org).
- **Ampacity:** Ampacity is the maximum current, in amperes (amps), that a conductor or equipment can carry continuously under the conditions of use without exceeding its temperature rating.
- **Application for Service:** Application for service is a formal request submitted by the customer or their agent to the Company stating their desire to obtain a specific electric service at a certain time and location. Applications may be processed by e-mail, telephone, or fax through the Company's Customer Service Center.
- **Approved:** Work or equipment that is acceptable to the FirstEnergy Operating Company or to the Authority Having Jurisdiction (e.g., electrical inspector).
- **Authority Having Jurisdiction (AHJ):** An organization, office, or individual responsible for enforcing the requirements of a code or standard, or for approving equipment, materials, an installation, or a procedure (e.g., electrical inspector).
- **Backfill:** Clean soil, free of large rocks (i.e., greater than two (2) inch diameter), sharp rocks, perishable material, or other debris.
- **Clearance:** Clearance is a specified minimum distance between two objects (measured surface-to-surface) to assure adequate space for safety, security, or access.
- **Code:** The National Electrical Code (NEC), National Electrical Safety Code (NESC), or other electrical codes or regulations in effect and that are applicable in the area served.
- **Company:** Refers to the ten FirstEnergy Operating Companies (FEOC) operating in: Maryland – Potomac Edison; New Jersey – Jersey Central Power & Light (JCP&L); Ohio – Ohio Edison, The Illuminating Company, or Toledo Edison; Pennsylvania and New York – Met-Ed, Penelec, Penn Power, or West Penn Power; West Virginia – Mon Power or Potomac Edison.

- **CRews Work Request Number:** A unique number assigned by the Company's work management system (CRews) for the design of a specific job. This number will be supplied to the developer by the Company representative from the local line shop/service center assigned to provide the electric system design for their development. This number should be used in any communication with your assigned Company representative or the local line shop/service center. Note: The Company Contact Center (See Section III. A) does not use this number or have access to it (it uses the Notification Number).
- **Customer:** Any person, partnership, association, corporation, or agency of municipal, county, state, or federal government receiving any service rendered by the Company at a contract location. This includes the party using the Company's service, or in applicable cases, the property owner, developer, or any party working on behalf of the customer such as an engineer, builder, contractor, or developer.
- **Customer's Installation (Electrical):** All wiring, conduit, meter socket, service disconnecting devices, appliances, lighting, and other equipment installed and/or owned by the customer on the customer's premises for the customer's use. The installation of the customer's electrical equipment is typically governed by the NEC as well as any local rules.
- **Customer Guide for Electric Service (CGES):** FirstEnergy document detailing the Company's requirements by state for service to individual locations including information on service laterals, meter installations (< 600 V), and customer equipment.
- **Developer:** The individual, company, or organization responsible for the construction of the planned project of residential, commercial, and/or industrial services set out in a recorded plot plan requiring electric service from the Company.
- **Development (Residential):** A planned project, which is developed by a developer/applicant, for electric service set out in a recorded plot plan for the construction of multiple single-family residences, detached or otherwise, mobile homes, or apartment houses, all of which are intended for year-round occupancy, if electric service to the lots necessitates extending the utility's existing distribution lines.
- **Distribution Lines:** Company lines (medium voltage and below) typically located in the public rights-of-way in/or along streets, alleys, highways, or on private property within the subdivision for general distribution of electric service to customers.
- **Environmental Protection Agency (EPA):** The EPA is an agency of the U.S. federal government that protects human health and the environment by writing and enforcing regulations based on laws passed by Congress (www.epa.gov).
- **Federal Aviation Administration (FAA):** The Federal Aviation Administration is the national aviation authority of the United States. An agency of the United States Department of Transportation, it has authority to regulate and oversee all aspects of American civil aviation (www.faa.gov).

- **Final Grade:** Final grade shall refer to the eventual permanent ground level after all finished grading, paving, and landscaping is completed. Final grade shall be used when determining minimum clearances for overhead and underground facilities.
- **Line Extension:** The extension of the Company's facilities (including but not limited to poles, fixtures, transformers, wires, cables, vaults, foundations and appurtenances) necessary for delivering electrical energy from the point where a line extension connects with and receives energy from an existing transmission or distribution source, which is the nearest and suitable source, to the new service line, which will provide electric service to the customer. Line extension rules and costs are further defined in each Operating Company's Tariff with the state.
- **Listed:** Equipment, materials, or services included in a list published by an organization (e.g., UL Listed) that is acceptable to the Authority Having Jurisdiction and concerned with evaluation of products or services, that maintains periodic inspection of production of listed equipment or materials or periodic evaluation of services, and whose listing states that the equipment, material, or services either meets appropriate designated standards or has been tested and found suitable for a specified purpose.
- **National Electrical Code [NFPA 70] (NEC):** The NEC is a set of national regulations that govern the installation of electrical equipment located on the customer's side of the point of service. All NEC references refer to the latest state adopted version of the NEC.
- **National Electrical Safety Code [IEEE C2] (NESC):** The NESC is a set of national regulations that govern the installation, operation, and maintenance of the electric supply and communication lines. NESC applies to equipment located on the electric utility's side of the point of service. All NESC references refer to the latest version of the NESC.
- **Notification or Design Request (DR) Number:** A unique number assigned by the Company used for designing, tracking, constructing, and billing of a specific job by the Company Contact Center. This number should be used in any communication with the Company Contact Center. (See Section III. A.)
- **Occupational Safety & Health Administration (OSHA):** is a federal government agency in the Department of Labor to maintain a safe and healthy work environment (www.osha.gov).
- **Point of Service:** Point of service is that point where the Company's equipment or conductors connect to the customer's conductors or equipment of the facility. The "point of delivery" is commonly known as the "point of service."
- **Secondary/Secondary Main:** conductors (cables) connected to the secondaries of distribution transformers from which customers services are supplied (< 600 V).
- **Select Backfill:** Graded sand, stone dust, limestone dust, earth or topsoil that is free from large or sharp objects, rocks, scrap building material, or corrosive material. Materials that "set up" such as fly ash, culm and foundry waste are not acceptable.

It is used to backfill a trench for buried conduit and is used to ensure the future integrity of the conduit or direct buried electrical cables.

- **Service:** Delivering electric energy from the Company's distribution system to a single point of connection at a customer's premises.
- **Service Lateral:** A set of underground service conductors extending from the Company's electric distribution facilities, including any risers at a pole or other structure or from transformers, handholes, or pedestals to the first point of connection to the service entrance conductors in a terminal box, meter, or other enclosure with adequate space, inside or outside the building wall.
- **Service Territory (electric):** Service territory is a defined area in which a given electric utility can legally provide service. The area is governed by a set of agreements and maps on file with the state agency that regulates public utilities.
- **Tariff:** Tariffs are a set of rate schedules, rules, and regulations for providing electric service throughout each Operating Company's service territory. The applicable Company Tariffs are filed with and approved by the state agency that regulates public utilities.
- **Temporary Electrical Service:** Service supplied for construction purposes or of limited duration, typically no longer than one year, and delivered to a single point through one meter.
- **Underground Equipment**
 - **Transformer Box Pad 15-inch:** 37" X 43" X 15" fiberglass box pad with 26" X 30" opening for single-phase pad-mounted transformers, transformer deferral cabinets, and single-phase sectionalizing enclosures. Note: The front of box pad is indicated on the top of the box pad and area for placement of conduit is indicated with a line on each side of the opening. (See Exhibit G.)
 - **Transformer Box Pad 32-inch:** 37" X 43" X 32" fiberglass box pad with 26" X 30" opening for single-phase pad-mounted transformers, transformer deferral cabinets, and single-phase sectionalizing enclosures. Note: The front of box pad is indicated on the top of the box pad and area for placement of conduit is indicated with a line on each side of the opening. (See Exhibit G.)
 - **Three-Phase Transformer Pads:** Precast concrete foundations as specified in Exhibit J or concrete flat pads as specified in Exhibits K, L, and M.
 - **Handhole Small Lawn (600 V):** Handhole, lawn type, Tier 5, HDPE, 12" X 20" opening X 15" depth, includes flat cover, also available with a 15" domed cover. Mounted at grade. (See Exhibit I.)
 - **Handhole Medium Lawn (600 V):** Handhole, lawn type, Tier 5, HDPE, 17" X 30" opening X 17" depth, includes flat cover. Mounted at grade. (See Exhibit I.)
 - **Handhole Streetlight Lawn (600 V):** Handhole, lawn type, HDPE, 9" round opening, 9" depth, includes flat cover. Mounted at grade. (See Exhibit I.)
 - **Pedestal:** Fiberglass secondary junction enclosure, stake-less pedestal, with 3" flanged base, overall dimensions 18" X 22" X 30", above ground dimensions 9" X 14" X 18". (See Exhibit H.)

- **Three-phase Junction/Sectionalizing Enclosure:** pad-mounted enclosure containing multi-position primary (15 kV, 25 kV, or 35 kV) junction modules/bus for all three-phases, typically fiberglass with 19.5" integral base, 88" W x 50" D X 49.5"H, flip up lid. (See Exhibit R.)
- **Single-phase Junction/Sectionalizing Enclosure or Transformer Deferral Cabinet:** pad-mounted enclosure containing multi-port primary junction module/bus (15 kV, 25 kV, or 35 kV) for one phase, typically fiberglass cabinet mounted on single-phase transformer box pad, 35.5" W X 28" D X 28"H, flip up lid. (See Exhibit G.)
- **Manhole Small:** Precast concrete manhole, 2-piece, base with internal dimensions 6' X 8' X 7', variable cover designs based on use, H20 with impact. (See Exhibits N, P, and Q.)
- **Manhole Large:** Precast concrete manhole, 2-piece, base with internal dimensions 6' X 12' X 7', variable cover designs based on use, H20 with impact. (See Exhibits N, P, and Q.)

III.APPLICATION REQUIREMENTS

A. Contacting the Company

The developer shall contact the Company Contact Center concerning the project by calling the local operating company 800 number listed below. A Company representative will be assigned to your project from the local line shop/service center.

Operating Company Contact Center Numbers:

- Jersey Central Power & Light: 800-662-3115
- Met-Ed: 800-545-7741
- Mon Power: 800-686-0022
- Ohio Edison: 800-633-4766
- Penelec: 800-545-7741
- Penn Power: 800-720-3600
- Potomac Edison: 800-686-0011
- The Illuminating Company: 800-589-3101
- Toledo Edison: 800-447-3333
- West Penn Power: 800-686-0021

B. Required Information for the Company

The developer shall provide the Company with a local building authority approved/recorded copy of the customer plot plan drawn to scale including all easements for other utilities/facilities, crossroads, proposed structures, wells, septic, decks, drives/parking areas, pools, ponds, planned major landscape changes and future development areas, and any other known or proposed obstructions that may interfere with the Company supplying electric service.

Electrical loading information shall also be required for the design. For residential structures, this would include typical square footage, load characteristics, and fuel options (i.e., natural gas, electric, or other) for heating and hot water. Also include information regarding voltage and load requirements for any non-residential subdivision facilities, such as pumping stations, swimming pools, community buildings, etc. The company representative may require more detailed information for commercial and industrial loads or commercial or industrial developments to establish accurate electric load profiles.

If the project will be developed in phases, the developer shall provide a master plan drawing which details the total area to be developed, including all future streets, and a proposed timeline for the construction of the various phases.

The subdivision plot plan drawings shall be provided in both hard-copy full-size print form for design purposes and electronically in .dwg format so they can be readily added into the Company GIS land base.

For street lighting applications in conjunction with the development, the developer shall contact the Company Representative for details. (Note that street lighting requirements are frequently under the control of the local jurisdiction and the specific requirements may not be known at the time the electric system design is being established by the Company. In these situations, the Company may require the installation of conduit stubs out of manholes, handholes, or transformers to allow for the establishment of a future electric system supplying the street lighting system required by the local jurisdiction. This will typically require a conduit stub from one or more Company equipment locations. The Company may also require the stub to be extended and terminated in a handhole or pedestal.)

C. Timeline

All required information shall be provided at least sixteen (16) weeks prior to the date service is required for residential subdivisions of 20 lots or less. For residential subdivisions between 20 and 200 lots, this information shall be provided at least twenty-four (24) weeks prior to the date service is required.

Larger subdivisions or those with multiple phases of construction, commercial, municipal, or other large loads may require additional time. Additionally, more complex subdivisions designs (varying lot sizes, non-rectangular lots, multiple elevation changes, multiple commercial/municipal loads, etc.) may require a timeframe much longer than those quoted above. Contacting the Company during the initial planning stages of these larger subdivisions will help to ensure the design and installation of the electric system occurs in a timely manner.

D. Location of Company Facilities

The required location of Company underground facilities in residential developments is the front lot line with each dwelling served by a separate service. The specific location of the underground electric facilities shall be chosen to avoid open drainage ditches, creeks, marsh areas, areas that are prone to flooding, areas of steep terrain, or other areas that are environmentally sensitive or may hinder construction or operation of the electric system.

Additionally, the location of Company underground facilities, including conduit, manholes/handholes, and foundations, shall be chosen so that the area is accessible and has

adequate working space for the equipment and personnel needed to install and maintain the facilities.

Any changes to the location of the Company facilities shall be approved by the Company's Engineering Section prior to the installation of those facilities. Future access to these facilities shall not be impaired by landscaping, fencing, guard rails, grading, buildings, or other structures or barriers. (See Exhibits T and U.)

For commercial and industrial developments, the Company will develop a construction plan which incorporates the most practical layout, taking into consideration safety, reliability, maintenance requirements, future access, economics, customer load requirements, and the design of the development including the design requirements of the individual commercial or industrial services. The location of the underground facilities, the location of the service equipment, the right-of-way requirements, and other design aspects may vary significantly from the requirements for residential developments. Although there may be significant design differences for these types of developments, the conduit, manholes, and equipment foundations utilized will be the same as those found in the Exhibits and will be installed in the same manner.

E. Easements

All Company-owned equipment within the subdivision shall be located within the bounds of a recorded easement on private property. One blanket utility easement for the entire development shall be obtained from the developer (i.e., property owner) and be recorded on the plat for the subdivision by the developer. The individual FirstEnergy Operating Company shall be specifically named in the easement. The right-of-way agreement covering the use of the easement is obtained from the property owner and is legally recorded against the development as a permanent record by the Company. Right-of-way agreements shall be properly executed and recorded prior to selling any individual lots.

Easements required for Company underground facilities are ten feet in width unless otherwise specified by the Company. Along front lot lines, the easement extends into private property from the street right-of-way. Along the side lot lines, the easement is typically split evenly between the adjacent lots. (See Exhibit C for a typical residential subdivision layout with easements.)

Easements shall be free and clear of any structure that impedes access. This includes structures independent and separate from the main structure or portions of the main structure that protrude beyond the foundation such as porches, stoops, bay windows, or other such structure extensions that project into or over the easement.

F. Permits

The developer shall also arrange for expediting the acquisition of any local (e.g., municipal or township), county, or environmental permits, including but not limited to the following:

1. Freshwater & Tidal Wetlands,
2. CAFRA/Waterfront Development,
3. Soil Erosion & Sediment Control,
4. Stream Encroachment,
5. Department of Transportation (DOT) Road Crossings,
6. Turnpike Road Crossings,

7. Army Corps of Engineers Navigable Water Crossings,
8. Railroad Crossings or Occupation,
9. Federal Aviation Agency & State DOTs Permits for work near aviation facilities.

The developer shall be required to produce evidence of such permits that is deemed satisfactory by the Company.

IV. COMPANY ELECTRICAL SYSTEM DESIGN

A. Electric System Design Drawing

The developer shall receive the Company electrical layout design drawing(s) prior to beginning trenching or equipment foundation, junction, handhole, manhole, and pedestal site preparation.

B. Drawing Symbols

The location of the conduit, transformers, manholes, handhole/pedestal, and other equipment and structures necessary for the installation of the electric system serving the development shall be shown on the drawing supplied by the Company. The facilities will be represented by the symbols shown on Exhibit B.

C. Responsibilities

1. Details on the responsibilities of the developer and the Company for the various facilities needed for the installation of the electric system are included in Exhibit A.
2. The installation of these facilities shall comply with all Company standards and requirements as detailed in the attached Exhibits.

D. Communications with the Company

1. The developer shall reference the CREWS Work Request number in all correspondence with their Company representative or the local service center/line shop. The Company representative shall supply the developer with this number.
2. The developer shall coordinate a construction schedule with the Company concerning the installation of the distribution facilities.
3. Communication between the developer and Company shall be necessary for the following items to minimize construction problems and delays:
 - a. Any modifications or revisions to the approved design shall be reviewed and approved by the Company's Engineering Section prior to implementation.
 - b. Any other problems or questions regarding the project shall be promptly reviewed with the Company.

E. Inspections by the Company

The developer shall notify the Company of the schedule for trenching at least one week prior to the opening of the trench to allow for the scheduling of trench, conduit, and equipment foundation inspections. This notice will also provide the Company with the

opportunity to schedule the cable and associated equipment installations. The Company, at its sole discretion, may waive the inspection requirement. The Company will not install cable or other equipment in or on facilities that fail to meet the Company's requirements.

F. Design Changes

1. Any changes to the conduit system design, installation, or installation schedule shall be discussed with the Company Representative. Conduit system design changes or equipment location changes shall be approved by the Company engineering staff in writing (hard copy or electronic) prior to installing those facilities.
2. The developer may be required to pay additional charges for developer requested design changes, or for return trips or other occurrences that cause the Company additional expense.

V. CONSTRUCTION REQUIREMENTS

A. One-Call Notification

1. The excavator shall mark the proposed excavation site with white paint/chalk, white flags, or white stakes and then notify the appropriate State One-Call Agency three to four days minimum (per local Agency's rules) before excavation begins.
2. The nationwide telephone number for the "Call before You Dig" process is 8-1-1. The developer/excavator may also contact 811 through the Internet by using their website at: www.call811/state-specific.aspx.
3. Finally, the developer may contact each state directly. For projects in:
 - a. **Maryland:** Call Miss Utility Maryland, telephone number (800) 257-7777 or use website: www.missutility.net/maryland.
 - b. **New Jersey:** Call New Jersey One-Call System, telephone number (800) 272-1000 or use website: www.nj1-call.org.
 - c. **New York:** Call Dig Safely New York, telephone number (800) 962-7962 or use website: www.digsafelynewyork.com.
 - d. **Ohio:** Call Ohio Utility Protection Service (OUPS), telephone number (800) 362-2764 or use website: www.oups.org.
 - e. **Pennsylvania:** Call Pennsylvania One-Call System, telephone number (800) 242-1776 or use website: www.paonecall.org.
 - f. **West Virginia:** Call West Virginia 811, telephone number (800) 245-4848 or use website: www.wv811.com.

B. Site Preparation

1. The developer shall receive Company approved electrical layout design drawing(s) prior to beginning trenching or equipment foundation, junction, and pedestal/handhole site preparation.

2. The developer shall provide site preparation in the following manner prior to the installation of Company's facilities:
 - a. Grade all underground Company easements and street rights-of-way to their final grade.
 - b. Provide a clear level area, free of obstructions at final grade, for all transformers, junctions, switchgear, handholes, and pedestals as per the attached Exhibits.
 - c. Identify all required boundaries and provide lot corner pins and lot number stakes for all lots.
 - d. Provide radius stakes for all curved portions of streets where Company cables will be installed.
 - e. The developer shall provide truck access to all Company-owned equipment and poles (as designated by the Company). The truck access drive shall be a minimum of twelve (12) feet in width, installed to withstand a 40,000-pound vehicle including the size and weight of any necessary equipment, and provide unobstructed access to any equipment/pole located within a ten (10) feet reach of the drive. All access drives shall be permanent, maintained, and visible for all-season access. The developer shall contact the Company for details.

C. Excavating & Trenching

1. The trench and excavations are to be provided at the locations indicated by the Company's approved electrical design drawing(s). In certain instances, the Company may choose to field stake the trench location at the site.
2. The Company is not obligated to accept any trenching done prior to obtaining Company approved electrical design drawing(s) and/or field indication of the trench location.
3. After existing underground utility facilities have been located by One-Call personnel, hand digging is required within a tolerance zone (see table below), which is from all sides of the mark-out stake, flag, or hash mark and the closest edge of any parallel trench dug by another party adjacent to the Company's underground facilities.

State	Tolerance Zone Dimension
Maryland	18 inches
New Jersey	24 inches
New York	24 inches
Ohio	18 inches
Pennsylvania	18 inches
West Virginia	18 inches

4. The trench shall be excavated to the specifications shown in Exhibit F.
5. The bottom of the trench should be in undisturbed, tamped, or relatively smooth earth. In rocky soil, the conduit shall be laid on a protective layer of clean, tamped select backfill at least two (2) inches thick. See Exhibit F for additional conduit installation requirements.
6. The trenching specifications outlined in Exhibit F are those of the Company and not necessarily those of other utilities. The developer shall therefore coordinate the

occupancy of the trench with the other utilities approved by the Company to occupy the trench.

7. Where trench depth must exceed four feet, prior approval shall be obtained from the Company's Engineering Section.
8. The Company reserves the right to inspect the trench and conduit installation prior to backfilling to ensure compliance with all Company requirements. The developer shall notify the Company before backfilling starts.

D. Conduit Installation

1. The developer shall install the conduit system to provide proper protection of the cable, in accordance with the layout provided by the Company's electrical design drawing(s). The Company's Engineering Section shall approve any changes to the layout in writing (hard copy or electronic).
2. Conduit(s) are required for all electrical cables. The Company will specify the size and number of the conduits to be installed. The conduit(s) shall be furnished and installed by the developer as per the electrical design layout provided by the Company.
3. When conduits are required by the Company for electrical system needs other than the developer's needs, the Company shall provide the additional conduits and the developer shall install these conduits.
4. Location, depth, size, and type of conduit shall be installed as directed and according to the Company's specifications. The standard electrical-grade conduit shall be rigid PVC, heavy wall, sunlight resistant, listed & labeled, Schedule 40 conduit per NEMA TC 2 (latest revision). See Exhibit F for additional conduit requirements.
5. Conduit shall be run in a straight and level path. There shall be no abrupt changes in conduit direction (elevation or sideways) except for bends at pad-mounted equipment and for turning-out service lateral conduits to lots. See Exhibit F for additional installation requirements.

E. Trench Backfill

1. The developer shall provide Company approved backfill to cover and protect underground distribution facilities. (See Exhibit F for backfill specifications).
2. The Company reserves the right to examine and approve the backfill before its use and reject any materials that are not satisfactory for the backfill.
3. Backfill is to be installed in the trench in such a manner that the conduit is not damaged. Backfill shall be tamped to avoid settling. Any damage or repairs required due to settling of the trench shall be the responsibility of the developer.
4. A red electrical warning tape at least three inches wide shall be provided by the developer and shall be installed by the developer directly above all conduits approximately 12 inches below final grade as shown in Exhibit E.
5. Electronic markers, if provided by the Company, shall be installed by the developer in the locations as specified by the Company.

6. The cover over the conduits shall meet the minimum requirements as stated in Exhibit F before the Company will install their cables. The developer shall ensure that the minimum recommended coverage over the conduits are always maintained through all phases of construction. Any necessary corrections to the depth of cover or any temporary mechanical protection required over buried conduit to prevent damage due to surface activity shall be the responsibility of the developer until all stages of the development have been completed.

F. Equipment Foundations, Manholes, & Other Submersible Structure Installations

1. Transformer foundations, handholes, pedestals, and manholes shall be located as indicated on the Company electrical layout design drawing(s). Installation details for these structures include excavation dimensions and base material/foundation requirements. These details are provided in the Exhibits at the end of this document.
2. For pad-mounted equipment installations and submersible structure installations, the customer shall provide the excavation, and provide and install the base material. The responsibility to provide and install the equipment foundations or submersible structures will vary by Operating Company. Those responsibilities are detailed in Exhibit A.
3. Telephone, CATV, and street lighting pedestals are to be installed a minimum of 18 inches from transformer pads, junctions, switchgear, manholes, or handholes/pedestals and placed to the rear of the equipment and away from access point to allow for safe operating clearance and maintenance of the equipment.
4. Foreign pipes or conduits shall not be installed under manholes, splice boxes, box pads, or equipment foundations including pipes or conduits for gas, water, sewer, telephone, and other communication lines.
5. Replacement of equipment foundations, submersible structures, or other electrical power service equipment supplied by the Company that is damaged during activities associated with the installation of the development by the developer or the developer's subcontractors shall be the responsibility of the developer.

VI. EXHIBITS

Underground Electric Material Responsibility Guidelines

Material	Supplied By										Installed By									
Operating Company	CE	JC	ME	MP	OE	PE	PN	PP	TE	WP	CE	JC	ME	MP	OE	PE	PN	PP	TE	WP
Trench/Backfill	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D
Conduit	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D
Warning Tape	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D
1–PH Transformer Pad	C	C	C	C	C	C	C	C	C	C	C	D	C/D	D	C	D	D	C	C	D
3–PH Transformer Flat Pad	-	-	-	D	D	D	-	D	D	D	-	-	-	D	D	D	-	D	D	D
3–PH Transformer Box Pad	D	D	D	-	D	-	D	-	D	-	D	D	D	-	D	-	D	-	D	-
Handhole Pedestal	C	C	C	C	C	C	C	C	C	C	C	D	C/D	D	C	D	D	C	C	D
Manhole	D	D	D	D	D	C	D	C	C	D	D	D	D	D	D	D	D	C	C/D	D
Switchgear Foundation	C	C	D	C	D	C	C/D	C	C	D	C	D	D	D	D	D	D	C	C	D
1–PH Junction Enclosure	C	C	C	C	C	C	C	C	C	C	C	D	C/D	D	C	D	D	C	C*	D
3–PH Junction Enclosure	C	C	C	C	C	C	C	C	C	C	C	D	C/D	D	C	D	C/D	C	C*	D

C - Company; D - Developer

*excavation by Developer

Company Abbreviations

CE – The Illuminating Company

ME – Met Ed

OE – Ohio Edison

PN – Penelec

TE – Toledo Edison

JC – Jersey Central Power and Light

MP – Mon Power

PE – Potomac Edison

PP – Penn Power

WP – West Penn Power

Notes:

Mechanical protection for cables on riser poles varies among the FirstEnergy Operating Companies and can include conduit and U–guards. The responsibility for supplying and installing these materials also varies significantly among the FirstEnergy Operating Companies. Consult the Customer Guide for Electric Service (CGES) for the state where the development will be installed and/or your Company representative for details on these riser pole material requirements.

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EXHIBIT A


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Conduit (see Note 1) (Exhibits E & F)

Primary conduit – 

Secondary conduit – 

Service Conduit – 

Riser pole (conduit endpoint) (Exhibit E) –  (Company owned)  (Customer owned)

Secondary pedestal (Exhibit H) – 


Secondary handhole (Exhibit I) – 

Single-phase box pad foundation (Exhibit G):

Transformer – 


Fuse enclosure – 

Sectionalizing enclosure – 

Manhole (see Note 2) (Exhibits N–Q) – 

Three-phase pad-mounted switchgear (Exhibit S) – 

Three-phase pad-mounted transformer (Exhibits J–M) –  or 

Three-phase sectionalizing enclosure (Exhibit R) – 

Notes:

1. Conduit size and configuration will be indicated near conduit. Standard trade size of SCH 40 PVC Electrical Grade conduit will be listed first followed by number of conduits in duct bank and configuration with horizontal conduit number listed first, then vertical number listed. For example, a six-way duct comprised of 6" SCH 40 conduits two conduits wide and three conduits high would be marked: 6" 6W 2X3. Single conduits may be labeled with only trade size and no other information. For example, a one-way 5" SCH 40 conduit may be labeled: 5".
2. Manhole sizes will be indicated on the drawing near the structure. The size will be listed with the width first, then the length, and then the depth in feet. For example: 6'X8'X7' for a six-foot wide by eight-foot long manhole with seven feet depth. The manhole top will be indicated on the drawing near the manhole by the figure number from Exhibit Q. For example, to indicate the manhole lid for pad-mounted switchgear the drawing would be marked with "Fig. 9". Consult your Company representative for detailed information prior to ordering the manhole.
3. Three-phase pad-mounted transformers will be placed on pre-cast concrete foundations or flat-pad foundations. The required foundation will be indicated next to the three-phase transformer symbol. Pre-cast foundations will be designated J1 through J5 corresponding to Exhibit J. Flat-pad foundations will be designated K or L corresponding to Exhibits K and L, respectively.

Electrical Equipment Drawing Symbols

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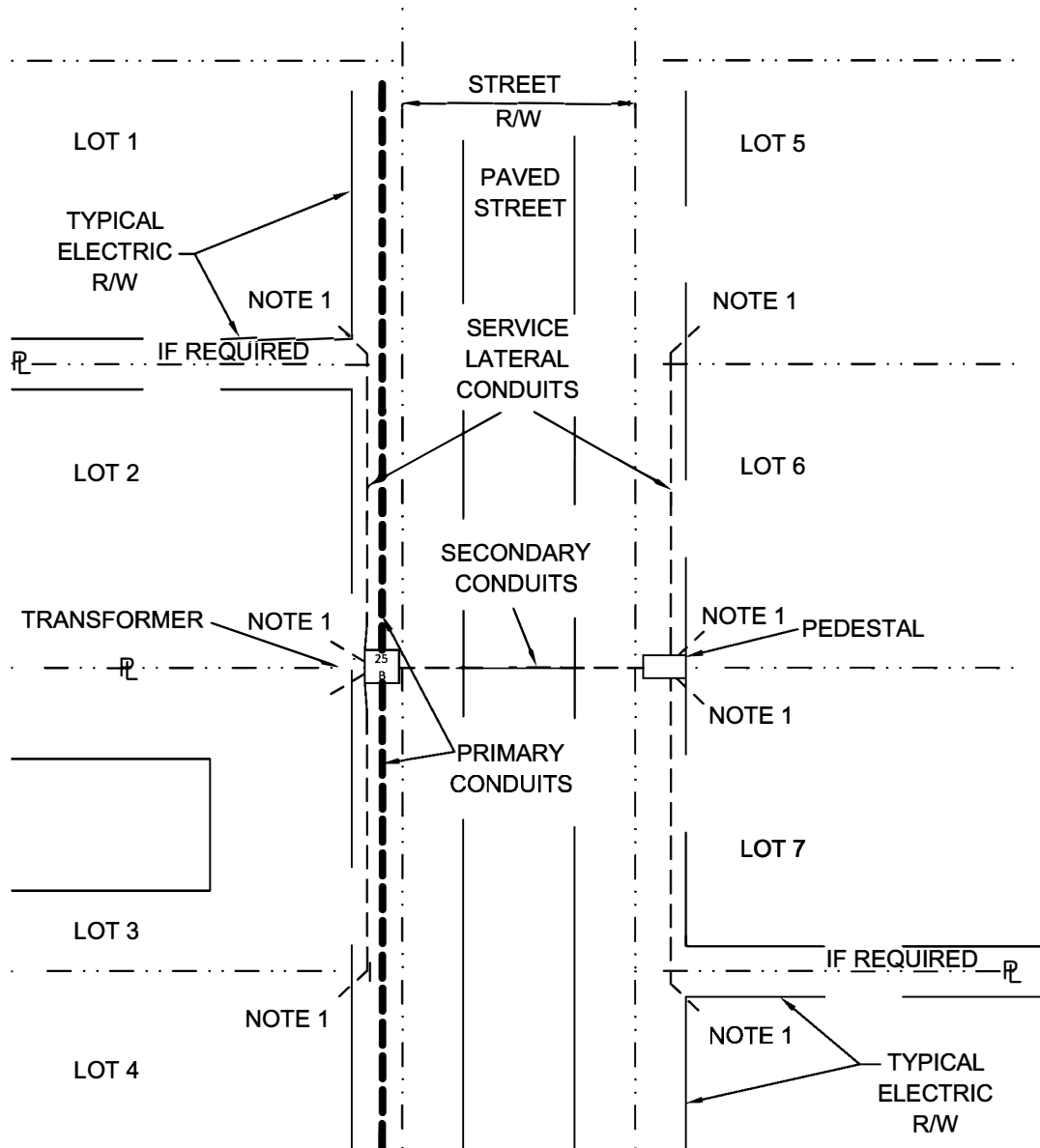
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EXHIBIT B

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Notes:

1. Extend the service conduit to the Company designated meter location. Consult the CGES for the state where the project will be built for specific requirements for the service conduits.
2. This eight (8) lot example is for information purposes only showing typical equipment and right-of-way locations. Actual designs can vary significantly supplying a greater or lesser number of lots based on the particular characteristics of the subdivision.

Typical Residential Subdivision Layout

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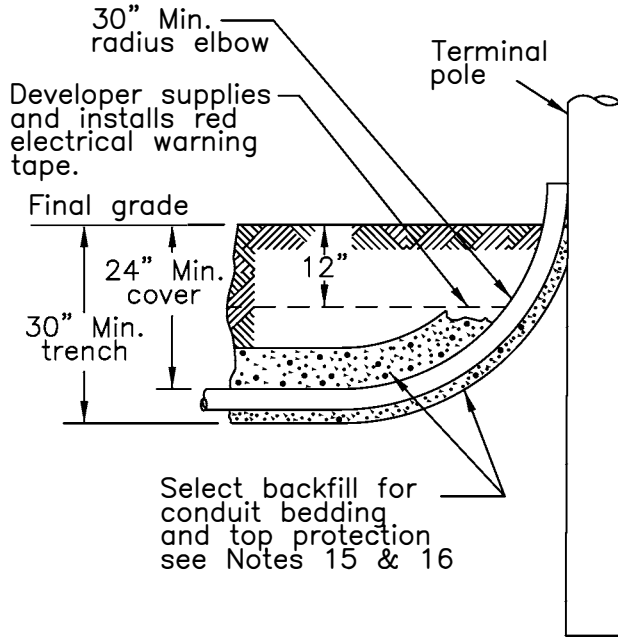
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EXHIBIT C

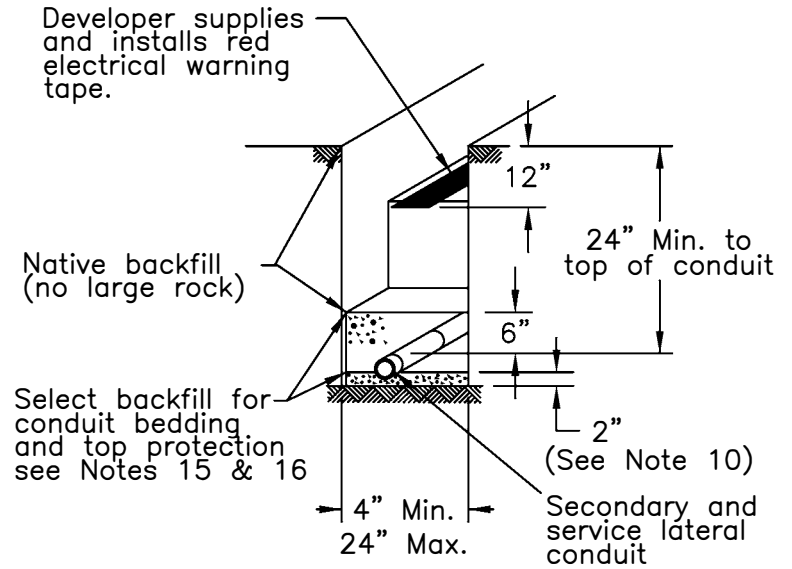
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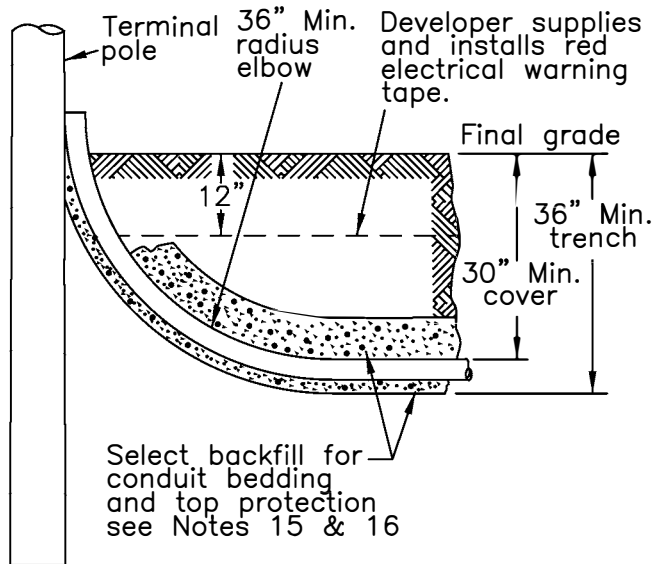
Secondary/Service Conduit at Pole



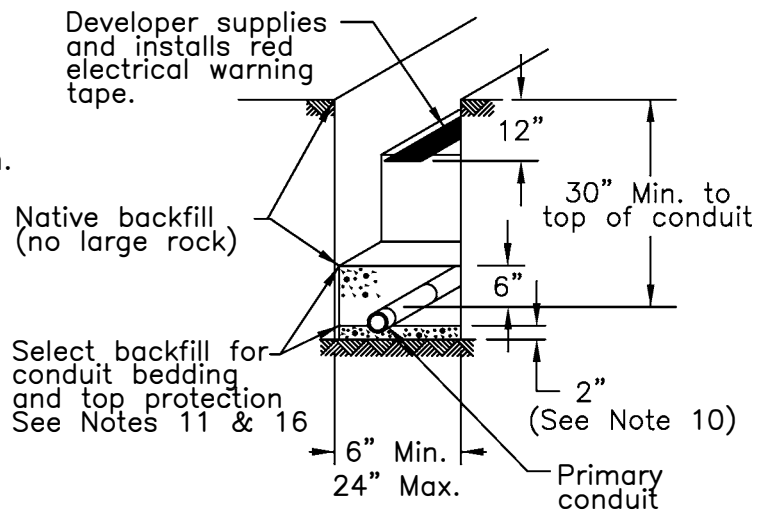
Secondary/Service Lateral Trench



Primary Conduit at Pole



Primary Trench



Detailed notes for trench, conduit, and backfill requirements provided in Exhibit F.

Typical Trenching Details for Installation of Secondary/Service Lateral & Primary Conduits

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Notes:

1. The developer shall provide trenching, conduit, and backfill to Company requirements.
2. The developer shall not deviate from the Company's approved trench route unless expressly approved in writing (hard-copy or electronic) by the Company's engineering group representative. It shall be the developer's responsibility to notify the Company of any conflicts that the proposed electrical design creates with obstacles, other facilities, or easements. Changes requested following the design acceptance by the developer may require the Company to be compensated if facilities need to be relocated.
3. Before excavation begins, the excavator shall notify the appropriate state "One-Call" agency (refer to Section V.A.3). The developer shall be responsible for any damage caused by the excavator.
4. The developer shall also coordinate the installation of all other buried utilities that are installing their facilities nearby, will jointly occupy the trench, with Company approval, or cross the electrical supply trench.
5. Below are the Company's required minimum clearances between electric supply lines and the following utility lines:
 - a. Steam or cryogenic lines – six (6) feet (use of an approved thermal barrier may reduce this clearance).
 - b. Fuel lines: low-pressure gas, oil, propane, or other – four (4) feet; gas lines that are greater than four (4) inches in diameter or high-pressure lines – ten (10) feet.
 - c. Water, sewer, and telecommunications (i.e., telephone and CATV) lines – one (1) foot.
 - d. Clearances from telephone and CATV lines may be reduced to zero (0) feet or no deliberate separation (a.k.a. – random lay) if all involved parties agree and NESC [2017] Rule 354 is met.
 - e. Other utility companies (i.e., local water, sewer, and gas (fuel)) may require greater clearances than stated above.
 - f. If required (e.g., trenching through solid rock) clearances may be reduced to one (1) foot if all parties involved agree.
 - g. Other facilities are prohibited from running above/below and parallel to electrical supply lines without specific Company approval.
6. The Company's minimum cover requirements for the primary (> 600 V) and secondary (0 – 600 V) conduits are based on providing adequate cover per NESC codes (depth). It shall be the responsibility of the developer to ensure that the minimum required coverages over the conduits are maintained. Any necessary corrections to the depth of cover or required mechanical protection to prevent damage to the conduits from surface activity shall be the responsibility of the developer. Minimum cover over the conduits shall be maintained until all stages of the development are completed.

Minimum Cover Requirements

Voltage V (Φ- Φ)	Minimum Cover Over Conduit(s)
0 – 600 V	24 inches
>600 V – 50 kV	30 inches

7. When primary (> 600 V – 50 kV) and secondary (0 – 600 V) conduits share the same trench and are located side-by-side, the depth of cover for both conduits shall be to the primary conduit requirement with a minimum of two (2) inches of separation. If the conduits are stacked, the primary conduit(s) shall be on the bottom at the required primary depth. The secondary conduit(s) shall be on top of the primary conduit(s) with a minimum separation of two (2) inches between the conduits.
8. See Exhibit E for details on the trench dimensions. Contact the Company representative if the trench must be more than four (4) feet deep.
9. The developer shall clear the cable route of trees, tree stumps, boulders, or other obstructions at and below grade. The developer shall be responsible for any damage caused by the excavator. This includes damage to any tree whose root system is subsequently damaged from trenching operations. The excavator shall grade the trench route to final grade level.
10. The bottom of the trench shall be relatively smooth, undisturbed earth, sand, or well-tamped earth which is free of rock, cinders, or sharp objects. Trench excavations in rocky soil may require a two (2) inch layer of select backfill on the bottom of the trench as determined by the Company.
11. Conduits shall be rigid PVC, heavy wall, sunlight resistant, listed and labeled, Schedule 40 conduit per NEMA TC2 (i.e., electrical grade). Additional requirements, such as concrete encasement of elbows or galvanized steel elbows, may be specified by the Company based on the specific design parameters of the conduit system and will be detailed in the electrical layout drawing.

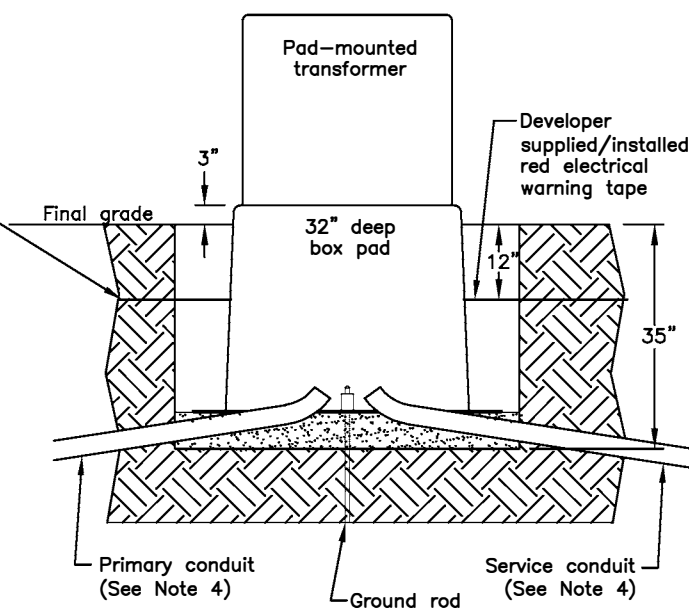
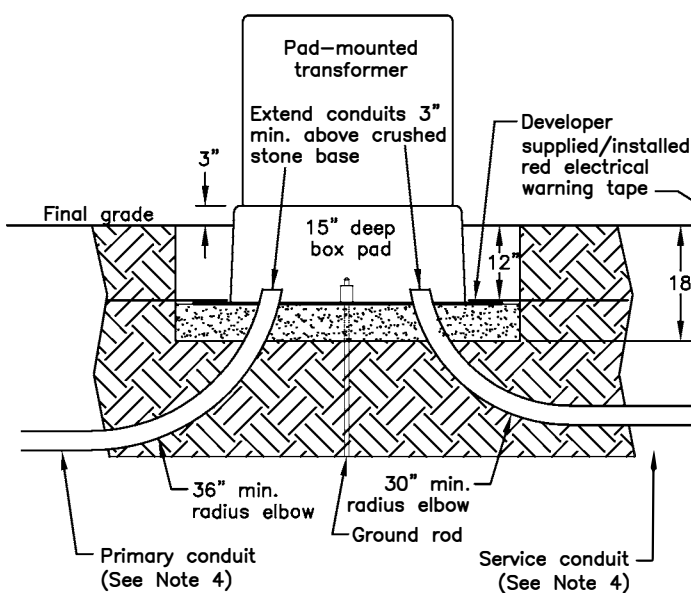
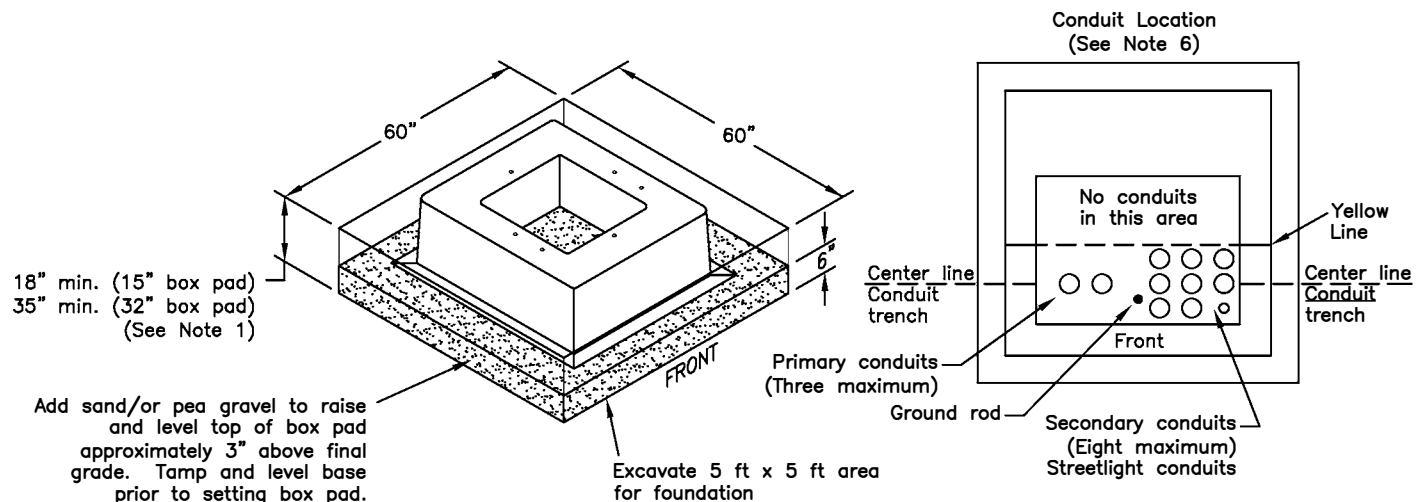
Conduit Requirements

Conduit Size	Conduit Type	Conduit Bend Radius
6" – 8"	SCH40 PVC	48"
3" – 5"	SCH40 PVC	36"
1-1/2", 2"	SCH40 PVC	18"

12. Secondary/service conduit elbows shall have a minimum radius of 30 inches. Service risers shall be rigid PVC, heavy wall, sunlight resistant, listed and labeled, Schedule 80 conduit per NEMA TC2. Primary conduit elbows shall have a minimum radius of 36 inches for sizes from 3" to 5". For conduits 6" and larger, the elbows shall have a minimum radius of 48 inches.

APPROVED BY: *RWJ/TJC*

13. All joints shall be glued together. Conduit shall be cleaned and confirmed with a mandrel 1/2 inch smaller than the conduit inside diameter. Unused conduits shall be plugged at each end to keep water and dirt out. When conduit runs are greater than twenty (20) feet, a 1/4-inch unbroken nylon or polypropylene pulling rope shall be installed in each conduit. If the Company cannot pull conductors through the conduit run, or if the pulling rope is broken or unusable because it is glued to the conduit, the developer shall make the necessary repairs.
14. Before backfilling, the developer shall verify that the Company and local electrical inspector have completed all required inspections of the trench and conduit.
15. The developer shall backfill around all conduits with six (6) inches of select backfill. Select backfill shall be graded sand, stone dust, limestone dust, rock free earth or topsoil. Materials that "set up" such as fly ash, culm and foundry waste are not acceptable. The remainder of the trench shall be backfilled with native soil and not contain large rocks (greater than two (2) inch diameter), rocks with sharp edges or other debris. An additional six (6) inches of mounded backfill is recommended to allow for settling.
16. Backfill should be compacted in six (6) inch layers by hand or using a pneumatic or vibrating tamping equipment to lessen the effects of settling. Do not run wheels or tracks of equipment along the trench to compact the backfill as this could damage the conduits.
17. A red "electrical" warning tape at least three (3) inches wide shall be provided by the developer and installed directly above all conduits twelve (12) inches below final grade as shown in Exhibit E.



Notes:

1. The Company shall specify a 15" or 32" deep fiberglass box pad foundation.
2. Use the "FRONT" label on the top of the foundation for orientation.
3. Install box pad foundation on six (6) inches of leveled and tamped sand or pea gravel. Backfill after foundation is installed with native soil containing no large rocks (greater than two (2) inches), sharp rocks or other debris.
4. Cut off the conduit elbows three (3) inches above the compacted base. Install 1/4-inch unbroken nylon or polypropylene pulling rope in each conduit.
5. Developer shall furnish and install 5/8" X 8' ground rod driven at least 7'6" into the ground in the front-center of the box pad opening as shown.
6. Locate primary conduits in front of the yellow line on the box pad on the left side of the opening. Locate secondary and streetlight conduits on the right side of the opening in front of the yellow line.

Typical Single-Phase Box Pad Foundation Installation

FirstEnergy

Developers Guide

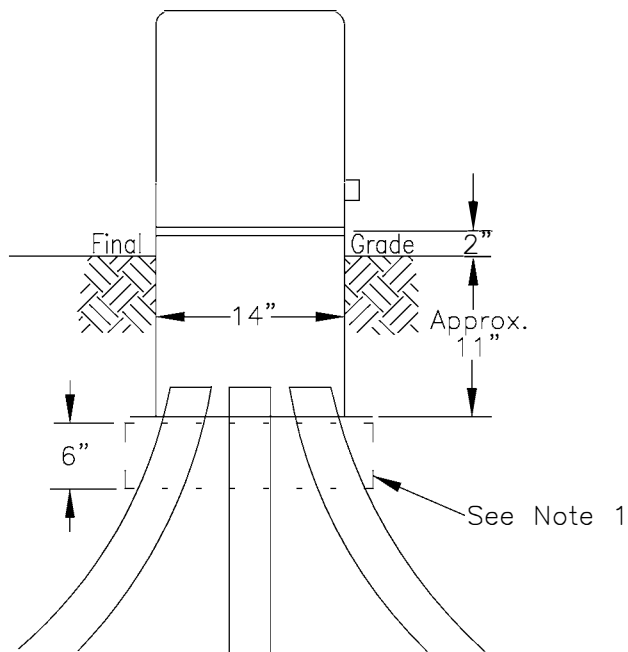
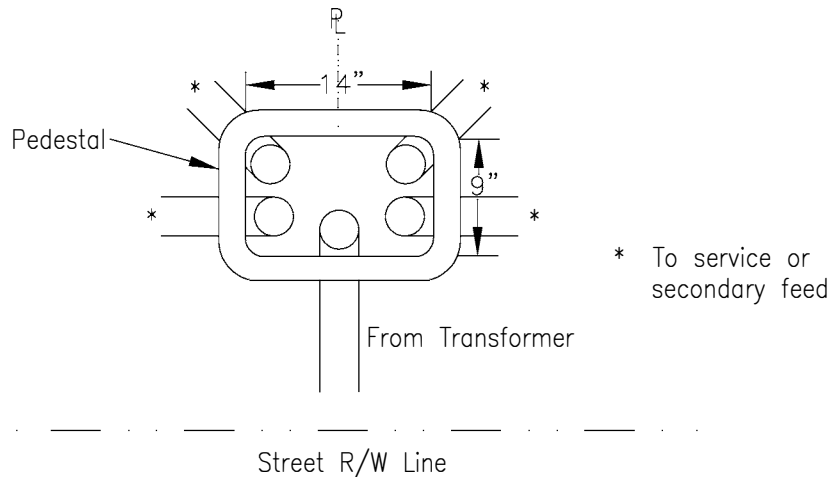
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Notes:

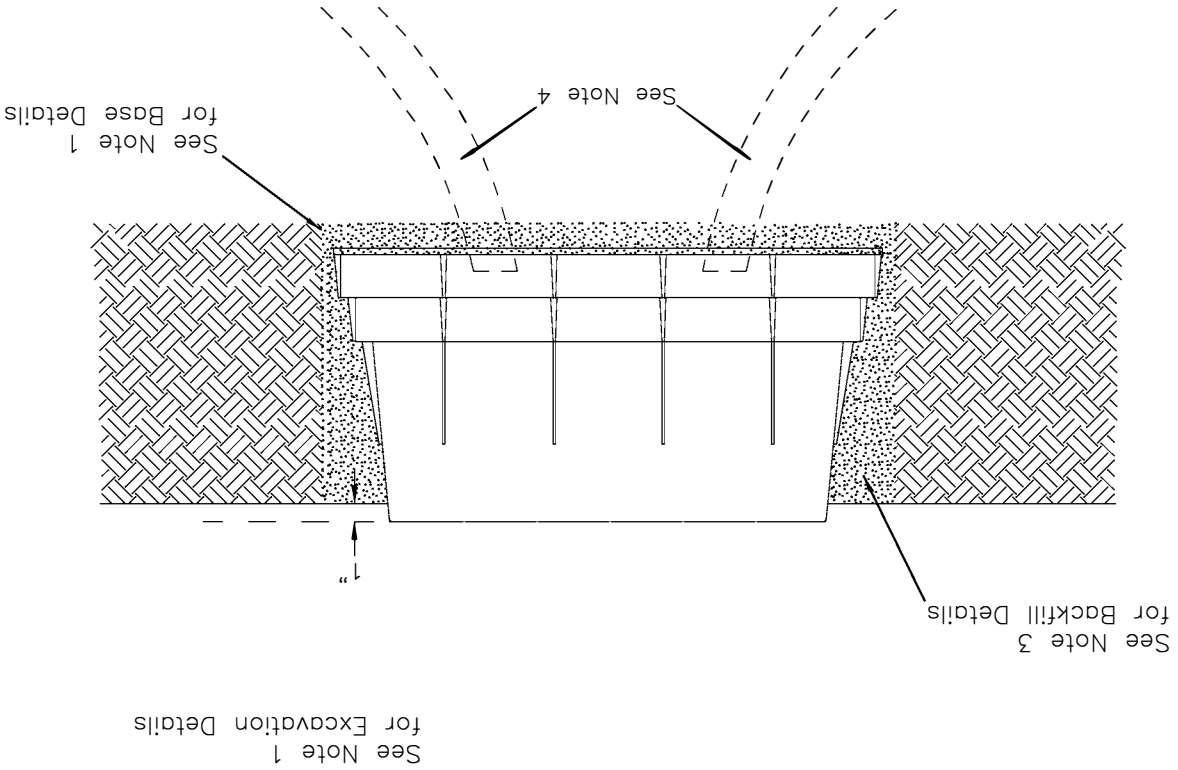
1. Excavate a 24" x 18" x 17" deep area and install six (6) inches of sand or pea gravel that is level and compacted.
2. Install pedestal base section so the top is approximately two (2) inches above final grade.
3. Backfill around the pedestal base with native soil that contains no large rocks (greater than two (2) inches), sharp rocks or other debris.
4. Cut off the conduit elbows three (3) inches above the compacted base. A 1/4-inch unbroken nylon or polypropylene pulling rope shall be installed in each conduit.

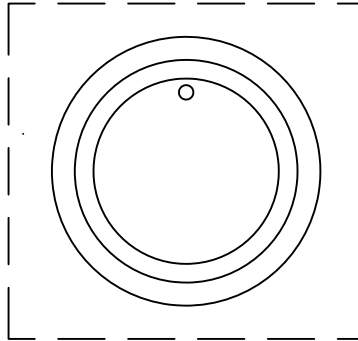
Secondary Pedestal Installation Details

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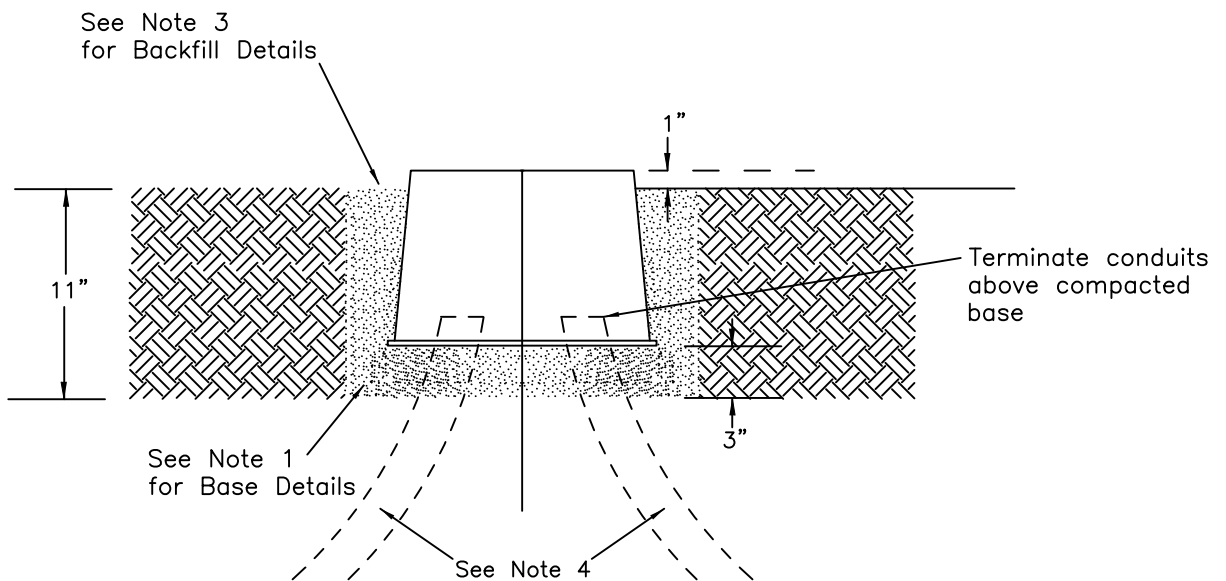
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1. For 12" x 20" x 15" small handholes, excavate a 28" X 36" X 17" deep area and install a three (3) inch sand or pea gravel base that is leveled and compacted. For 17" X 30" X 18" large handholes, excavate a 30" X 42" X 20" deep area and install a three (3) inch sand or pea gravel base that is leveled and tamped. (The dimensions listed are for the opening in the top of the handhole and the overall height of the handhole.)
2. Install the handhole so the top is approximately one (1) inch above final grade.
3. Backfill around the handhole with native soil containing no large rocks (greater than two (2) inches), sharp rocks or other debris.
4. Cut off the conduit elbows three (3) inches above the compacted base. A 1/4"-inch unbroken nylon or polypropylene pulling rope shall be installed in each conduit.



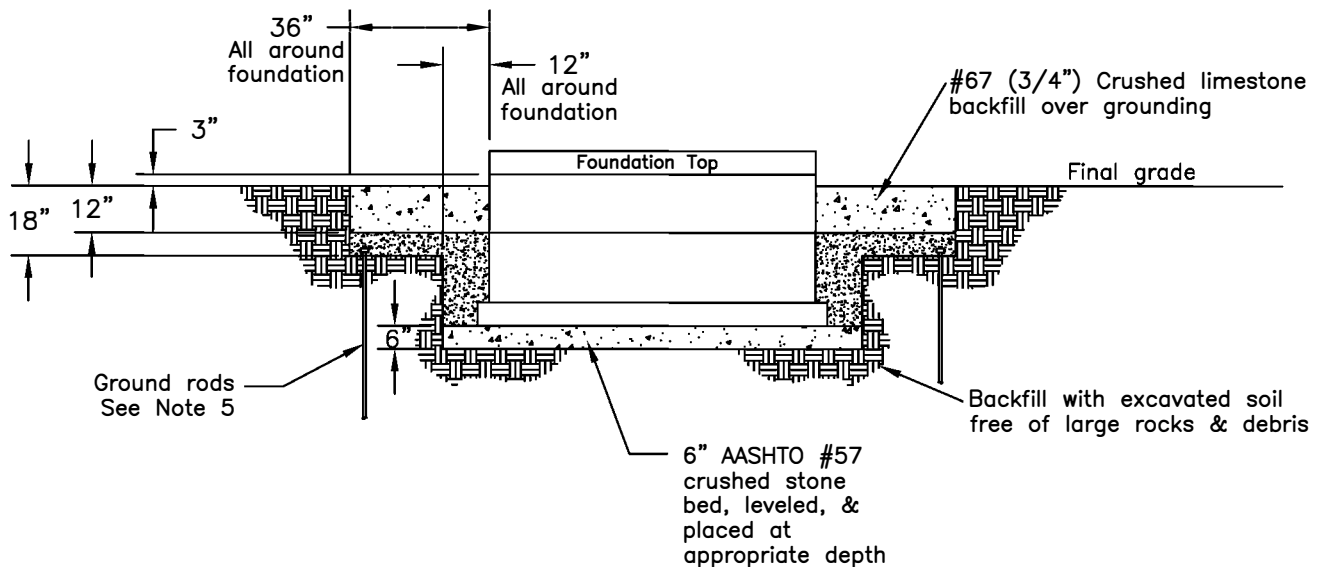
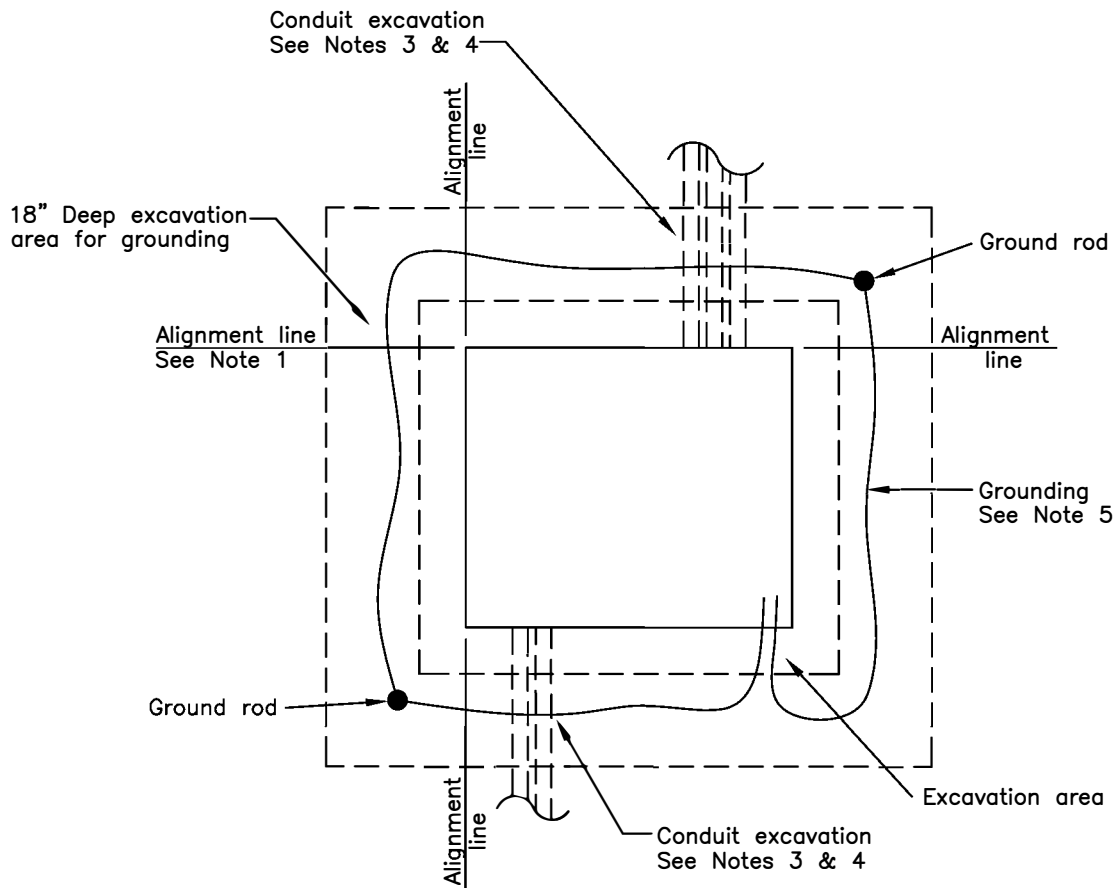


See Note 1
for Excavation Details



Notes:

1. Excavate a 16" x 16" x 11" deep area and install a three (3) inch sand or pea gravel base that is level and compacted.
2. Install the handhole so the top is approximately one (1) inch above final grade.
3. Backfill around the handhole with native soil containing no large rocks (greater than two (2) inches), sharp rocks, or other debris.
4. Cut off the conduit elbows three (3) inches above the compacted base. A 1/4 inch unbroken nylon or polypropylene pulling rope shall be installed in each conduit.



For dimensions see Exhibit J page 2 of 3.
For Notes see Exhibit J page 3 of 3.

Three-Phase Transformer Pre-Cast Concrete Foundation (Installation Details)

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Service Guide

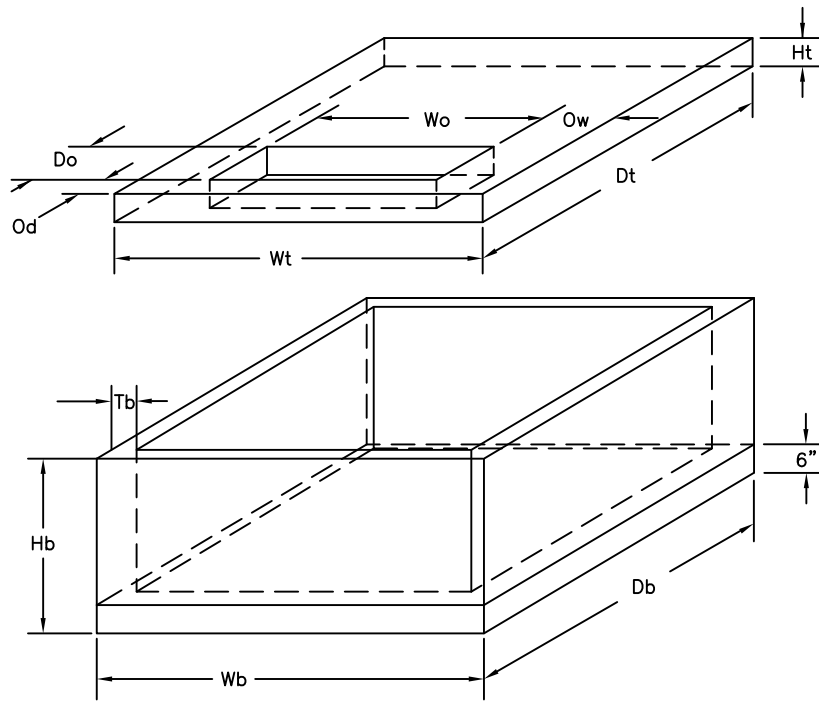
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Pre-Cast Concrete Transformer Foundation Dimensions														
Transformer Size (kVA)	Found. Code	Base					Top				Opening in Top			
		Wb	Db	Hb	Tb	WT.	Wt	Dt	Ht	WT.	Wo	Do	Ww	Wd
22,940 GrdY/14,400 Volt and Below														
45 – 150	J1	72"	54"	42"	4"	4,275#	72"	54"	6"	1,725#	55"	14"	8.5"	6"
225 – 1000	J2	78"	66"	42"	4"	8,000#	78"	66"	6"	2,400#	60"	19"	9"	6"
1500 – 2500	J3	96"	96"	42"	6"	12,000#	96"	96"	9"	6,400#	60"	19"	18"	9"
1500 – 2500 (Note 7)	J4	96"	96"	54"	6"	14,000#	96"	96"	9"	6,400#	60"	19"	18"	9"
34,500 GrdY/19,920 Volt														
1500 – 2500	J3	96"	96"	42"	6"	12,000#	96"	96"	9"	6,400#	60"	19"	18"	9"
1500 – 2500 (Note 7)	J4	96"	96"	54"	6"	14,000#	96"	96"	9"	6,400#	60"	19"	18"	9"
34,500 Delta Volt Live-Front (Includes CEI 36 kV System)														
All Sizes (Note 8)	J5	138"	120"	54"	6"	24,655#	138"	120"	9"	10,270#	102"	36"	18"	18"

Pre-Cast Concrete Transformer Foundation - Excavation Dimensions					
Transformer Size (kVA)	Found. Code	Width	Depth	Height	Stone Base
	22,940 GrdY/14,400 Volt and Below				
45 – 150	J1	96"	78"	45"	6"
225 – 1000	J2	102"	90"	45"	6"
1500 – 2500	J3	120"	120"	45"	6"
1500 – 2500 (Note 7)	J4	120"	120"	57"	6"
34,500 GrdY/19,920 Volt					
1500 – 2500	J3	120"	120"	45"	6"
1500 – 2500 (Note 7)	J4	120"	120"	57"	6"
34,500 Delta Volt Live-Front (Includes CEI 36 kV System)					
All Sizes (Note 8)	J5	162"	144"	57"	6"

Three-Phase Transformer
Pre-Cast Concrete Foundation
(Fabrication Details)

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Service Guide

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Notes:

1. The developer shall contact the Company prior to beginning work to discuss the details of the transformer foundation position and orientation, working clearances, barrier protection, construction specifications, and inspection procedures. The customer is responsible for purchasing, owning, installing, and maintaining the pre-cast transformer foundation and associated secondary rack equipment. The developer shall coordinate site preparations with the desired delivery date. The developer shall provide a clear and firm approach to this point of delivery and keep the area above the transformer clear of obstructions that may block the use of Company vehicles (e.g., crane access to the transformer).
2. The developer is responsible for the excavation to install the transformer foundation and for backfilling afterwards (see page 2 of Exhibit J for excavation dimensions). The excavation shall be two (2) feet wider than the vault dimensions. The excavation depth shall be 45-inches deep for 42-inch high foundations bases and 57-inches deep for 54-inch high foundation bases. Six (6) inches of AASHTO #57 crushed stone shall be leveled and compacted in the bottom of the excavation. Pavement (concrete, asphalt or grass-crete) shall be provided to within ten (10) feet of the installation for Company trucks. For delivery, the developer should provide three (3) 4" X 4" X 8' pieces of lumber off to the side for unloading the foundation top at delivery time.
3. Conduits shall enter near the corners of the pre-cast foundation in order to provide for proper cable bending radius and pulling set-up. Conduits shall have end bells and shall be terminated flush with the inside surface of the foundation. The areas around the conduits in the foundation wall shall be re-sealed with grout.
4. The developer shall install a continuous loop of #2 bare, seven (7) strand, soft drawn copper ground wire connected to two (2) 5/8" X 8' ground rods and installed in opposite corners of the vault excavation in undisturbed earth (see page 1). Both ends of the ground wire shall enter the foundation through a one (1) inch diameter hole to be drilled or chiseled in the upper right-hand corner of the knockout panel. Each ground wire tail shall extend fifteen (15) feet inside the vault beyond the knockout point.
5. The decision to open the sump drainage or leave it closed will be made by the Company based on field conditions. The developer is responsible for taking corrective action (improve drainage, sump pump, etc.) for a foundation that fills with water and water is leaking through service conduits into the customer's building. The area surrounding the foundation shall be graded so that ground water will not collect.
6. Where damage to transformer by vehicles is possible, the transformer shall be protected by appropriate barriers (see Exhibit V for details). Consult with Company for details.
7. The deeper base for the 1500-2000 kVA transformer is used when secondary conduit configuration requires a deeper wall to maintain NEC/NESC minimum cover over the conduit.
8. Foundation for 34.5 kV live-front transformer includes six (6) inch thick dividing wall between the high voltage and the low voltage compartments centered 55-1/2" from the inside edge of the low voltage compartment side wall.

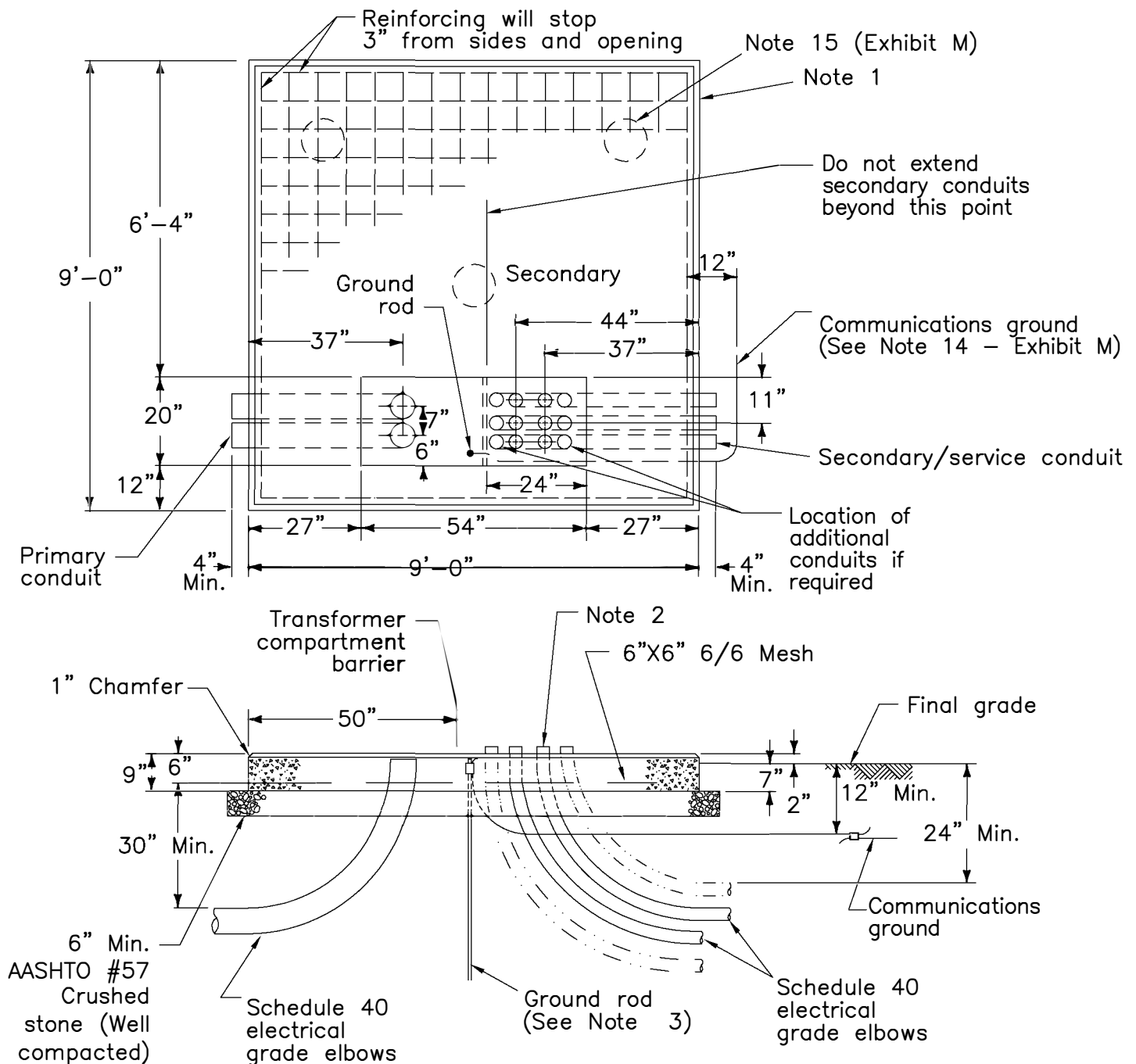
**Three-Phase Transformer
Pre-Cast Concrete Foundation
(General Notes)**

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Notes:

1. Reference Exhibit M for concrete pad foundation, pad-mounted transformer General Notes.
2. Secondary conduits should not extend more than 2 inches above the top of foundation. Primary conduits should be cut off 2 inches below the top of foundation to allow for terminating the cables.
3. Customer shall furnish and install one 5/8-inch diameter x 8-foot ground rod, grounding connections and #6 copper communications ground wire (minimum wire required - 7-1/2 feet).
4. See Exhibit T for clearance from building wall or other parts of building.

**Concrete Flat-Pad Foundation
Pad-Mounted Transformer 750 to 2500 kVA,
Three-Phase, 34.5 kV & Below High-Side**

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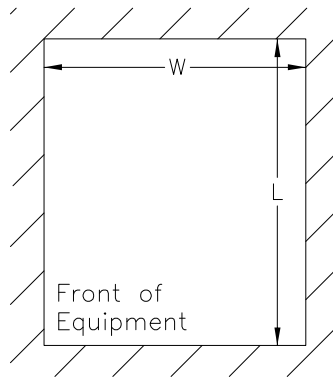
1. The developer shall contact the Company prior to beginning work to discuss the details of the transformer foundation position and orientation, working clearances, barrier protection, constructions specifications, and inspection procedures. The customer is responsible for installing, owning, and maintaining the transformer foundation. The developer shall provide a clear and firm approach to the transformer foundation and keep the area above the foundation clear of obstructions that may block the use of Company vehicles (e.g., crane access to the transformer).
2. Install conduits before placing the pad. Conduits shall not be placed under sections of the pad supporting the transformer so that the original ground will not be disturbed.
3. Conduit shall be rigid, electrical grade, Schedule 40 PVC (see Exhibit F for details).
4. Backfill shall be clean soil, free of large stones (greater than four (4) inch diameter) and perishable material. All backfill shall be spread and compacted in maximum layers of six (6) inches.
5. Level and thoroughly compact the six (6) inch AASHTO #57 crushed stone base.
6. Concrete pad may be poured-in-place or may be pre-cast (4000 min. psi concrete).
7. To prevent water migration from concrete when pouring, place waterproof membrane on crush stone base before pouring concrete.
8. Reinforcing wire mesh shall conform to ASTM designation A185.
9. Cement to be 1 or 1-A and meet ASTM designations C-150 and C-175, respectively.
10. Poured pad concrete to develop minimum 4000 psi at 28 days age, contain 5.5 bags of cement per cubic yard and a maximum of six (6) gallons of water per 94-pound bags of cement and conform to ASTM designation C-94. Fourteen (14) day minimum drying time before transformer is set. For Exhibit K, the volume of concrete is approximately 0.7 cubic yards. For Exhibit L, the volume of concrete is approximately 1.7 cubic yards.
11. Developer shall seal all openings around conduits with grout; cap all spare conduits to prevent entry of rodents and animals into transformer compartment.
12. If conduit extends into building, it shall be sealed (per NEC) at building end to prevent gas from entering building through the conduit.
13. Where damage to transformer by vehicles is possible, transformer shall be protected by appropriate barriers. (See Exhibit V for details). Consult with the Company for details.
14. Grounding/bonding of all communications equipment (telephone, CATV, etc.) that are within six (6) feet of the pad is required. Connection for communications ground shall be minimum #6 solid copper wire that is attached directly to the ground rod and extends twelve (12) inches beyond the edge of the concrete pad foundation (minimum wire required: Exhibit K - 7.5 feet, Exhibit L – 8.5 feet).
15. In areas where settling may occur, install three (3) concrete piers eight (8) inch minimum diameter, 36 inches deep, in a triangular configuration under the foundation. (See Exhibit K and L.) Developer shall contact Company for details.

Concrete Flat-pad Foundation Pad-Mounted Transformer General Notes

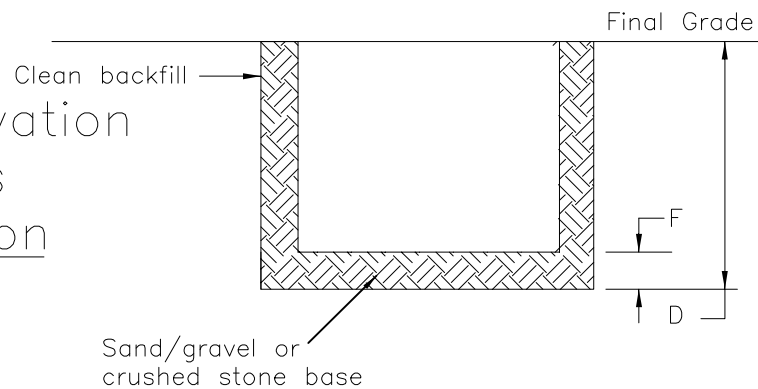
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Excavation Plan View



Excavation Cross Section



Type of Facility	Exhibit	FirstEnergy SAP #	Minimum Dimensions (Inches)			
			W	L	D	F
Box Pad, 32" (Single Phase Transformer)	G	36925903	60	60	35	6
Box Pad, 15" (Single Phase Transformer)	G	36925873	60	60	18	6
Handhole Lawn Small 12" X 20" X 15"	I	36510453	36	24	17	3
Handhole Lawn Medium 17" X 30" X 18"	I	36510883	42	30	20	3
Handhole Street Light 9" round X 11"	I	46516832	16	16	11	3
Pedestal	H	620363	24	18	17	6
Pre-Cast Manhole Small 6' X 8' X 7'	P, Q	—	124	148	112	12
Pre-Cast Manhole Large 6' X 12' X 7'	P, Q	—	124	196	112	12
Switchgear Box Pad (15 kV)	S	23955106	120	120	39	6
3-Phase Transformer Precast Foundation	J	—	—	—	—	—
3-Phase Sectionalizing Enclosure	R	46522442	100	62	21	3

See Exhibit J for excavation and other details for pre-cast concrete transformer foundations.

Base for box pads, handholes, or pedestals shall be sand and/or pea gravel. Base for pre-cast concrete transformer foundations, or manholes shall be AASHTO #57 crushed stone. Base shall be level and compacted prior to setting structure.

FirstEnergy Approved Suppliers of Pre-Cast Concrete Manholes, and Transformer Foundations

- AC Miller Concrete Products, Inc. (www.acmiller.com) (610-948-4600)
- Oldcastle Precast, Inc. (oldcastleprecast.com) (888-965-3227)
- Lindsay Precast (www.lindsayprecast.com) (800-837-7788)

Manhole & Equipment Foundation Excavation Requirements Summary

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Notes:

1. The size, location, orientation, and manhole top will be indicated on the Company electric system design drawing. (See Exhibit Q for standard manhole tops).
2. The developer shall contact the Company prior to excavation to discuss the details of the manhole position and orientation, working clearances, manhole size, manhole top requirements, installation specifications, and inspection procedures. The developer is responsible for purchasing and installing the pre-cast manhole and associated manhole top. The developer shall coordinate site preparations with the desired delivery date and coordinate the delivery with the Company approved supplier. The developer shall provide a clear and firm approach to the point of delivery and keep the area above the manhole clear of obstructions that may block the use of Company vehicles (e.g., crane access to the manhole). Note, this access shall be maintained for the life of the development to allow for future upgrades or replacement of the equipment contained in the manhole. The developer shall consult with the Company for details.
3. The developer is responsible for the excavation to install the manhole and for backfilling afterwards. The excavation shall provide eighteen (18) inches of clearance between the excavation walls and all outside walls of the manhole. The manhole shall be set on a twelve (12) inch base of compacted and leveled AASHTO #57 crushed stone. See Exhibit N for details on the excavation size. The Company approved manhole supplier may have additional requirements for delivery. The developer shall contact the supplier and ensure those requirements are met.
4. Conduits shall enter the manhole by connecting to the conduit terminators supplied in the end and side walls of the manhole. The conduits shall enter the manhole as indicated on the Company drawing. A 1/4-inch unbroken nylon or polypropylene pulling rope shall be installed in each conduit.
5. The developer shall install two 5/8" X 8' ground rods in opposite corners of the manhole outside of the manhole. The ground rods should be driven into the side wall of the excavation at a slight angle. The rod may also be driven vertically at ground level. In both cases, the top of the ground rod shall be at least twelve (12) inches below ground. A #2 bare, seven (7) strand, soft drawn copper ground wire shall be connected to each ground rod. The ground wire shall pass through the manhole wall at the conduit entrance and shall have a minimum of a ten (10) foot tail inside the manhole to allow for connections to the manhole ground ring.
6. Backfill around the manhole shall be the native soil from the excavation. Backfill around any conduits entering the manhole shall comply with the requirements for conduit listed in Exhibit F.
7. The area around the manhole shall be graded so that the ground water will not collect in the manhole or the area around the manhole.

Manhole Installation Notes

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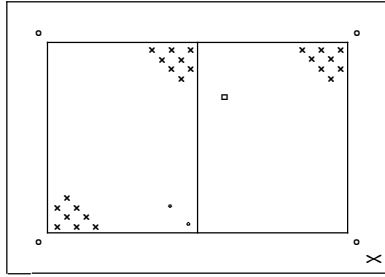


Figure 6—Grass
Figure 7—Sidewalk

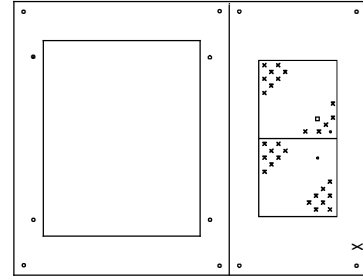


Figure 9

6' x 8' x 7' Tops

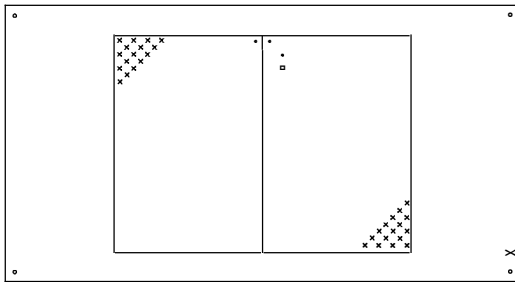


Figure 10—Grass
Figure 12—Sidewalk

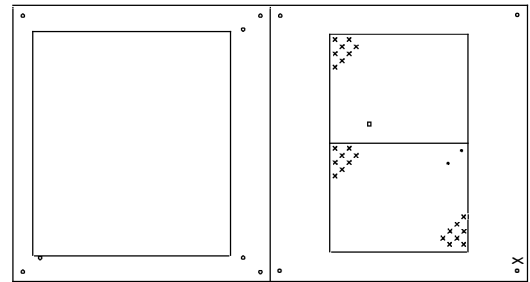


Figure 11

6' x 12' x 7' Tops

- Figure 6&7 – Manhole top for splices and submersible sectionalizing equipment on 6' X 8' X 7' manhole.
 Figure 9 – Manhole top for pad-mounted switchgear on 6' X 8' X 7' manhole.
 Figure 10&12 – Manhole top for splices and submersible sectionalizing equipment on 6' X 12' X 7' manhole.
 Figure 11 – Manhole top for pad-mounted switchgear on 6' X 12' X 7' manhole.

Notes:

1. Company representative will provide specifications and approved suppliers of these manhole lids.
2. Manhole size and type of lid will be listed on the Company electrical layout design drawing.
3. Excavation dimensions and base requirements for the manholes are listed in Exhibit N.
4. Manhole installation notes are listed in Exhibit P.
5. Figure numbers reference FE Material Specification 2600–30–R14 AYE.

Manhole Top Options

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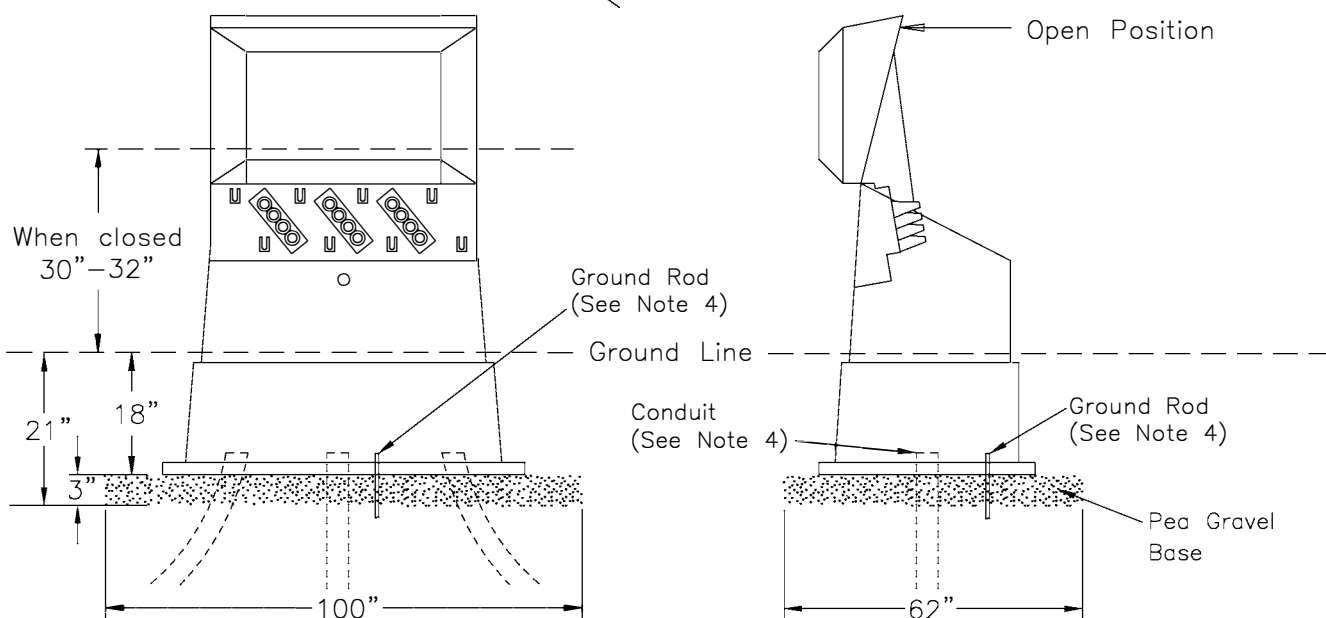
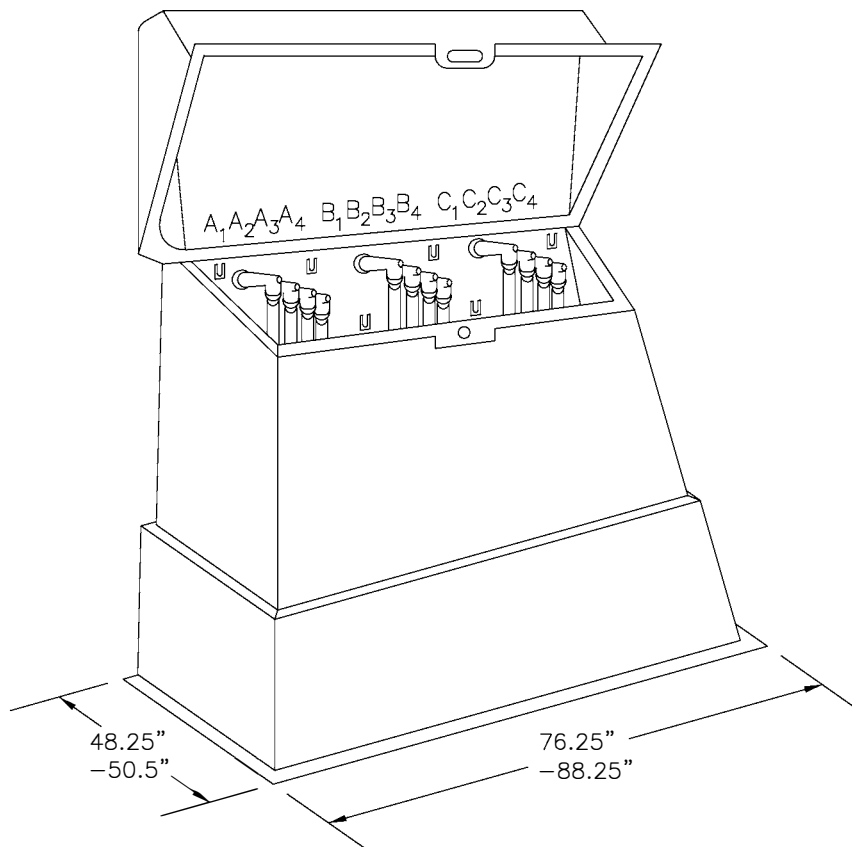
Exhibit Q

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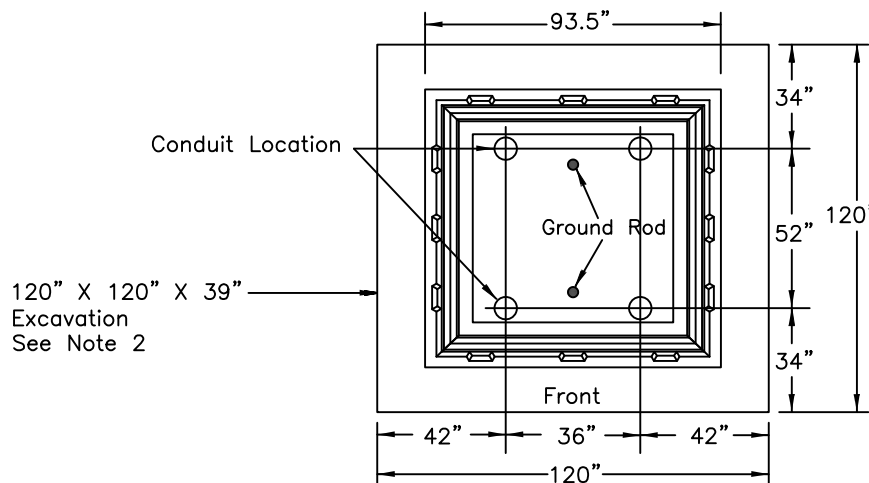
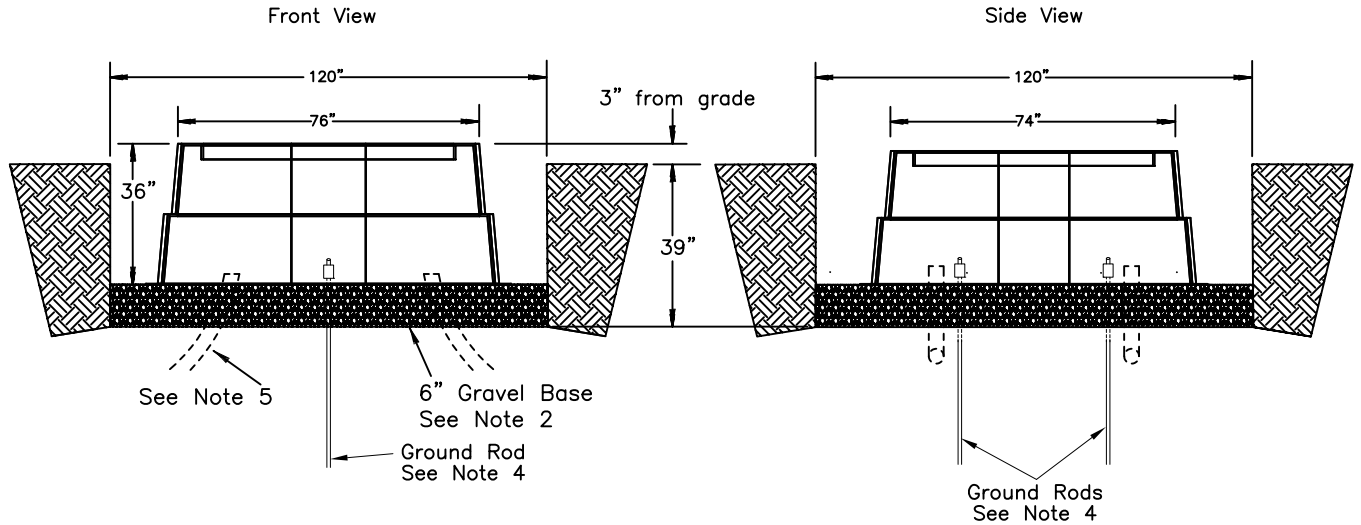
Notes:

1. Orientation of the cabinet and conduit details will be shown on the Company electrical system design drawing. Contact the Company representative with any questions prior to beginning the installation.
2. Excavate a 100\" X 62\" X 21\" deep area and install three (3) inches of pea gravel that is leveled and compacted. Backfill around the base with native soil that contains no large rocks (greater than two (2) inches), sharp rocks, or other debris.
3. Cut off the conduit elbows three (3) inches above the compacted base. A 1/4-inch unbroken nylon or polypropylene pulling rope shall be installed in each conduit.
4. Developer shall furnish and install 5/8\" X 8\" ground rod driven at least 7'6\" into the ground in the front-center of the base as shown.
5. Grade the area around the cabinet so it will not be subject to flooding or pooling water.

Three-Phase Sectionalizing Enclosure Installation Details

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Notes:

1. Orientation of the switchgear foundation is critical. Location and orientation will be shown on the electrical system drawing. Contact the Company representative prior to beginning the installation to confirm proper orientation of foundation and conduits.
2. The excavation shall be 120" X 120" X 39" deep. The base shall be six (6) inches of pea gravel that is leveled and compacted. Backfill around the foundation with native soil that contains no large rocks (greater than two (2) inches), sharp rocks or other debris. All backfill shall be compacted in maximum layers of eight (8) inches.
3. The top of the foundation shall be approximately three (3) inches above ground level.
4. The developer shall provide and install two 5/8" X 8' ground rods with at least 7'6" of buried length in the middle of both the front and back of the opening as shown in the drawing above.
5. Cut off conduit elbows three (3) inches above the compacted gravel base. A 1/4-inch unbroken nylon or polypropylene pulling rope shall be installed in each conduit. Conduit near switchgear foundation may need to be deeper, consult with Company representative for details.
6. Grade the area around the foundation so that it will not be subject to flooding or pooling water.

Pad-Mounted Switchgear Foundation Installation Details

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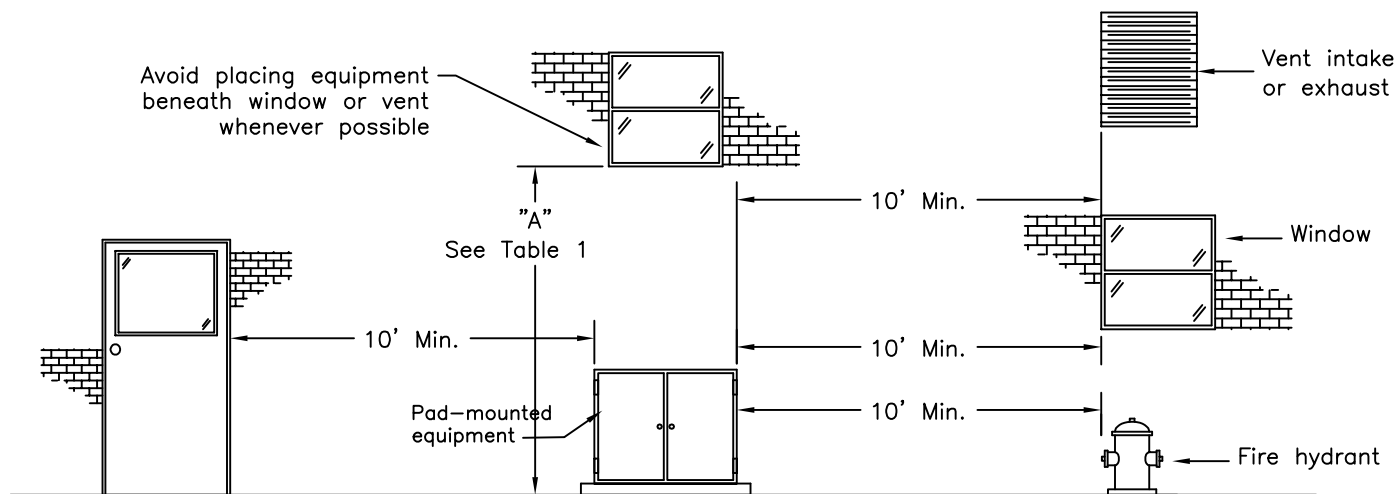
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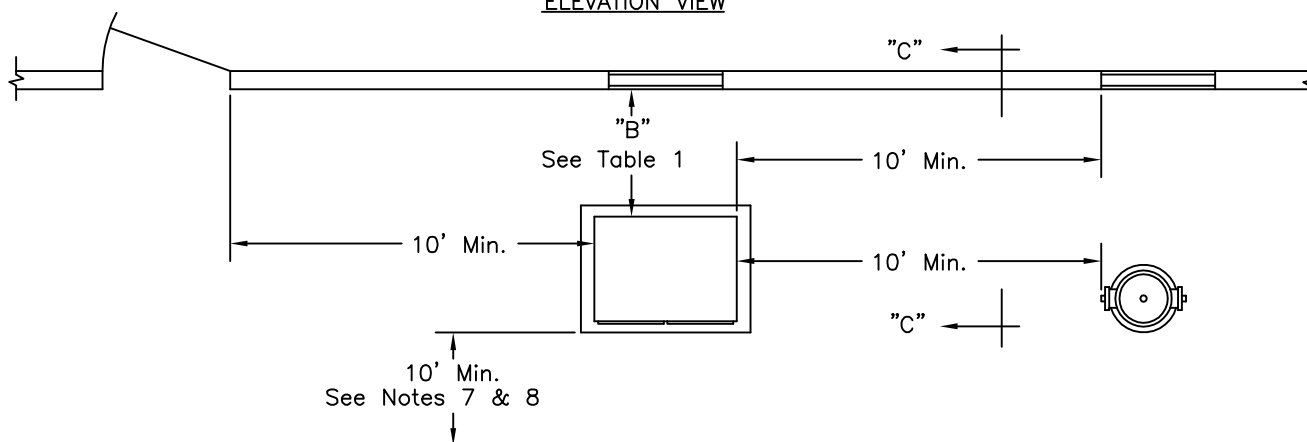
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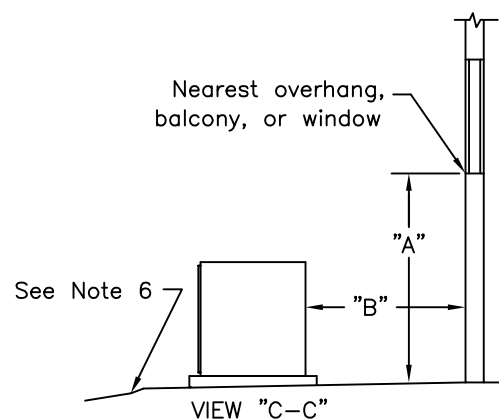


ELEVATION VIEW



PLAN VIEW

Table 1		
Building Surface Type	Minimum Distance "B" in feet to building vertical surface	
	"A" > 18 ft	"A" ≤ 18 ft
Steel or masonry	4 ft	10 ft
Wood, vinyl, or aluminum	10 ft	10 ft



VIEW "C-C"

A = vertical distance in feet to nearest overhang, balcony, or window.

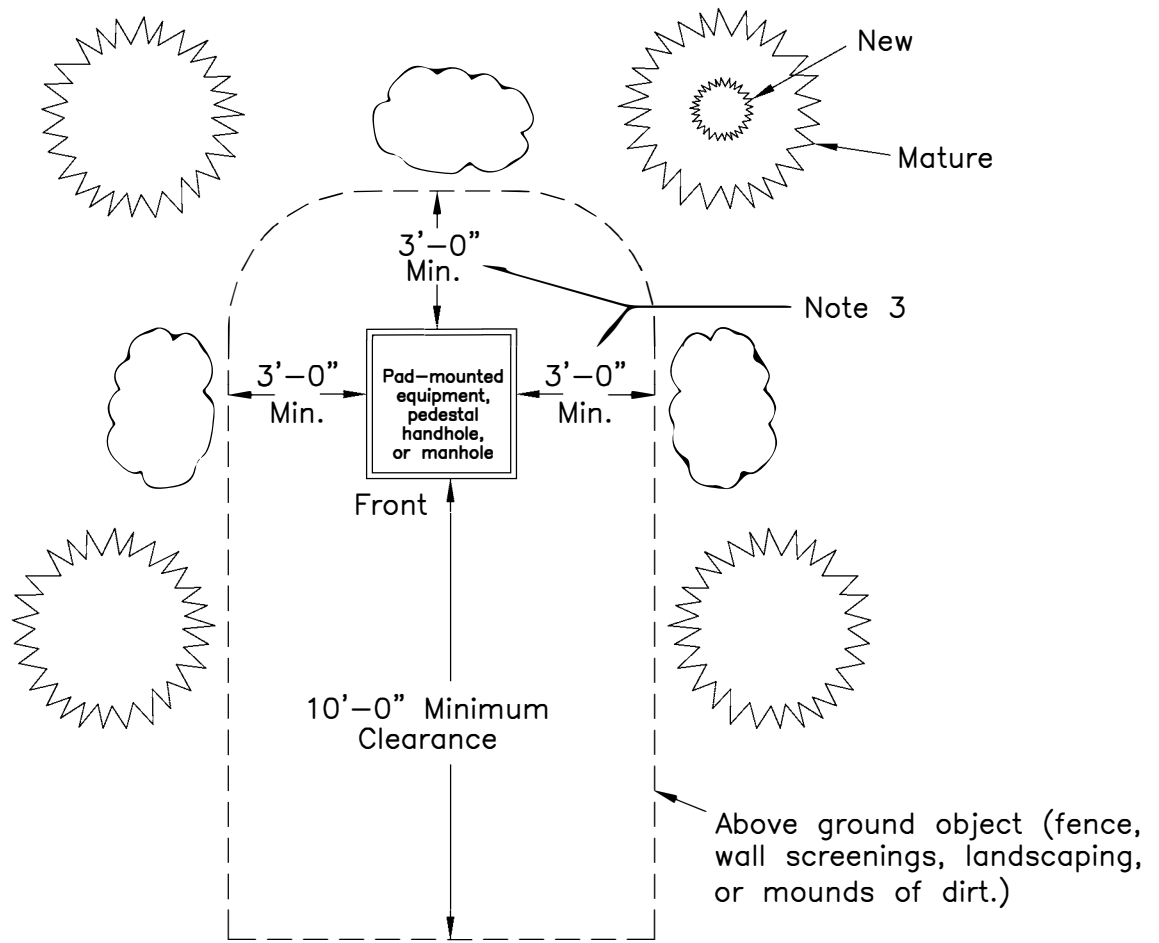
Notes:

1. Adequate access shall be provided to accommodate line trucks or other necessary lifting equipment for maintenance or replacement.
2. Building overhangs, balconies, or steps shall not extend over the top of pad-mounted equipment.
3. 3 ft minimum clearance to gas meter.
4. 10 ft minimum clearance to fire hydrants, fire escapes, sprinkler valves, standpipes, doorways, open stairways, & high pressure gas lines.
5. 15 ft minimum clearance to storage tanks containing volatile flammable liquids or gases (e.g., propane gasoline, oxygen).
6. Area around pad-mounted equipment shall slope away from building or be curbed to confine oil from a ruptured tank.
7. The front of pad-mounted equipment shall face away from building. If equipment must face a building, 10 ft clearance shall be maintained.
8. No vegetation (e.g., shrubs), fences, or other permanent objects shall be set within 3 ft from the sides and back and 10 ft from the front or any side with a door of any pad-mounted equipment. See Exhibit U.
9. Customer is responsible to comply with any and all building codes, local ordinances, and insurance regulations associated with the equipment installation.

Recommended Minimum Clearances From Structures for Oil-Filled Pad-Mounted Equipment

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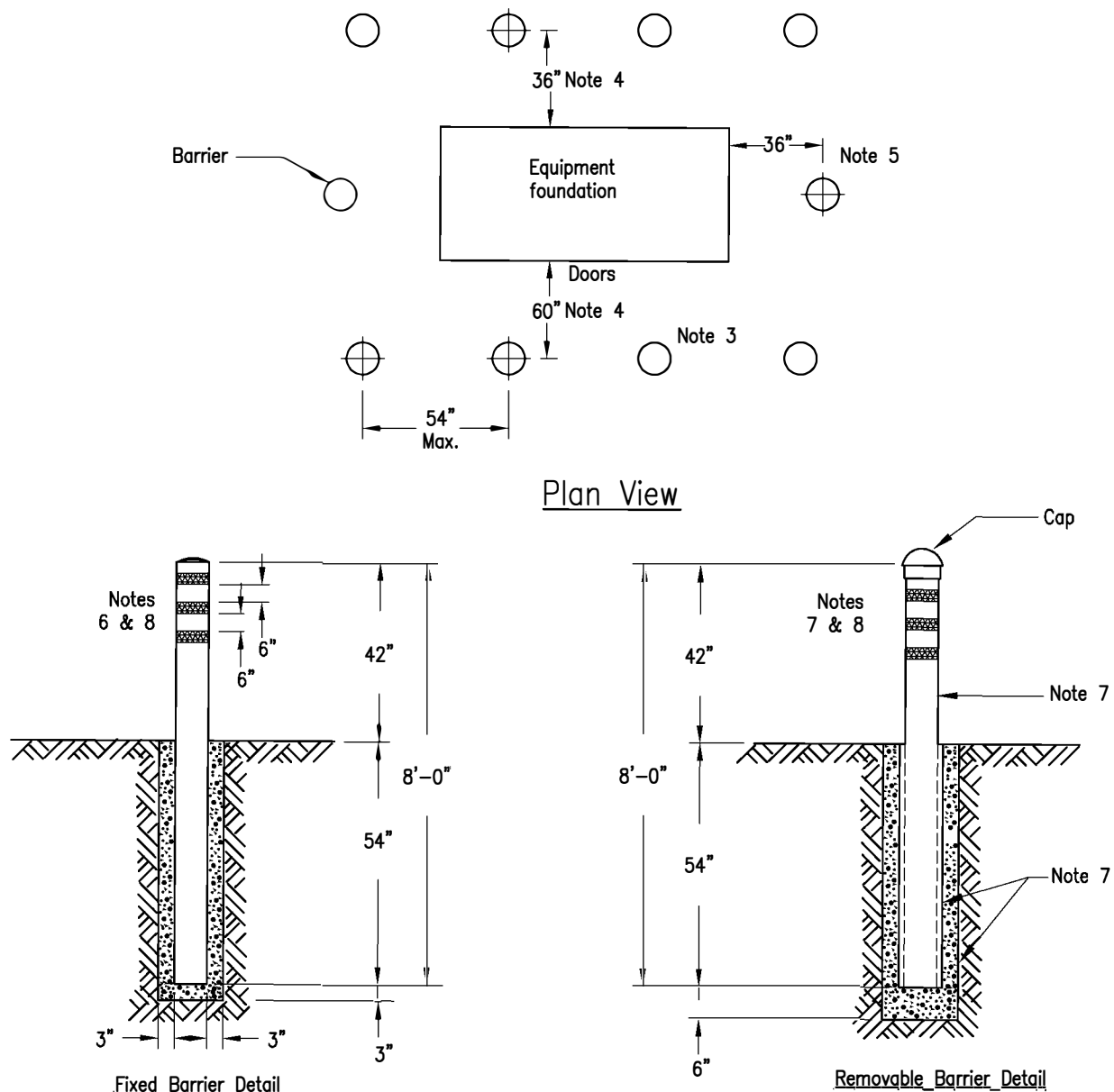
Notes:

1. **Warning:** Pad-mounted transformers and pad-mounted equipment have underground electric cables entering and exiting them below grade. When it is decided to install plants or objects around a pad, call the appropriate state One-Call agency found in Section V.A. before digging so that underground cable locations can be marked.
2. Three (3) feet minimum clearance shall be maintained even after all plants have reached their maturity. **To allow future growth, plant vegetation should be placed at least seven (7) feet from the back and side of the pad-mounted device, pedestal, or hardware.** Avoid planting shrubs or setting posts directly over cables. Avoid vegetation with thorns or spines.
3. If pad-mounted equipment is a switch or other similar device with front, side, or rear doors, the minimum 3-foot clearance shall be increased to 10 feet.
4. Minimum safety clearances to gas meters shall be three (3) feet and to tanks containing flammable liquids or gases (e.g., propane, gas, oxygen) fifteen (15) feet.
5. For minimum clearances to buildings or structures – see Exhibit T.
6. Company shall not be responsible for replacing shrubs, plants, fences, wall screenings, and other obstructions that need to be removed for maintenance or restoration work.

Clearances of Pad-Mounted Equipment, Pedestals, Handholes, or Manholes From Shrubs, Plants, Fences, Wall Screenings, & Other Obstructions

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Notes:

1. Use barriers to protect equipment from possible damage from vehicles. Customer shall contact Company for placement.
2. Provide clearance for the operation, removal, or replacement of equipment when overhead obstacles prevent removal of equipment, one barrier shall be removable.
3. When necessary, height of barrier above ground may be increased to prevent large vehicles from striking pad-mounted equipment.
4. Position barriers 60" from equipment foundation on all sides where equipment doors will be located. Removable barriers shall not be installed as a means of providing clearance to open equipment doors.
5. This distance may be reduced to 24 inches provided clearances are maintained for items such as transformer radiators and metering.
6. For fixed vehicle barrier, use 6-inch diameter rigid galvanized steel conduit, cut to 8 feet and fill with concrete. Encase in 3 inches of concrete, as shown. Power installed bumper posts (minimum size: 84 inches long, 3-1/2-inch diameter, 8-inch helix) are also approved.
7. For removable vehicle barriers, use 6-inch diameter PVC Schedule 40 conduit, cut to 54 inches and encased in concrete. Insert 8 feet of 5-inch diameter galvanized steel conduit (do not fill with concrete), with cap, into PVC conduit. Use 6 inches of compacted stone or gravel for sump.
8. Vehicle barriers shall be painted yellow with three strips of 3-inch reflective tape.
9. Customer shall notify state one-call agency before excavation for posts.

Vehicular Barrier for Pad-Mounted Equipment

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