NSTAR ELECTRIC

CONSTRUCTION, MATERIAL, AND WORK SPECIFICATIONS FOR NEW 15/25kV PRIMARY UNDERGROUND DISTRIBUTION SYSTEMS UP TO 200 AMPS

These Specifications supersede all related URD specifications from former Boston Edison including W2.10-10.3, 2.10-10.5, and Comm. Electric 4-0385.

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I Scope

These specifications are for new construction of underground residential distribution systems. Additional requirements for commercial distribution will supplement this standard and are outlined separately. These specifications are not intended to apply to existing developments where the Company maintains an underground distribution system.

The information contained within is not intended to be a substitute nor supersede the Company's "Terms and Conditions for Electric Service" as filed with the Massachusetts DPU or the "Information and Requirements for Electric Service" booklet (see latest edition).

NSTAR reserves the right to make final interpretations of this specification and its appendices, and may make amendments as necessary to ensure proper construction.

II Definitions

Hereafter, where referred to in these specifications, "Company" shall refer to the NSTAR Electric & Gas Company. "Developer" shall refer to the land developing company, their sub-contractor, or individual residential property-owner where underground service is being planned for installation. "UDS" or "URD" shall mean Underground Residential Distribution System. "MEC" is the Massachusetts Electrical code, the state version of the National Electrical Code. "NESC" is the National Electrical Safety Code, which applies to all electrical construction in the public way or accessible to the public. "Company CSE" refers to NSTAR Company Customer Service Engineering, the normal point of contact for originating and advancing new requests for service. "Company Inspector/Supervisor" is the established NSTAR representative that shall perform on site inspections and approvals at different stages of construction.

III Prerequisites

The Company will agree to the installation of the UDS upon compliance <u>by the Developer</u> of the following requirements:

A. If required by the Company, the Developer may need to execute an Electric Line Extension Agreement for Overhead and Underground Systems.

B. That the Inspector of Wires of the municipality in which the subdivision is to be located, approve of the specific features of the proposed "UDS" installation which falls within his/her jurisdiction. The Developer is responsible for compliance with all Municipal requirements and permits.

C. That the Developer grants to the Company the following permanent easements including perpetual right of access to each easement as defined in the Company's

easement form. Except as specifically prohibited below, planting trees and shrubs within easements shall be at the discretion of the Company.

1. A blanket easement within the street layout for installation of primary power and secondary cables and all supporting infrastructure including conduit, manholes, splice boxes, pedestals, pads, pad mounted equipment, and riser poles.
2. As required, a fifteen foot wide easement along sidelines and/or across lots, on private property, for power and communication cables, ducts, pads, and enclosures.

D. That the Developer shall be responsible for the location of all foreign objects such as water, gas, telephone, CATV, sewage, drainage and ledge along the proposed route of the UD system before excavation begins. Such facilities must be completed prior to the installation of the electric system.

1. In general, the Company specifies an arrangement whereby other utilities share the opposite side of the road layout reserving the side proposed on the UDS construction plan for power and communication facilities. The UDS construction plans are an integral part of the electric system. The system shall be installed as detailed on the construction plans and any changes must be approved by the Company prior to the installation. The Company reserves the right to revise the construction plans.
2. That the Company be given all pertinent data necessary for petitions on state and town road crossings forty-five days prior to construction. Commonwealth of Massachusetts law requires anyone planning to excavate in a public way to give notice to all public utilities. Please review the latest Massachusetts Dig Safe Law & Rules online at: http://www.digsafe.com/laws_statelaws.htm and call **888-DIG-SAFE (344-7233).**
3. That the Company receive town/city approved final plans scaled no less than 1 in. = 100 ft. prior to engineering. In addition to approved prints, UDS construction plans shall be provided as AutoCAD (version 2005 or earlier) files with layers showing all utilities, property lines; formatted as detailed in Construction Standard C1100. After construction, final as-built plans are also to be provided to NSTAR in the same format.
4. A legend of all utilities and infrastructure shall be consistent with the Company's Operations Records Department.
5. That in addition to meeting these specifications, the Developer agrees to meet any other specific requirements as identified by the Company in the planning stages of the system. The Developer agrees that the Company shall make the final decision as to the electrical and mechanical requirements of the system in accordance with these specifications. The Company's interpretation of these specifications shall be binding on the Developer.

IV Supporting Standards

These are separate electronic documents, but have information and requirements that are integral to this standard. See latest revisions available on NSTAR.com.

A. Construction Standards:

C1100 - Distribution Duct Bank Construction and Materials
C2010 - Cold Shrink Termination for 15/25kV Jacketed Cable
C2012 - Installation of 200 Amp Loadbreak Elbows on 15/25kV Pad Mount Equipment
C2021 - Primary URD Risers for 15/25kV an Below
C2022 - Power Cable Risers for 15/25kV and Below
C2026 - Installation of Premolded Joints on 15/25kV Cable
C3800 - Installation of S&C PME-9, Fused, Padmounted, Switch 15&25kV, 600 Amps
C3801 - Installation of Pre-Cast Foundation for Pad Mounted Three-Phase Transformer
C3802 - Clearance Requirements from Equipment to Buildings, Landscaping, or Traveled Way
C3813 - Installation of Precast Concrete Manholes
C3814 - Installation of Fiberglass/Composite Handholes, Box Pads & Switch Enclosures
C5000 - Grounding and Bonding distribution Pole–Mounted Equipment

B. Material Standards:

M1202 - 4'x6'x6' Inside Precast Concrete Manhole
M1204 – 6'x10'x8' Precast Concrete Manhole
M1208 – 4'x4'x4' Precast Concrete Secondary Pull Box
M1216 – 5'x5'x5' Precast Concrete Manhole
M1300 - NSTAR No. 1 Solid Cover
M1303 - NSTAR No. 1 Manhole Frame
M1600 – 600V EP Rubber Insulated Cable Material Standard
M1601 - 15-35kV Concentric Neutral Cable Material Standard
M3800 – Dead Front Primary Switching/Junction Enclosure
M3801 – Three Phase Transformer Precast Transformer Pad
M3803 - Precast Retaining Wall
M3902 – Single Phase Padmount Transformer Material Standard
M3904 – Three Phase Padmount Transformer Material Standard

C. Work Standards and other Applicable NSTAR Documents:

W1604 – Cable Pulling Operations
NSTAR Safety Manual, Latest Revision
NSTAR Information & Requirements Book, Latest Revision
NSTAR Terms and Conditions Line Extension Policy for New Service

V Bill of Common Materials

The key materials required for construction are listed in this section.
The "Compatible Unit" is an internal NSTAR designer reference. The "Catalog ID" is an internal NSTAR warehouse stock number. Each catalog ID has an approved list of equivalent Manufacturers and Part numbers. No substitutions are allowed. The material cross-reference list is available on nstar.com.

A. 15kV Primary Cable and Accessories

DESCRIPTION	COMPATIBLE UNIT	CATALOG ID
PRIMARY CABLE		
15KV #1 SOL AL, 1/C SINGLE, EPR CABLE	UCANM-#1AL-1	92
15KV #1 SOL AL, 3x1/C TRIPLEX, EPR CABLE	UCANM-#1AL-3T-WD	93
15KV 4/0 AL, 3x1/C TRIPLEX, EPR CABLE	UCANM-4/0AL-3T	16332
JOINTS AND TERMINATIONS		
JOINT, 15KV PREMOLDED KIT, #2 STR / #1 SOL	UJMP-2-1S	1454
JOINT, 15KV PREMOLDED KIT, 4/0	UJMP-4/0	16334
TERMINATION, 15/25KV 1PH, COLD SHRINK, 1/0 AL, #1 SOL or #2 STR	UTC-1/0/1/2	9937
TERMINATION 15KV HEAT SHRINK, 4/0 AL,	UTM-SH-4/0	1423
200 AMP ACCESSORIES		
FEEDTHROUGH BUSHING, 15KV	U2MBWF	516
BUSHING WELL INSERT, 15KV	U2MBWS	515
INSULATING CAP, 15KV	U2MCAP	1119
ELBOW, 15 kV LOADBREAK, 4/0 STR	U2ME-4/0	16333
ELBOW, 15 kV LOADBREAK, #1 SOL AL, #2 STR CU	U2ME-1SOL	517
INSULATED STANDOFF BUSHING, 15 kV	U2MISB	515
MULTI-TAP, 15KV, 3 WAY	U2MJN-3W	806
MULTI-TAP, 15KV, 4 WAY	U2MJN-4W	1486
1 PHASE CABLE SWITCHING STATION MULTI-TAP ENCLOSURE (TURTLE), 15KV, 4 POSITION	U2MJCAB-1PH	9533
3 PHASE CABLE SWITCHING STATION MULTI-TAP ENCLOSURE(TURTLE), 15KV, 3 x 4 POSITION	U2MJCAB-3PH	2590

B. 25kV Primary Cable and Accessories

DESCRIPTION	COMPATIBLE UNIT	CATALOG ID
PRIMARY CABLE		
25KV 1/0 SOL AL, 1/C SINGLE, EPR CABLE	UCANH-1/0AL-1	8714
25KV 1/0 SOL AL, 3x1/C TRIPLEX, EPR CABLE	UCANH-1/0AL-3T	8716
JOINTS AND TERMINATIONS		
JOINT, 25KV PREMOLDED KIT, 1/0 SOL AL	UJHP-1/0S	9864
JOINT, 25KV PREMOLDED KIT, TRANSITION, 1/0 SOL TO #2 STR	UJHP-1/0S-2	9865
TERMINATION, 15/25KV 1PH, COLD SHRINK, 1/0 SOL AL,#1 SOL or #2 STR	UTC-1/0/1/2	9937
200 AMP ACCESSORIES		
FEEDTHROUGH BUSHING, 25KV	U2HBWF	9540
BUSHING WELL INSERT, 25KV	U2HBWS	9756
INSULATING CAP, 25KV	U2HCAP	9457
ELBOW, 25 kV LOADBREAK, 1/0 SOL AL	U2HE-1/0SOL	9754
MULTI-TAP, 25KV, 4 WAY	U2HJN-4W	9772
1 PHASE CABLE SWITCHING STATION MULTI-TAP ENCLOSURE (TURTLE), 25KV, 4 POSITION	U2HJCAB-1PH	9534
3 PHASE CABLE SWITCHING STATION MULTI-TAP ENCLOSURE (TURTLE), 25KV, 3x4 POSITION	U2HJCAB-3PH	9536

C. Secondary Cable and Connectors

DESCRIPTION	COMPATIBLE UNIT	CATALOG ID
600 VOLT CABLE		
600V 4/0 AL, 3x1/C TRIPLEX, XLPE INSUL CABLE	UCAS-4/0AL-3T YS-4/0AL-TPX	87
600V 4/0 CU, 3x1/C TRIPLEX, EPR/HYP CABLE	UCAS-4/0CU-3T YS-4/0CU-TPX	8746
600V 500 CU, 3x1/C TRIPLEX, EPR/HYP CABLE	UCAS-500CU-3T YS-500CU-TPX	16016
HANDHOLE CONNECTORS, 600 Volt Insulated		
MOLE BUS, 4 POS, 1 WAY, #12 - 350 KCMIL	UCN-M4P1W-350	9761
MOLE BUS, 4 POS, 1 WAY, #2 - 750 KCMIL	UCN-M4P1W-750	9764
MOLE BUS, 6 POS, 1 WAY, #10 - 500 KCMIL	UCN-M6P1W-500	9763
MOLE BUS, 6 POS, 1 WAY, #2 - 750 KCMIL	UCN-M6P1W-750	9762
MOLE BUS, 8 POS, 2 WAY, #2 - 750 KCMIL	UCN-M8P2W-750	15981

D. Miscellaneous Accessories

DESCRIPTION	COMPATIBLE UNIT	CATALOG ID
FAULT INDICATORS		
FCI, 25kV or 15kV Cable, autorange trip, current reset	U2FI	9660
FCI, 15 kV Elbow Test Point Mount, 800 Amp trip, voltage reset	U2FI-TP-VR	692
GROUNDING MATERIALS		
5/8" Dia. Ground Rod With Connector	UGN4x4	9229
1/0 Copper Ground Wire, bare tinned, 7 strand	UGN4X4, UWB-1/0CU-1	115
Ground Wire Connector 1/0-1/0 Cu Wire	UGN4x4	608
Ground Rod Connector to 1/0 Cu Wire	UGN4x4	9009

E. Conduit, Riser Stand Pipes, and Manholes

DESCRIPTION	COMPATIBLE UNIT	CATALOG ID
See **C1100** Standard for all conduit, fittings, risers, accessories, and installation details.		
See **C3813** Standard for all common manholes, frames and covers, accessories, and installation details.		

F. Equipment Box Pads and Handholes

DESCRIPTION	COMPATIBLE UNIT	CATALOG ID
(Dimension included are top surface x height)		
Handholes		
Fiberglass handhole: 15"x10"x12" –lighting only	NHHPS	840
Fiberglass handhole: 23"x14"x15" -single residence	NHHPM	9571
Fiberglass handhole: 30"x17"x18" – standard use	NHHP	841
Composite handhole: 30"x17"x18", H20 rated	NHHC	9572
Box Pads – Transformers and Splices		
Fiberglass box pad/splice box: 43"x37.5"x32" For NSTAR North Transformers (single phase) or splice box (top opening = 26"w x 32"d)	NPDX-FN	1622
Fiberglass box pad/splice box (ledge areas only): 43"x37.5"x15" For NSTAR North Transformers (single phase) – shallow depth or splice box (top opening = 26"w x 32"d)	NPDX-FNS	7747
Fiberglass Cover (Use with Cat. IDs 1622, 7747, 16955)	NPDX-F1PCOV	1349
Fiberglass box pad/splice box: 43"x37"x32" For NSTAR South Transformers (single phase; top opening = 26"w x 26"d)	NPDX-FSO	16955
Large Box Pads – Switchgear		
Fiberglass box pad for 15kV PME-9 Switches (and 3 phase primary splice box) 75"x72"x36"	NPDS-F75x72	14024
Fiberglass cover for use with Cat. ID 14024	NFDS-F75x72COV	14078
Fiberglass box pad for use with 25kV PME-9 Switchgear: 86"x84"x36"	NFDS-F86-84	14556
Fiberglass base cover for use with Cat. ID 14556	NFDS-F86x84COV	14557

VI Ownership and Responsibility are as follows:

A. Primary and Secondary System

1. The Primary and Secondary Electrical Distribution System located in the public way, future public way, or easement areas shall be designed by the Company. All Electrical Materials shall be furnished by the Company, or by the Developer/Company Approved Contractor (except for transformers and meters) as defined by the NSTAR Terms and Conditions Line Extension Policy for New Service. Materials to be provided may include cable, transformers, loadbreak elbows, terminations, high voltage splices, connectors and switching enclosures. Installation of cable and accessories may be completed by the Company or by Company approved electrical sub-contractors to the Developer at the Company's option and at the Developer's expense per NSTAR terms and conditions. After passing final inspection and electrical acceptance testing, system shall then be transferred and owned and maintained by the Company.

2. The necessary supporting non-electric infrastructure located in the public way, future public way, or easement areas shall be designed by the Company. All Materials shall be furnished by the Developer, or otherwise by the Company as defined by the approved Company Terms and Conditions Line Extension Policy for new service. All material installation costs including all excavations, backfilling and resurfacing shall be paid for by the Developer. Materials include conduit, fittings, fiberglass/poly pads, foundation pads, manholes, splice boxes, riser pipes, and all grounding provisions. The Developer shall provide for concrete encasement of conduit as required by the Company. At a minimum, primary use conduit street crossings shall be encased in concrete. Specific details noted in NSTAR standards shall be strictly adhered to unless approved in writing by the Company. All electrical supporting infrastructure located in the public or future public way and easement areas, will be owned and maintained by the Company after all Company inspections and conveyances of ownership are completed.

3. Precast retaining walls shall be furnished and installed by Developer where there is a possibility of a transformer or any other equipment being undermined due to a sharp drop off behind the unit or covered over from being installed into the side of an embankment. A simple retaining wall is available per NSTAR Materials Standard M3803, but more complex designs shall be installed as needed to preserve the final grades. Railroad ties and landscape timbers are not acceptable to shore around electrical equipment.

4. Installation of electrical conduits and cables on private property and common driveways with long setbacks: Per Company Terms and Conditions, the Developer shall either provide materials or acquire it from NSTAR at the customer's expense. The Company shall make final connections that energize the cables at the transformer, service hand hole, or riser as required. The cables and conduit along private ways shall be owned and maintained by the owner of record. For risers the Developer shall install the first ten feet of rigid galvanized

steel conduit, steel sweep, grounding and duct in accordance with Figure 9A. The Company will designate the quarter on the pole where the riser is to be located and will install the remainder of the riser materials not shown in the drawing.

B. Services and Metering

1. Except for meters, all service cable, connectors, enclosures and other material and equipment associated with services, shall be supplied and installed by Developer or others. Meters shall be supplied and installed by the Company.

2. The Developer or his agent is responsible for obtaining all required local permits to receive service.

3. Service conductors must be installed at a depth according to the latest edition of the Massachusetts Electrical Code (MEC), and is subject to inspection by the local Wire Inspector. This minimum depth is thirty inches. Services may be either direct buried or in duct as required by the MEC. For maximum reliability, the Company recommends that service cables be installed in a schedule 40 PVC conduit sized per the MEC.

4. If three phase service is required, Developer must contact the Company Customer Service Engineer for additional equipment and cable requirements.

5. The Company or an agent of the company shall make the final service connection at the transformer or secondary hand hole (at the property line).

6. All service cables on private property shall be owned and maintained by the owner of record. The Company will, at the request and expense of the owner of record, perform any needed maintenance or repair on service cables and conduit.

7. Connecting an underground secondary extension or new service to existing energized underground secondaries (also see I&R Book):
    a. The Developer subcontractor must excavate to the edge of the service hand hole or pad mount transformer position. The Developer shall not open or push service conductors into the hand hole or box pad.
    b. The Developer subcontractor shall leave a coil of cable within the excavation long enough for the Company to make final connections: minimum of three feet of cable for hand holes, and eight feet for transformer pads. Approx 3 feet of trench next to the hand hole or pad mount, will not be backfilled, and shall be covered and made safe w/ steel plate or ¾" plywood to allow for NSTAR connection.

VII Construction Standards & Issues

A. Cable & Conduit System

1. The primary operating voltage of the subdivision shall be single or three phase as determined by the Company, but may range from 4,160 V grounded-wye up to 22,860 V grounded-wye. Company personnel shall follow NSTAR Optimal Design Guidelines when designing new systems or line extensions.

2. The primary cable supply system shall typically be of a loop design installed in conduit. The number of primary ducts is determined by the number of primary cables needed to supply load, complete circuit loops, or allow for future expansion if possible. Multiple phases in separate ducts may be necessary in order to balance loads on the system.

3. For developments with 10 or more lots/services, Company may require two separate risers installed on two separate poles to feed into the subdivision. Cable shall be installed to complete a loop terminating at two risers or via use of cable switching stations supplied from a different source. For developments with 9 or fewer lots/services, 2 parallel conduits may be installed to one pole with sufficient cable to complete the loop circuit.

4. All underground conduit to be used with the primary or secondary cables listed in this standard (see section V Bill of Materials) shall be minimum 4 inch, schedule 40 PVC. Primary duct sweeps shall be 4" sched. 40 galvanized steel; 36" radius for risers, and 48" min. radius for any horizontal sweeps. Primary riser stand pipes and shall be 4" sched. 40 rigid galvanized steel.

   a. Duct shall be installed as detailed in C1100.

   b. No more than three cables can be installed per duct.

   c. Primary and secondary cables cannot be installed in the same duct.

5. Primary cable splices shall be avoided as much as possible, and if required shall be installed inside an enclosure suitable to the location. Typically, concrete or composite pull boxes are required if accessible to vehicle traffic. Fiberglass splice boxes shall be utilized only for grassy/nonpaved areas with no vehicle access. Bollards may be accepted by the Company for protection of some locations with limited vehicle access.

6. Secondary Mains - The secondary cable system shall typically be a single phase, three wire 240/120 volt system consisting of two phase cables and one neutral. The three conductors shall be of the size and insulation type specified by the Company. Potential three phase requirements shall be communicated to Company CSE for investigation.

7. Services and Meters - Residential services shall be single phase, three wire, 240/120 volts. If three phase power is required, Company CSE must be contacted in advance to verify availability and added cost. The local Inspector

of Wires shall be consulted for requirements pertaining to size of service entrance cable, depth of installation, joint trenching with other utilities and road and driveway crossings. Meter pedestals, where utilized, shall be located not closer than five feet from the back or sides of transformer pads or hand holes.

8. Service Entrance Installations - Service cables shall typically originate in hand hole unless designed by the Company to enter a transformer. Multiple or large sized service cables may be required to terminate in a handhole in order to minimize transformer cable congestion.

   a. Service entrance cables shall be installed up to the hand hole such that the Company can install and make up connections without delay.

   b. All services will be permanently marked in hand holes and manholes, with the correct house address (if available) or lot number.

   c. Developer shall not push new cables into energized equipment or box pads unless Company representatives are on site to provide assistance.

B. Conduit Design Layout Requirements

1. It is critical that maximum cable pulling tensions are not violated when cable is installed. Duct line design, including the number of and types of sweeps and the section length greatly affects pulling tensions. Single phase primary cable tension is limited to 600 pounds. Triplex primary or secondary URD cable used in these designs is limited to 1,000 pounds total. See standard W1604, or use other industry accepted guidelines such as Okonite bulletin EHB regarding pulling tensions and cable layout.

2. Road Crossings - All roadway crossings shall be perpendicular to the side of the road. This includes Company approved horizontally drilled crossings. State road crossings shall be concrete encased. Company may require encasement for certain installations or when in close proximity to other utilities. Primary use conduit road crossings are typically encased, secondary only use need not be encased. Driveway crossings shall be parallel to the side of the road.

3. Location of sweeps in the conduit run: The distance from the radius bend of the conduit to the nearest cable terminator and/or splice/pull box location shall be no more than 25% of the total section length. This way the cable may be fed in at the end nearest the radius bend to minimize pulling tensions and sidewall bearing pressures.

4. Conduit Run: The conduit layout between cable terminations and/or splice/pull box locations shall be as straight as practical and contain no more than one (1) 90° sweep with a minimum 48" radius, exclusive of quarter bends that may be present at pads or risers. Radius bends in the conduit shall be gradual and not less than twenty-five feet (25'). All conduits should enter under the fiberglass pad so that the pad can be replaced if necessary without disturbing the primary cables.

5. Pulling Length Limitations: The maximum allowable distance between cable pulling entrance and exit points is 600 feet, with a typical distance of approx 400 feet.

6. Typical conduit layouts are illustrated by Figures 6, 7 & 8. If a particular location requires longer section lengths or nonstandard arrangements that are not served by the design, Company CSE shall be contacted. All conduits must include a pull tape with footage markings, and must be capped as detailed in C1100.

7. Riser Poles: Details for primary riser poles are shown in Figure 9A, and secondary poles are shown in Figure 9B. All riser conduits must include a pull tape with footage markings, and must be capped.

8. A minimum separation of 18" in any direction between electric and natural gas facilities is to be maintained. If electric conduit is encased, separation may be reduced to 12". A minimum separation of 12" in any direction between electric and communications facilities is to be maintained.

C. Trenching and Backfilling

1. All excavation and roadway work shall adhere to OSHA, DOT, and NSTAR safety requirements without exception.

2. All trench lines, regardless of method of installation within the road taking shall be not less than three feet from paved surface of the road and shall not deviate more than one foot, six inches either side of this line in accordance with FIG-3. Final grades must be established, the surface roughly leveled, easement boundaries, street, lot and trench lines staked by the Developer before any trenching is started. The Company shall not be responsible for stakes incorrectly placed and will hold the Developer responsible for costs of construction changes resulting from such placement. The trench route must be clear of trees, bushes, stumps, ledge, large rocks and other impediments. The Developer shall adhere to specified depths and locations for trenches with any deviation from specified depths and locations being subject to the approval of the Company Inspector/Supervisor. Construction changes resulting from improperly established grades, settling, etc., shall be the responsibility of the Developer. The trenches shall be excavated in accordance with specific job plans and the general requirements of the Figures in this standard and C1100.

3. The entire conduit run, including splice boxes and equipment pad entries shall be inspected by the Company Inspector/Supervisor before any backfilling is begun. Backfill shall be the best of excavated material and shall not contain stones greater than three inches in any dimension and shall not contain ashes, cinders, shells, any organic matter or frozen material. Backfill shall be mechanically compacted. See C1100 for details. The trench shall be backfilled immediately following inspection and approval by the Company Inspector/Supervisor.

D. Installation of Box Pads, Equip. Pads, Manholes and Hand Holes

1. Box Pads, Manholes, And Hand Holes shall be installed and properly grounded in accordance with the following standards:
   a. C3801 - Installation of Pre-Cast Foundation for Pad Mounted Three-Phase Transformer
   b. C3813 - Installation of Precast Concrete Manholes
   c. C3814 - Installation of Fiberglass/Composite Handholes, Box Pads & Switch Enclosures

2. Splice/pull boxes, manholes and transformer box pads shall not be located at low points in the final grade, drainage areas or on abrupt slopes. In areas which have poor drainage, provisions must be made to keep foundations, utility vaults, pull boxes, etc., from filling with water.

3. All conduit openings into pull boxes, box pads and manholes shall be capped after installation to prevent entrance of dirt and debris. 2500 lb. strength pulling tape with footage markings shall be installed in all ducts per C1100.

4. All Manholes, castings, and covers shall be rated for H20 loading as detailed in NSTAR Material standards (Manholes M1201-1299 & Covers and Frames 1300-1399). Pull boxes or hand holes vulnerable to vehicle traffic or parking shall be polymer concrete composite designs (not plastic or fiberglass) rated for H20 loads. Manholes and pull boxes also shall not be installed at driveway entrances or where they are likely to be obstructed or made inaccessible by a vehicle.

5. Necessary building and roadway clearances for transformers and other equipment are outlined in Construction Standard C3802. When padmount equipment is installed in paved areas or otherwise subject to damage from vehicular moving or parking traffic, protective concrete filled steel posts or bollards must be furnished and installed by the Developer. A clear area surrounding all padmount transformers or equipment (4' on sides and 3' from the rear and 10' in front) must be maintained. See C3802 for details.

E. Grounding

Properly installed grounding is important for public and worker safety. Company standards show grounding details, but contact Company CSE with any questions.

F. Street and Area Lighting

1. Street or area lighting design shall be consistent with Company lighting standards. This includes fixture styles, light sources (HPS or MH), operating voltages and wattages. Company CSE can provide details on options.

2. Nonstandard lighting systems in the public way will not be accepted for future maintenance by the Company in communities where the Company maintains town lighting systems.

VIII Cable Installation and Terminations

The following standards shall be adhered to for proper construction.

A. C2012 -Installation of 15/25kV Loadbreak Elbows

B. C2021 - Primary URD Risers for 15/25kV an Below

C. C2026 - Installation of Premolded Joints on 15/25kV Cable

D. C5000 - Grounding and Bonding distribution Pole–Mounted Equipment

E. W1604 – Cable Pulling Operations

IX Inspections and Acceptance Testing

A. Company Inspector/Supervisors shall be contacted at predefined inspection points during the construction process. Failure to comply with properly scheduling inspections may result in work being "undone/ unexcavated" at the expense of the Developer in order to demonstrate full compliance with standards.

B. If Company has evidence of concern or has recorded previous violations of Company standards by a Developer or its contractor, Company Inspector/Supervisors may require disassembly of some work completed by the Developer's contractor, at the Developer's expense, as a way to ensure quality of construction. Installers may require recertification by company to complete specific tasks such as cable splicing and terminating.

C. Electrical acceptance testing of completed cable installation work is to be completed by Developer or Company approved sub-contractor .

1. All primary cable, terminations, elbows or splices shall be high voltage tested by a qualified tester at the expense of the Developer. Test voltages and leakage currrents shall be stabilized for 5 minutes minimum at the following voltages:

   a. 15kV Cable System – 40 kV DC
   b. 25kV Cable System– 60 kV DC

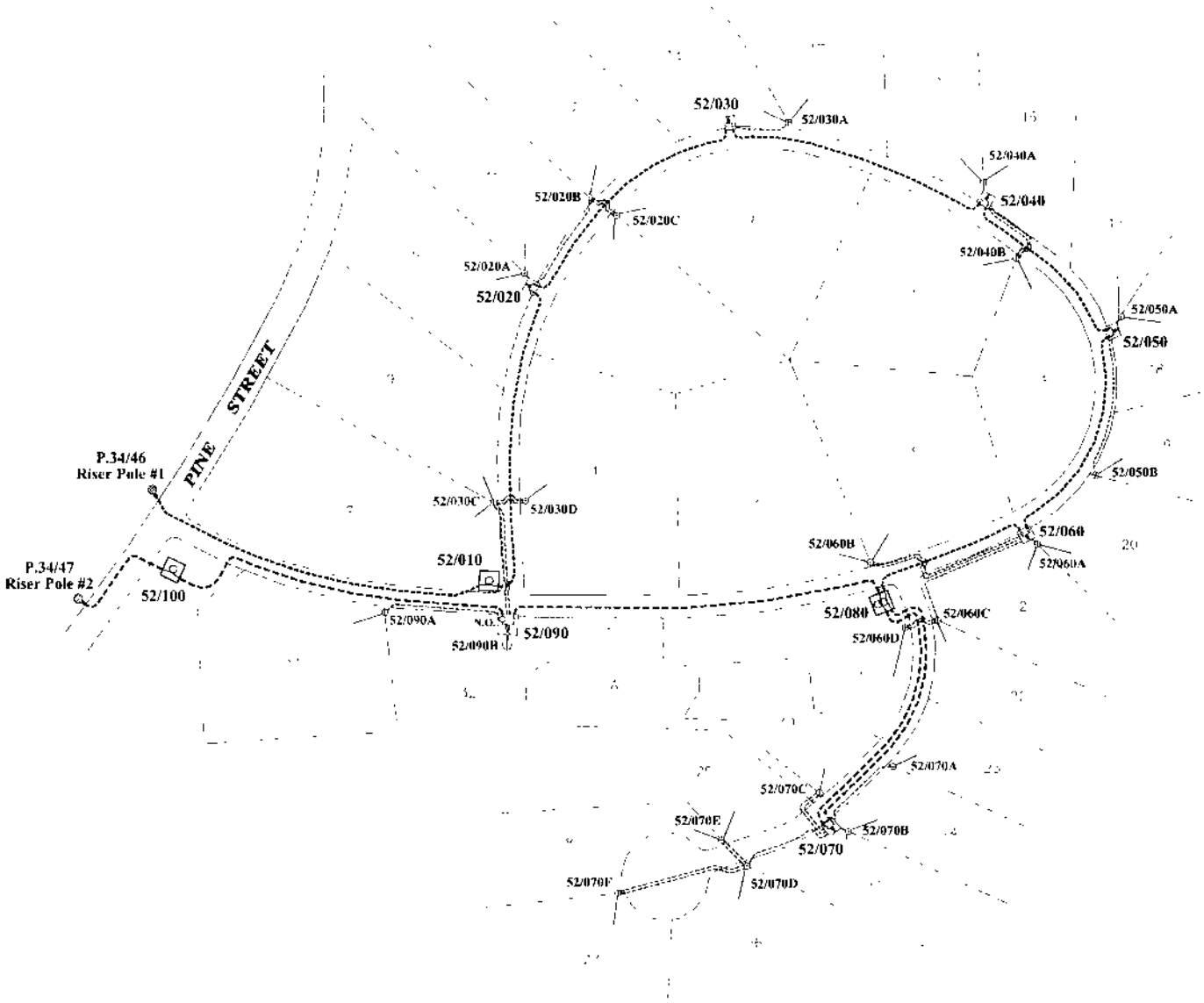
2. Certified high voltage cable test results are to be provided to the Company Inspector/Supervisor prior to the system being energized. This applies to future Company or private system installations, additions, or repairs.

3. Secondary cable that the Company authorizes be installed by Developer in the public way may require testing to 1000 Volts after installation.

D. Failure to comply with standard requirements, inspections, and acceptance testing protocols may lead to contractor removal from approved contractor list.

EXAMPLE RESIDENTIAL UD SYSTEM LAYOUT **FIG-1**

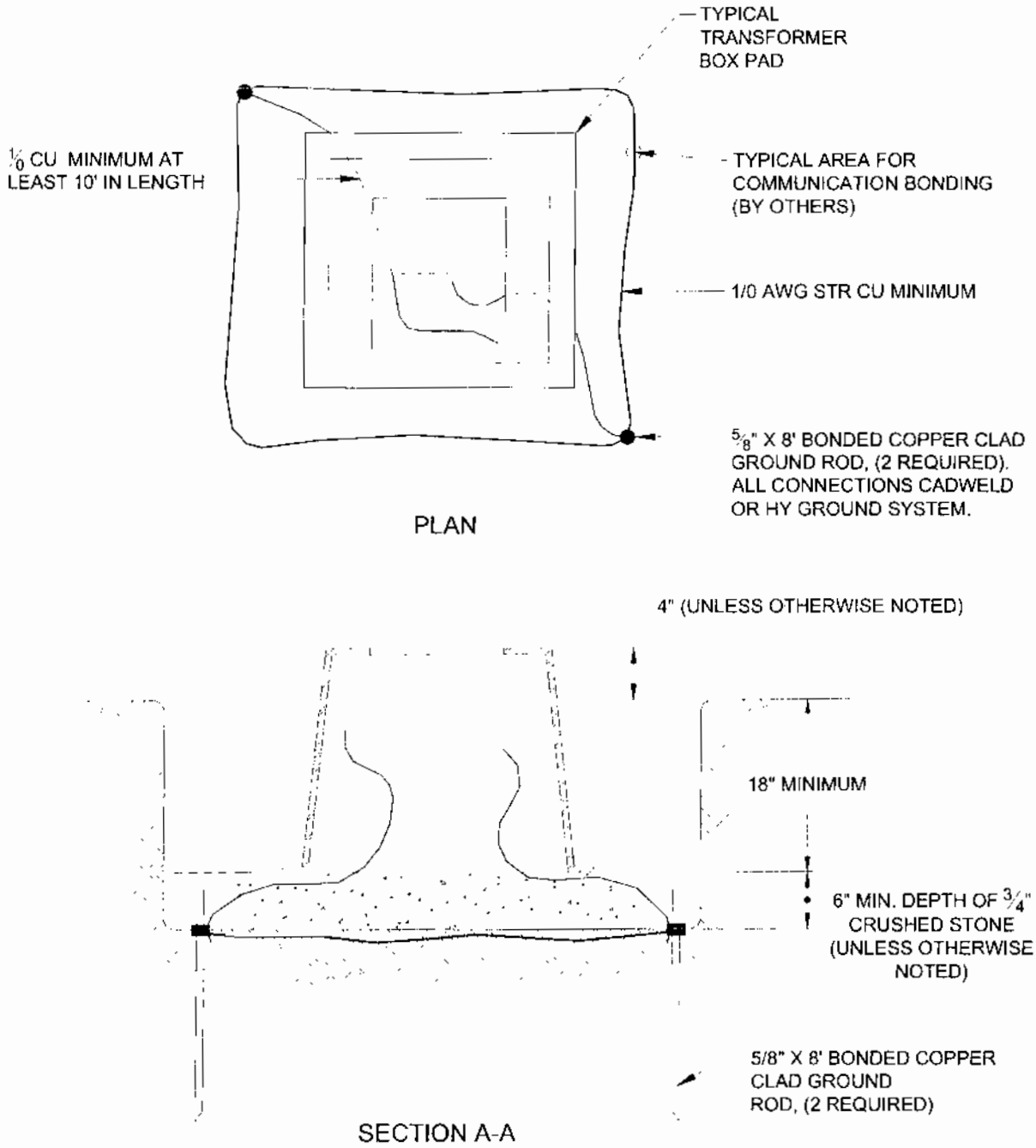
(Illustrative Purposes Only)



Notes:

1. URD Systems will be designed for each project by Company personnel using NSTAR Optimal Design Guidelines.
2. Numbering system shown is an example only and is not common to all areas.

GROUNDING RING (Refer to C3801, C3814) **FIG-2**

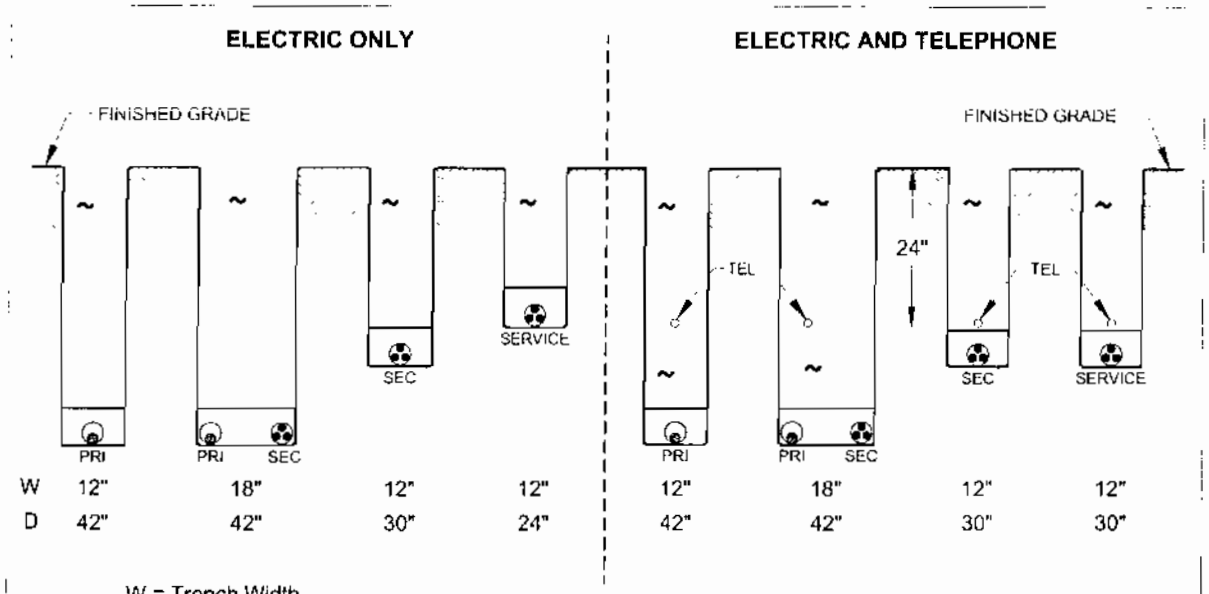


Notes:

1. The 5/8" ground rods shown in Fig 2 are a min. diameter and length; 3/4" x 10' is acceptable.

UD - TYPICAL TRENCH SECTIONS CABLE IN DUCT

FIG-3



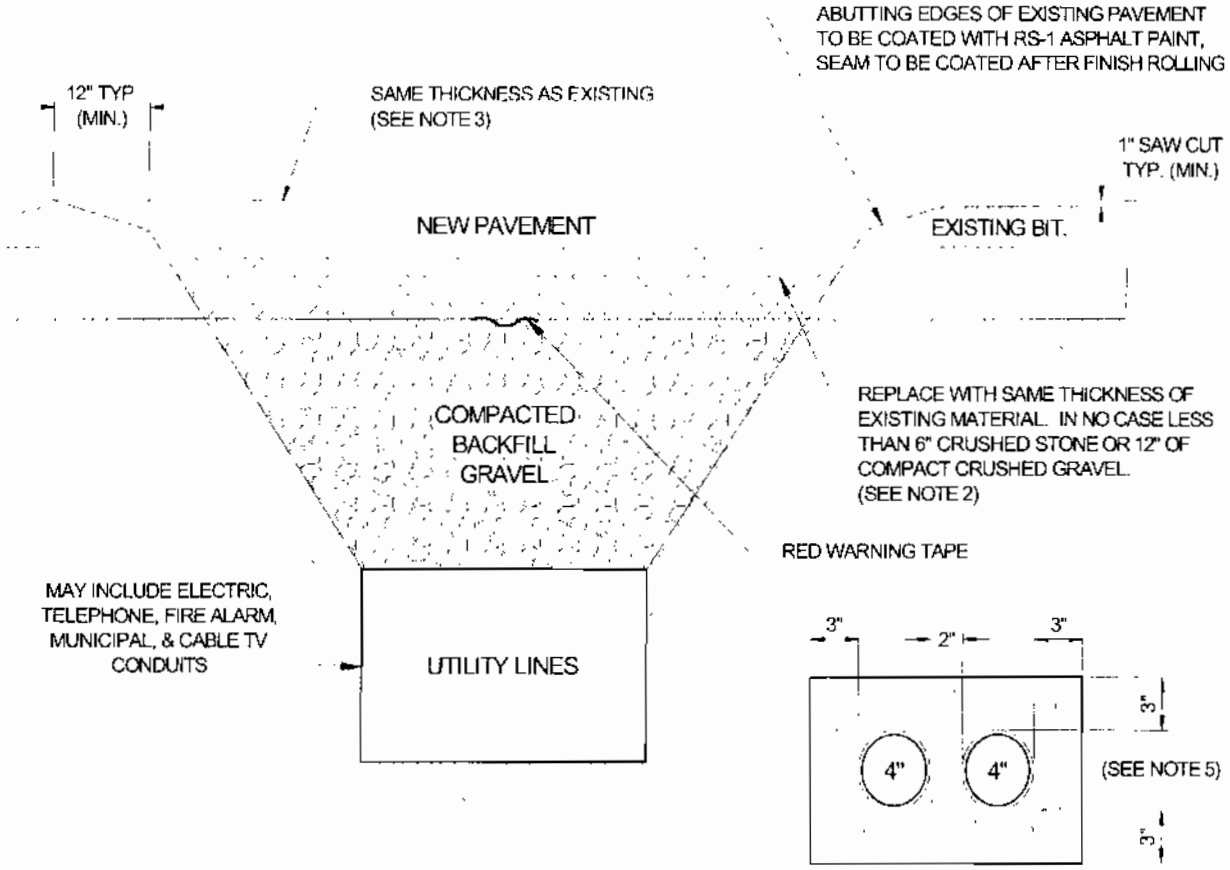
W = Trench Width
D = Trench Depth
~ = Buried Electric Warning tape 12" below grade; shared trenches with primary require additional marking tape.

Primary System may be 1 or more Ducts

Notes:

1. All public way conduit and backfill shall be installed in accordance with Construction Standard C1100 as required by the Company, or wiring inspector for private property.
2. All public roadway crossings with primary use conduit are to be encased in concrete. Additional locations may require concrete encasement as determined by the Company.
3. Minimum separation in any direction between electric and communications shall not be less than 12" under any circumstances.
4. Minimum separation in any direction between electric and gas lines and equipment shall not be less than 18". If electric conduit is concrete encased, minimum separation may be reduced to 12".

TYPICAL TRENCH / EXCAVATION - PUBLIC WAY ROAD CROSSINGS FIG-4



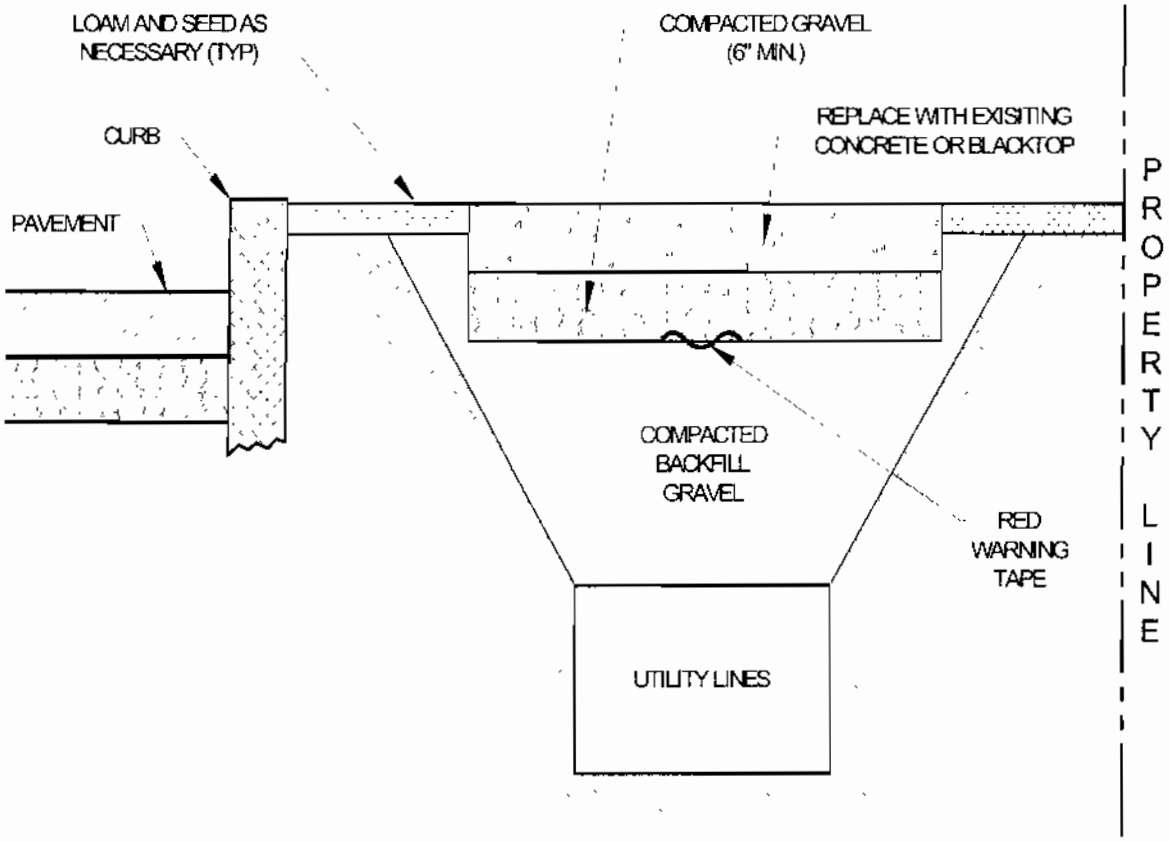
MINIMUM ELECTRIC REQUIREMENTS FOR STATE ROADS

Notes

1. Developer shall be responsible for the requirements of specific local and/or state permits
2. Base material must be 4" of bituminous concrete base Type I-1, for state roads
3. Finish material must be 3" of bituminous concrete top Type I-1 laid in two courses each with a 1 ½" thickness.
4. State roads require that infrared method be performed in conjunction with permanent patch to create a smooth driving surface consistent with existing roadway. This mix must be machine laid. The district office must be notified two days prior to starting work on state roads so that an inspector may be assigned.
5. Concrete encasement as required per D3820 Section VII and standard C1100 for all state roads. Typical conduit bank road crossings shall be encased.

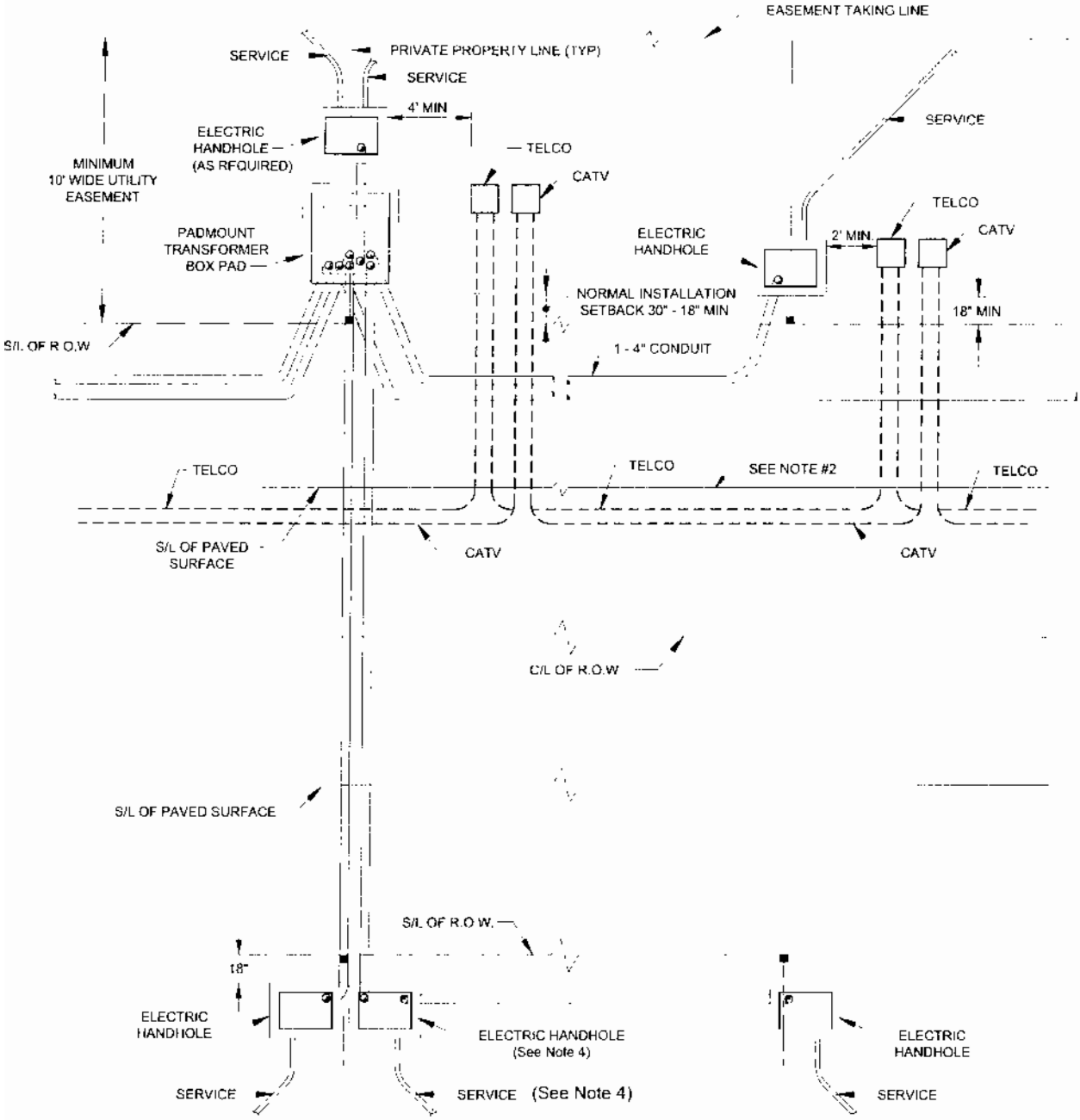
TYPICAL TRENCH/EXCAVATION IN THE PUBLIC WAY SIDEWALK CROSSINGS

FIG-5



PLAN VIEW OF TYPICAL TRANSFORMER BOX PAD, PULL BOX, HANDHOLE, AND CONDUIT LOCATIONS

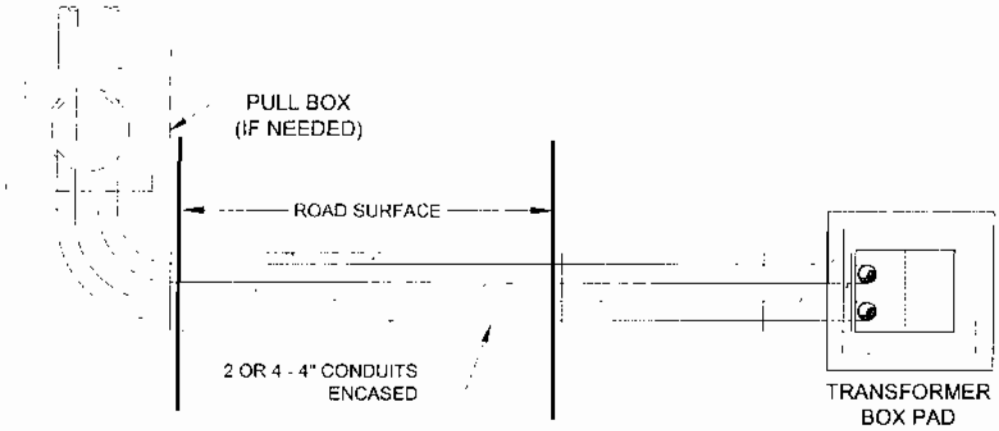
FIG-6



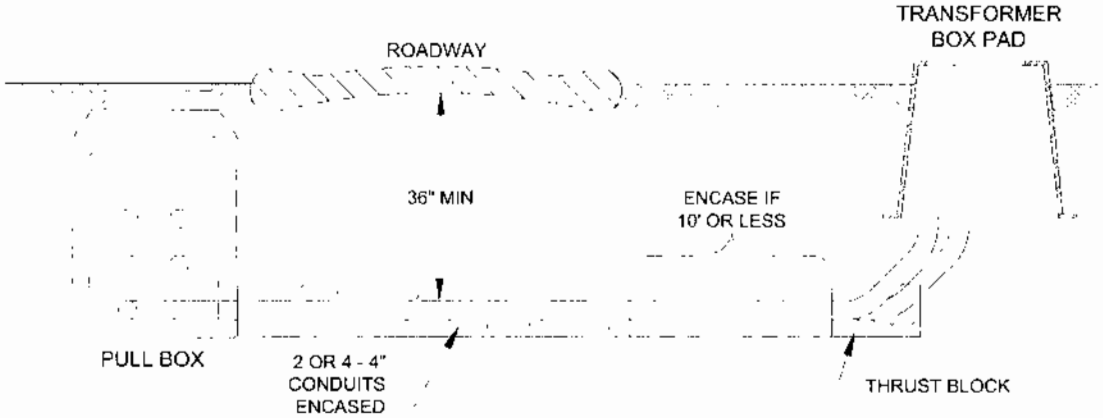
Notes:

1. See FIGS. 7 and 8 for typical primary secondary road crossing elevations. Duct lines crossing street shall typically be perpendicular to the edge of the street.
2. Minimum of 3' from S/L of hard surface to C/L of trench.
3. Refer to FIG-2 for pad grounding details.
4. If only one lot is to be served across the street, the 2nd hand hole may not be needed.

TYPICAL PRIMARY ROAD CROSSING TO TRANSFORMER BOX PAD FIG-7



PLAN VIEW



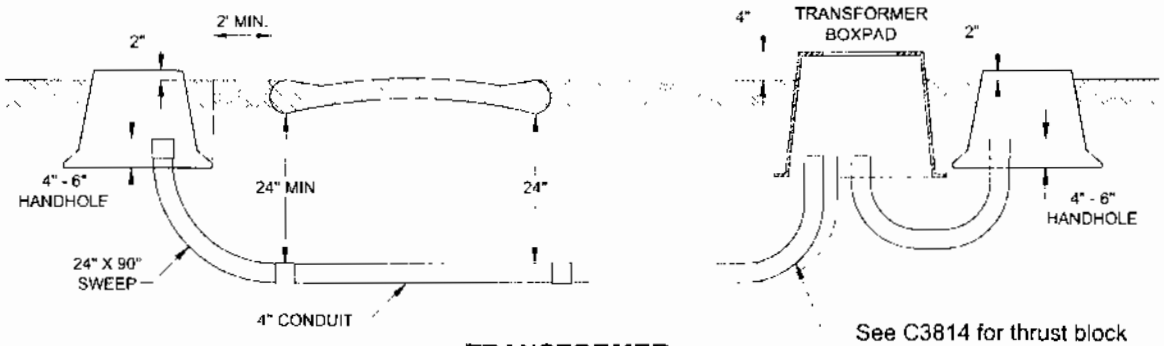
SIDE VIEW

Notes:

1. All primary use ducts for main line and box pad taps shall enter into opposite ends of the pull box only (not on sides). Bell ends and pull lines shall be installed per C1100.
2. Pull box or manhole outlined above may be required for future use or installations that have excessive sweeps and/or pull lengths. See Section VII-B.

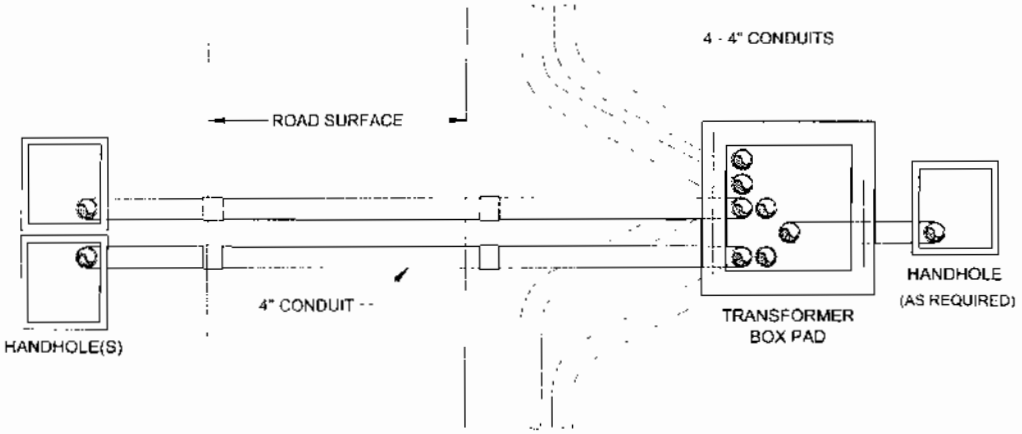
TYPICAL SECONDARY ROAD CROSSING

FIG-8

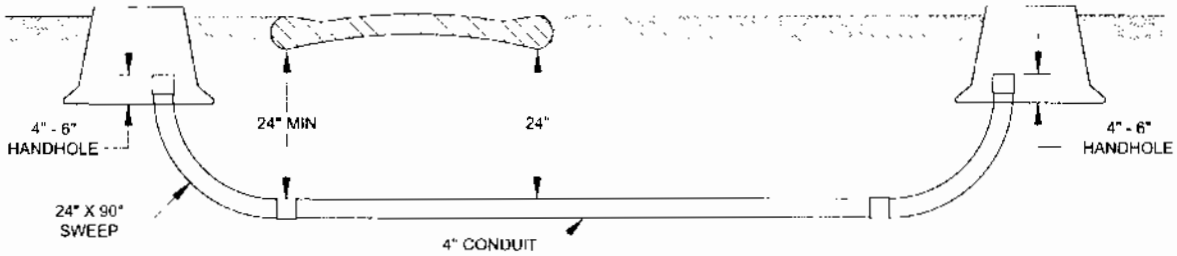


See C3814 for thrust block and conduit entrance detail

TRANSFORMER BOX PAD TO MANHOLE



PLAN VIEW

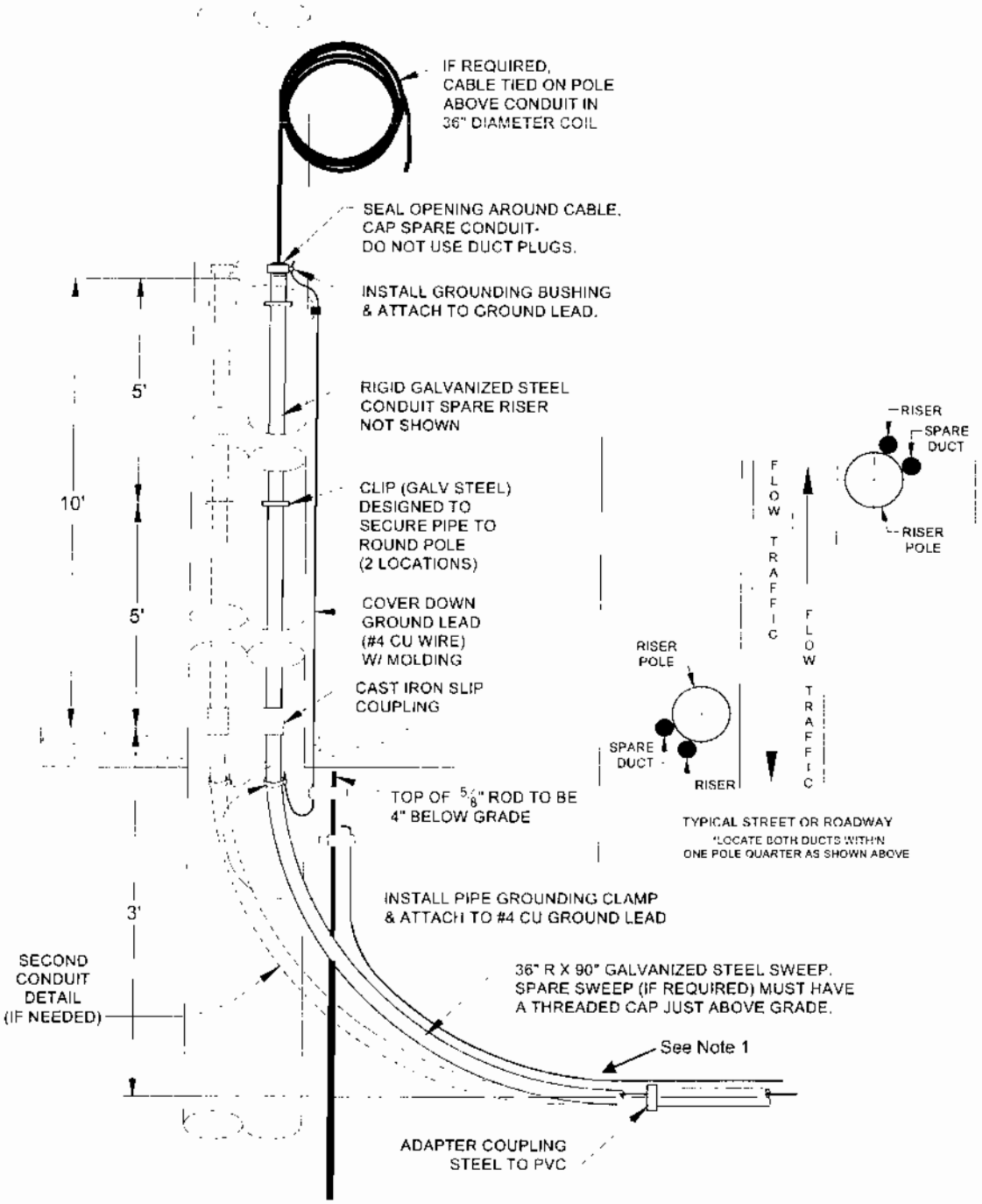


HANDHOLE TO HANDHOLE

Notes:

1. Conduit, bell ends, and pull lines shall be installed per C1100.
2. Handhole and Box Pad installation details shall conform to C3814.

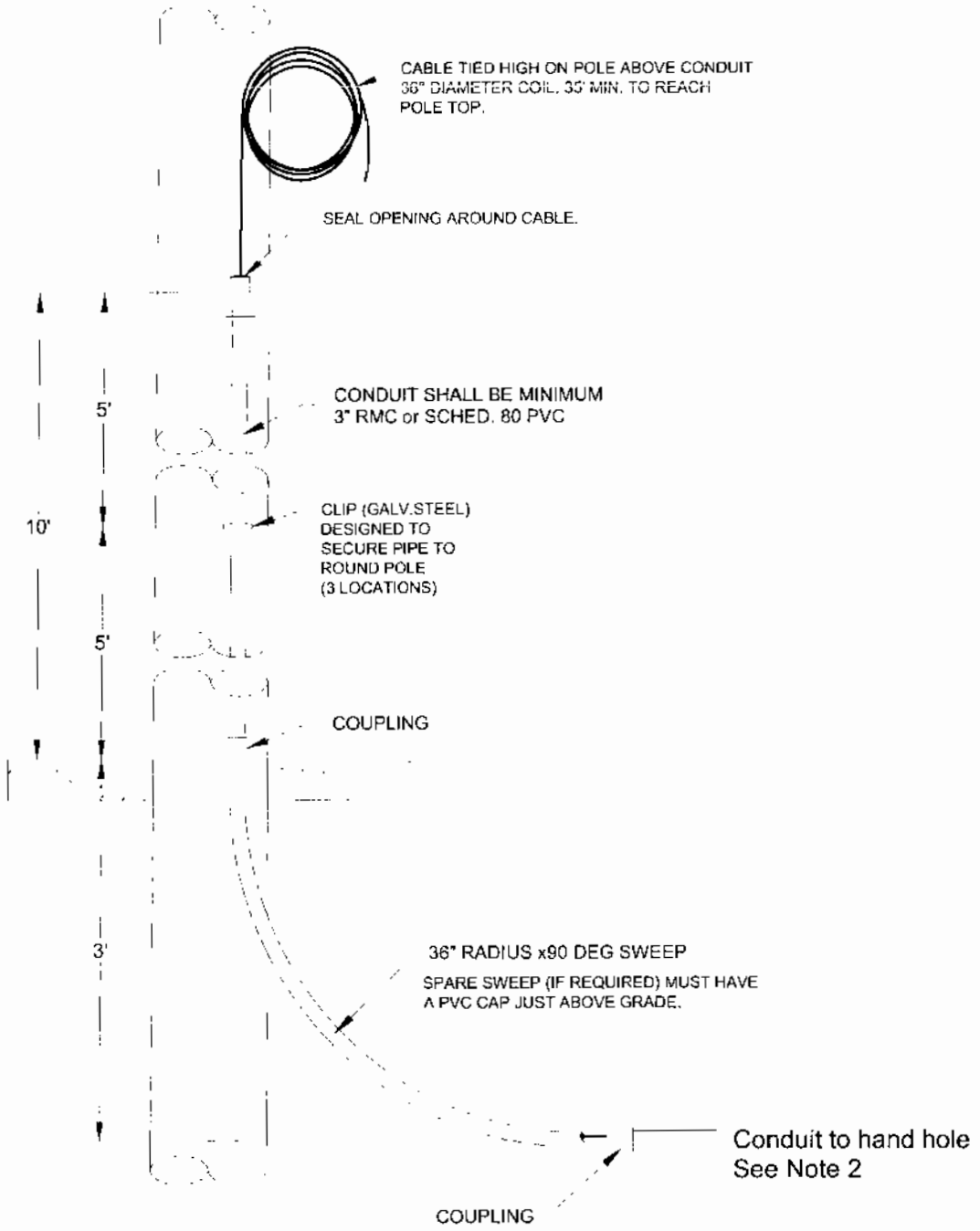
PRIMARY RISER POLE (See C1100) **FIG-9A**



Notes:

1. NSTAR south areas only - #2 bare copper wire (direct buried counterpoise) shall connect riser pole ground to the first pad/switch/manhole grounding ring.
2. Exothermic connections (Cadweld) are acceptable for buried connections.

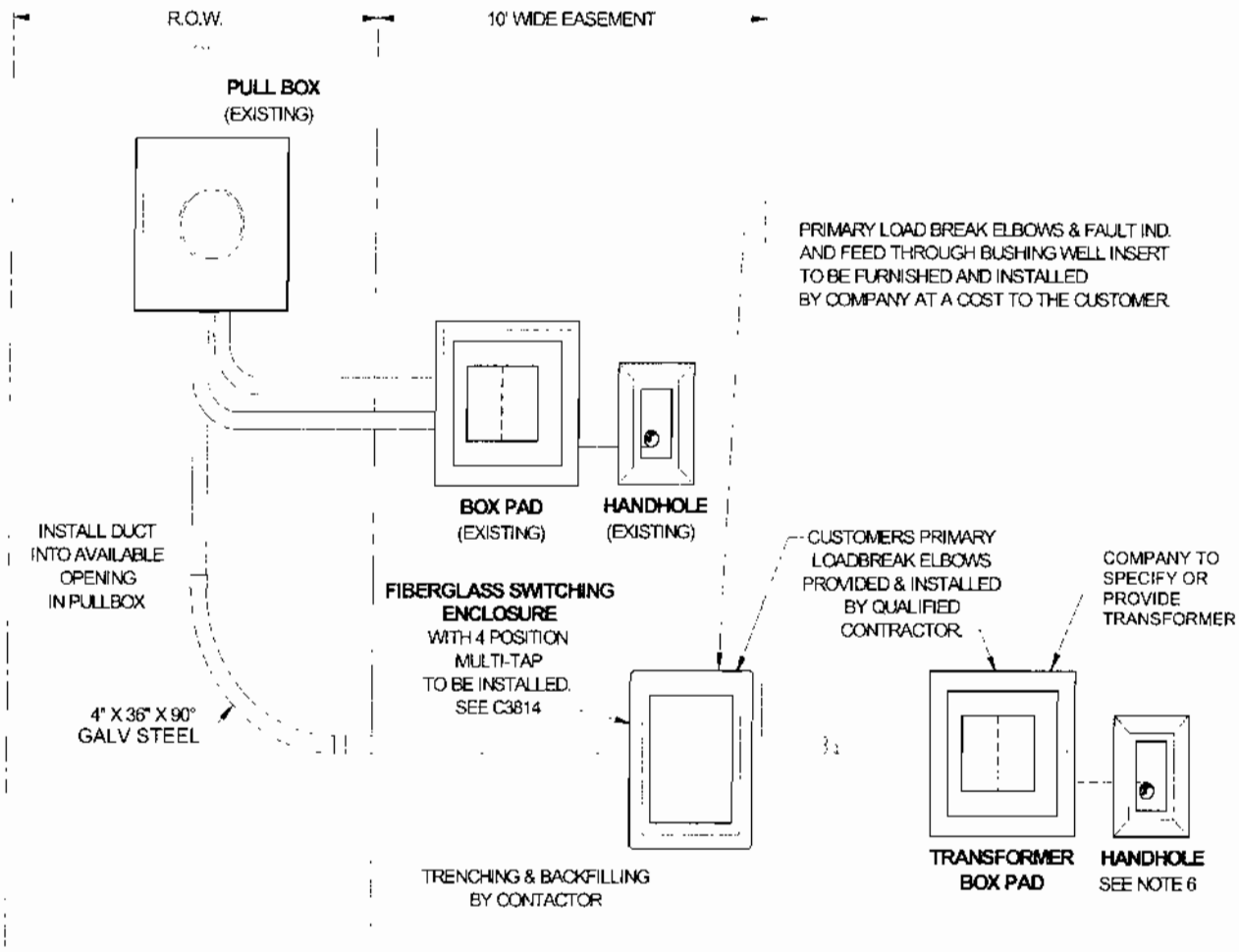
SECONDARY RISER POLE **FIG-9B**



Notes:

1. If galvanized rigid metal conduit (RMC) is used for the riser, grounding shall be installed per FIG-9A except for the counterpoise. PVC riser does not require a pole gropund.
2. See NSTAR I&R Book Sketches 6A and 6B for added details.

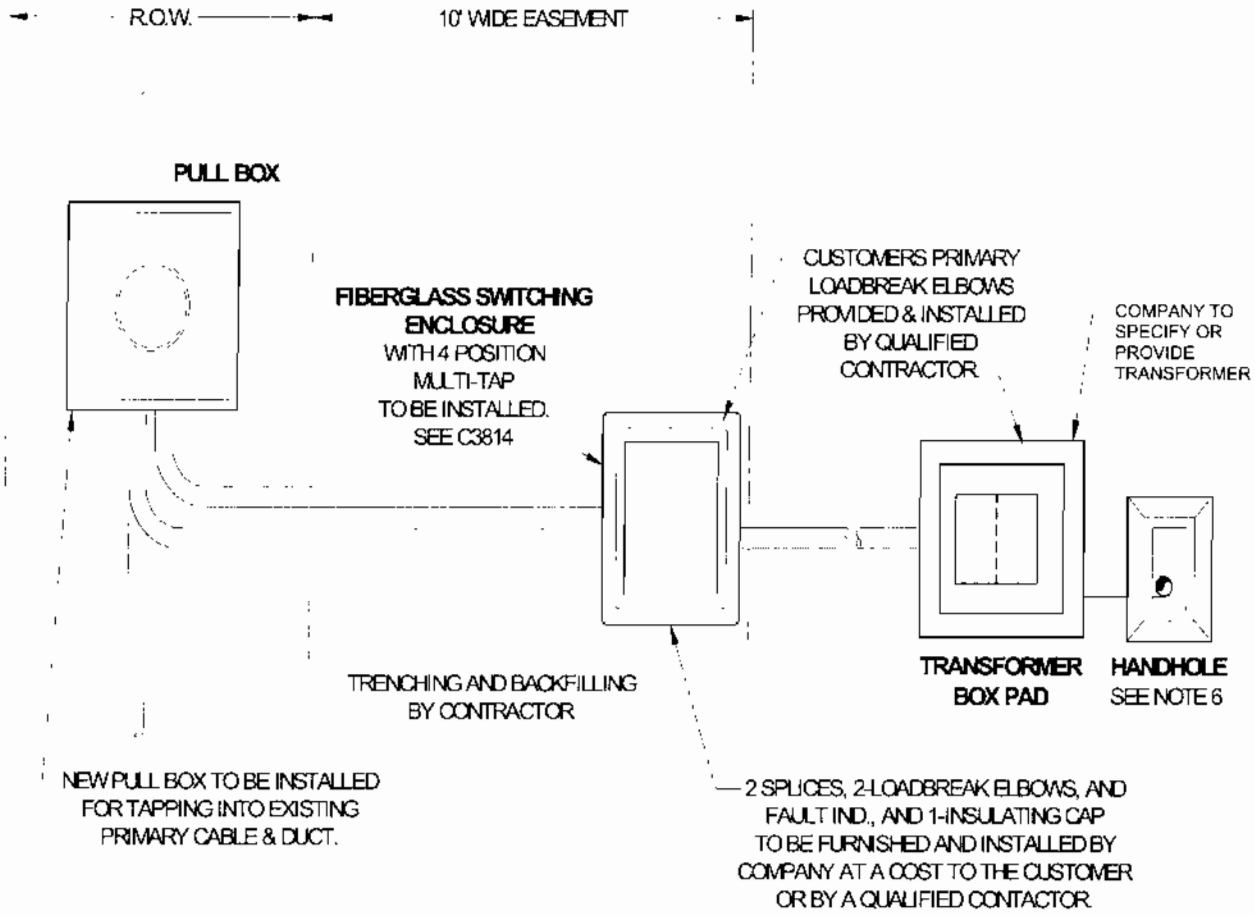
SINGLE PHASE PRIVATELY OWNED UD SYSTEM SUPPLIED FROM EXISTING MANHOLE/PULL BOX FOR SECONDARY METERING FIG-10A



Notes:

1. This standard will apply when it is determined by the Company that existing facilities are suitable to provide new primary service.
2. Pad location must be accessible to trucks for maintenance purposes, therefore location must be agreeable to Company. (Maximum 10' – 12' off traveled way. (See C3802)
3. Customer to provide easement prepared by the Company for placement of Company owned transformer on private property.
4. The installation of the primary cable as provided and installed by the Contractor must meet all Company specifications. All installations shall be inspected and approved prior to backfilling.
5. A high-voltage acceptance test is needed on all primary cable and accessories - see section IX.
6. Hand hole may be required behind transformer pad for service connections.
7. Refer to Dwg. FIG-2 for grounding detail. (Enclosure and transformer pad).
8. Fusible loadbreak elbow may be required by the Company at customer expense.

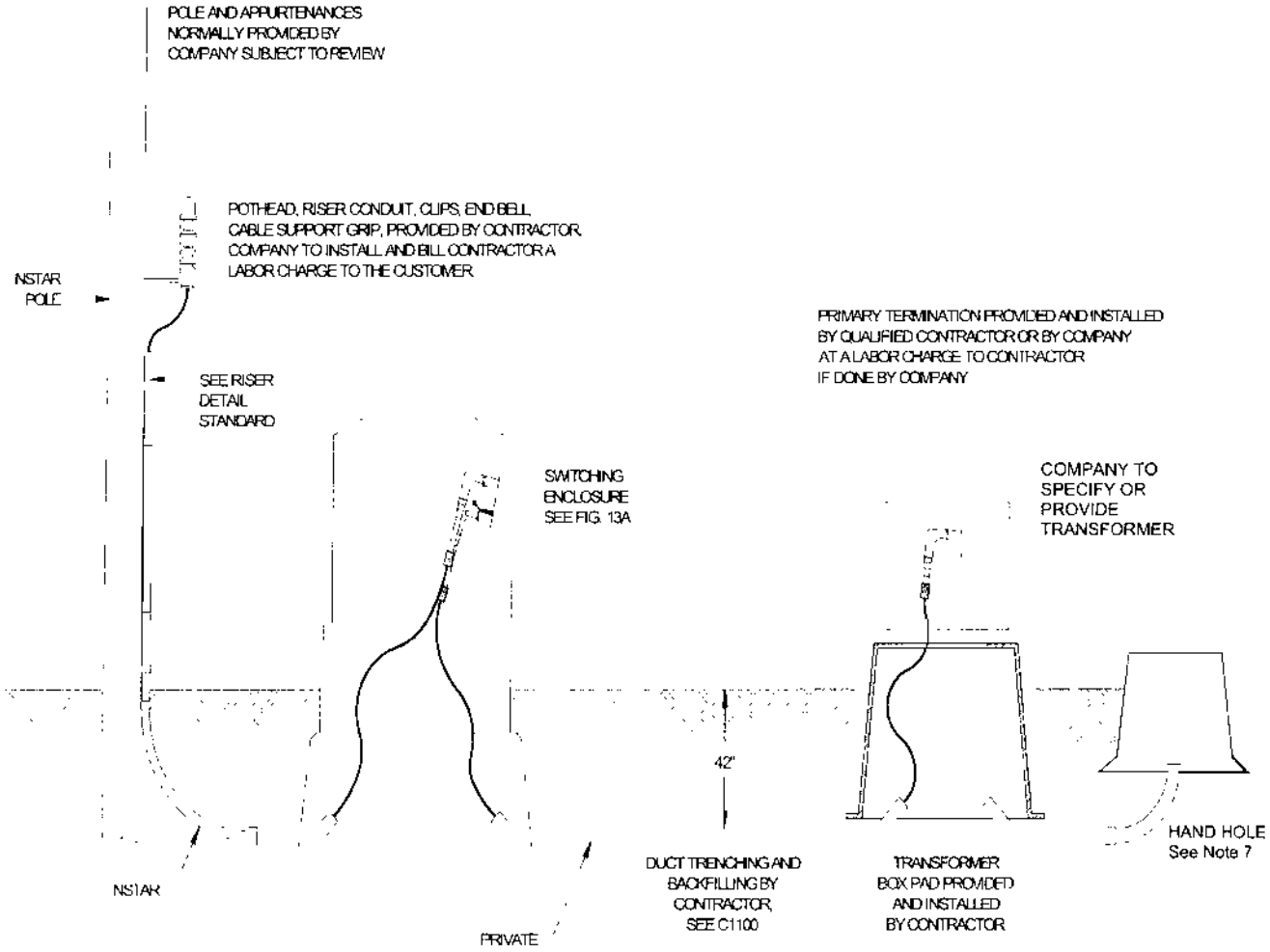
SINGLE PHASE PRIVATELY OWNED UD SYSTEM SUPLLIED FROM NEW MANHOLE/PULL BOX FOR SECONDARY METERING **FIG-10B**



Notes:

1. This standard will apply when there are no existing facilities suitable to provide new primary service. Note: Multi-Tap enables the customer's service to be isolated as required.
2. Pad location just be accessible to trucks for maintenance purposes, therefore location must be agreeable to Company. (Maximum 10'-12' off traveled way. See C3802)
3. Customer to provide easement prepared by the Company for placement of Company owned transformer on private property.
4. The installation of the primary cable as provided and installed by the Contractor must meet all Company specifications. All installation shall be inspected and approved prior to backfilling.
5. A high-voltage acceptance test is needed on all primary cable and accessories - see Section IX.
6. Hand hole may be required behind transformer pad for service connections.
7. Refer to Dwg. FIG-2 for grounding detail. (for enclosure and transformer pad).
8. Fusible loadbreak elbow may be required by the Company at customer expense.

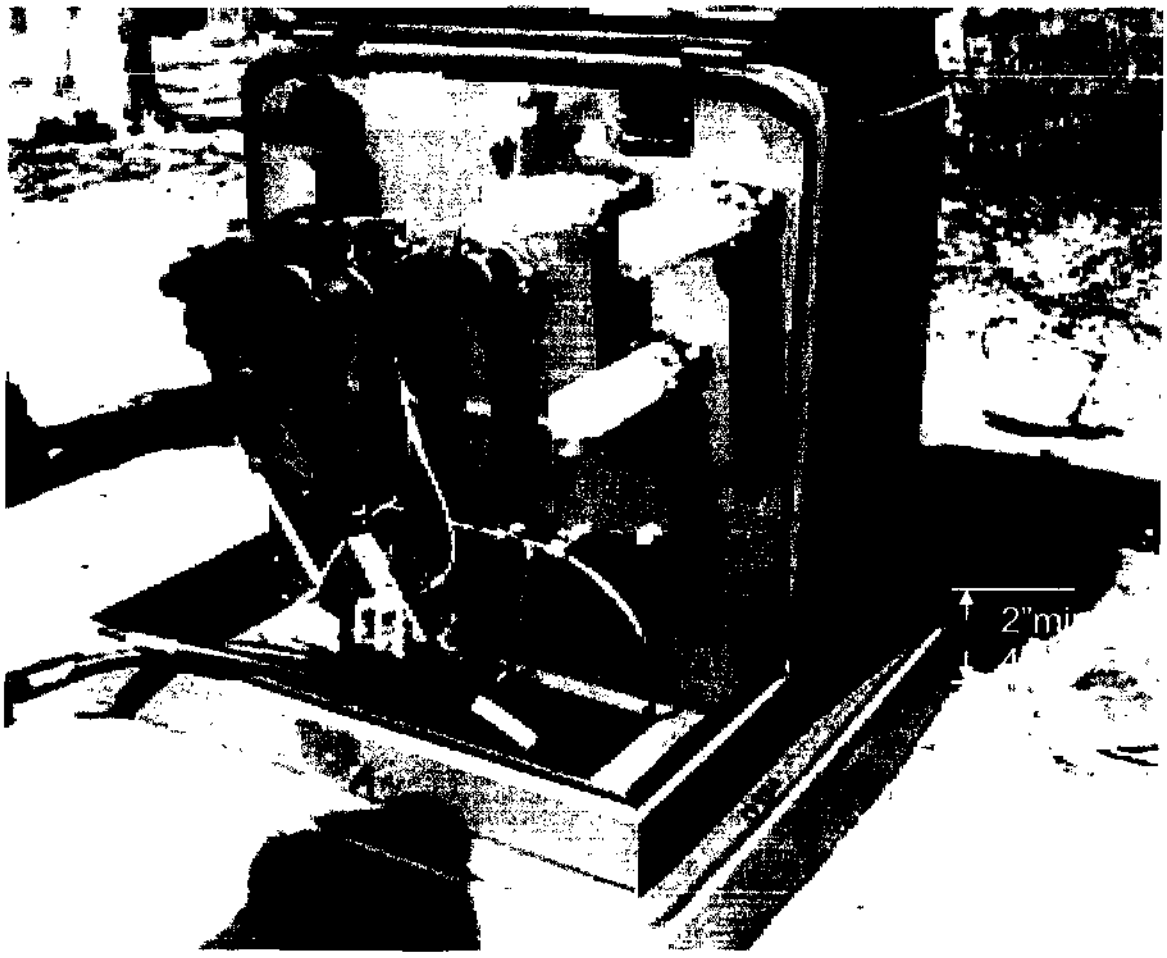
SINGLE PHASE PRIVATELY OWNED UD SYSTEM SUPPLIED FROM OVERHEAD DISTRIBUTION COMPANY POLE FIG-11



Notes:

1. Pad location must be accessible to trucks for maintenance purposes, therefore location must be agreeable to Company.
2. Customer to provide easement prepared by the Company for placement of Company owned transformer on private property.
3. The installation of the primary cable as provided and installed by the contractor must meet all Company specifications. All installations shall be inspected and approved prior to backfilling.
4. A high-voltage acceptance test is needed on all primary cable and accessories- see Section IX.
5. Refer to Dwg. FIG-2 for grounding detail. (Enclosure and transformer pad)
6. Refer to Dwg. FIG-9 for riser pole detail.
7. Hand hole may be required behind transformer and for service connections.
8. Fusible loadbreak elbow may be required by the Company at customer expense.

SINGLE PHASE DEAD-FRONT PAD MOUNTED TRANSFORMER (M3902) FIG-12

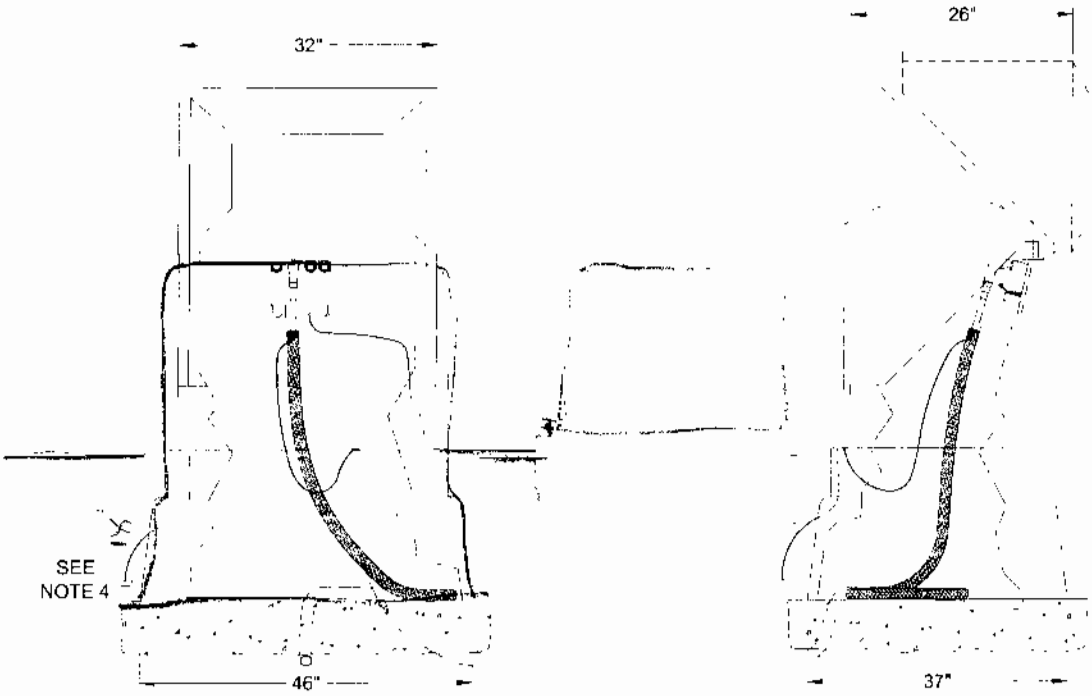


NOTES:

1. Interconnect all grounds; concentric neutral, transformer tank, and ground lead. Refer to FIG-2 for grounding detail
2. Primary bushing must have either an elbow connector or an insulated cap. The plastic cover provided is only a dust cap, not an insulated cap.
3. The primary concentric neutrals must be connected together. A tap from this connection will be made to both of the transformer tank grounding studs.
4. All cables must be clearly marked as to where they go TO (Manhole, Pad or Riser pole number) using slide on black on yellow 1" plastic tags equivalent to Tech Products Type ELVY.
5. For single-phase transformer pad details see NSTAR Construction Standard C3814.

SINGLE PHASE CABLE SWITCHING ENCLOSURE, 15 & 25kV

FIG-13A

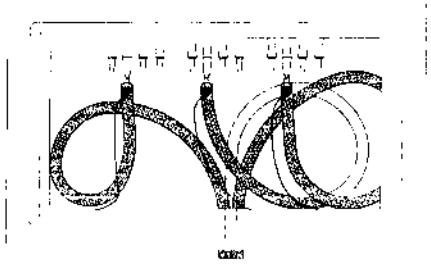


Note:

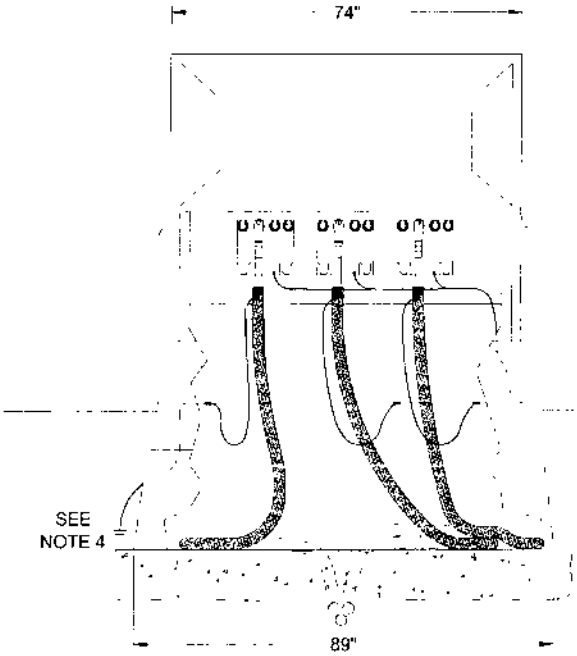
1. Enclosure installed per C3814; dimensions shown here are approximate.
2. Install 4" conduits with bell ends unless otherwise required by design.
3. Cables terminated w/elbows per C2012. Fusible elbows may be required by the Company.
4. Grounding in accordance with Dwg. FIG-2 and then connected to the ground ring bus.

THREE PHASE CABLE SWITCHING ENCLOSURE, 15 & 25kV

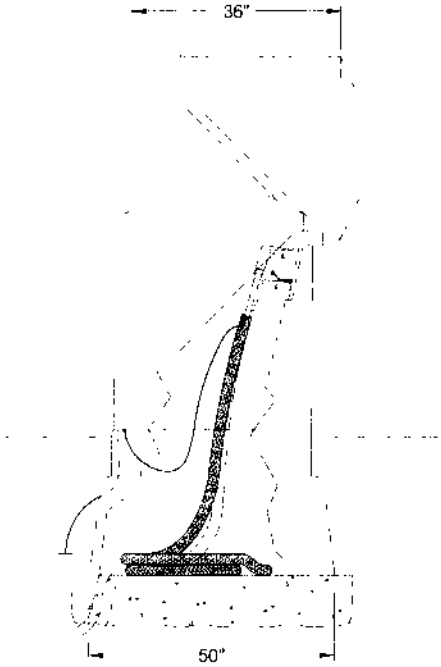
FIG-13B



TOP VIEW



FRONT VIEW



SIDE VIEW

Notes:

1. Enclosure installed per C3814; dimensions shown here are approximate.
2. Install 4" conduits with bell ends unless otherwise required by Company design.
3. Cables terminated w/elbows per C2012. Fusible elbows may be required by the Company.
4. Grounding in accordance with Dwg. FIG-2 and then connected to the ground ring bus.

XI Approval Signature

Approved by: Amin Jessa
Director, Distribution Engineering