SPECIFICATIONS FOR CUSTOMER-INSTALLED UNDERGROUND DISTRIBUTION FACILITIES (NON-RESIDENTIAL)

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This Specification covers the general requirements for the installation of conduit, pads, vaults, manholes and cable by a Customer within the bounds of a development (including all trenching and backfilling), for purposes of providing Distribution Facilities to the Point(s) of Delivery designated by the Company. This Specification covers direct buried, directionally bored, concrete encased and steel encased conduit installations. *This Specification is not intended to apply in either residential subdivision or streetlighting applications.*

1 Definitions

1.1 **Customer** – The owner(s) and/or their agents of the tract of land to be served by the underground electric system, and/or the party or parties responsible for the installation of the distribution facilities, such as a developer or contractor.

1.2 **Company** – Ameren Missouri.

1.3 **Company Representative** – Person(s) designated by the Company to coordinate various facets of the project between the Company and the Customer.

1.4 **Drawings** – Construction drawings provided by the Company which indicate the size, location, route and lengths of the Distribution Facilities to be installed, and which clearly define the Customer's accepted portion of the work.

1.5 **Specification** – This document and any additional Drawings supplied for a specific development.

1.6 **Conduit System** – That portion of the Distribution Facilities that includes the duct and/or duct bank, equipment pads and all subterranean structures, such as vaults, pulling boxes and manholes.

1.7 **Distribution Facilities** – Primary voltage (greater than 600V) and secondary voltage (less than 600V) facilities, including the Conduit System, up to the Point of Delivery.

1.8 **Point of Delivery** – The point at which the Company's equipment connects electrically to customer-owned equipment, without regard to the location of the Company's metering. Points of Delivery can include a customer switchgear lineup, transformer bushings, pre-bussed tap box, or multi-customer service equipment device.

2 Scope of Work

2.1 Customer Responsibilities

2.1.1 **Conduit Installation.** The Customer shall perform all work necessary to construct the complete integrated Conduit System according to the Drawings and Specifications furnished by the Company and any instructions otherwise provided by the Company Representative. This includes furnishing excavation and backfill for the trenches.

2.1.2 **Notice to Inspect.** The Customer shall notify the Company Representative with at least one full working day's advance notice before the start of Conduit System construction or installation of material, thus allowing for inspection of materials and workmanship by the Company.

2.1.3 **Field Surveying.** The Customer shall supply field surveying to locate easements, rights-of-way, and property lines necessary for the installation of the Conduit System as indicated on Drawings.

2.1.4 **Facility Locates.** The Customer shall determine the field location and elevation of all foreign lines and obstructions. Such information is necessary in order to provide adequate space for conduit and manhole construction, and to establish the proper trench grade to ensure that the installation is in accordance with the Drawings and Specifications.

2.1.5 **Fees and Permits.** The Customer shall give all notices, pay all fees, obtain the necessary permits and comply with all Federal, State and Municipal laws, ordinances, rules and regulations, as well as building and construction codes bearing on the installation of the Conduit System and the conduct of the work.

2.1.6 **Material Provisions.** The Customer shall provide all Conduit System materials except for those structures provided by Company (ref. Section 2.2.2). For those items that the Company provides, the Customer shall make arrangements with the Company Representative in advance to have the materials for the particular project released for the Customer to pick up. In the St. Louis Metro area, the Customer shall pick up all released materials from the Company's general warehouse at 12121 Dorsett Road in Maryland Heights. Outside the St. Louis Metro area, the Customer shall pick up these materials from the closest Regional warehouse. (The Customer shall refer to Section 1.0 of the *Ameren Missouri Electric Service Manual* for the locations and phone numbers of the Engineering and Estimating offices in these Regional areas.) In either case, at the time of pick up, the Customer shall provide the Company's Work Request number, which identifies the project for which the material has been released.

2.2 Company Responsibilities

2.2.1 **Job Drawings.** The Company shall furnish Drawings indicating the installation of the Conduit System according to the Company's layout and design. The Company shall provide detailed information for all the work on the Drawings, including the precise locations of manholes and vaults, padmount equipment, the conduit route, location, arrangement and number of ducts, in addition to information as to whether or not the conduit installation requires concrete encasement.

2.2.2 **Material Provisions.** The Company shall make available pulling boxes, non-traffic-rated vaults and accessories, transformer pads, switchgear pads, cable enclosure pads, and pedestals. To this end, the Company shall make available a number of warehouse locations

and personnel for purposes of having the Customer pick up these materials for a specific project (ref. Section 2.1.6). The Company shall not make available traffic-rated manholes or their accessories. The Company also shall not provide any conduit, bends, couplings, blocks, spacers, or bond wire.

2.2.3 **Supplier Contacts.** The Company shall furnish names and contacts of preferred suppliers of traffic-rated manholes and accessories (concrete-encased installations only). The Company does not provide traffic-rated manholes or accessories to the Customer because it does not stock such items on its property.

2.2.4 **Conduit System Inspection.** The Company shall inspect materials and workmanship associated with the Customer-installed Conduit System prior to backfilling and upon notification by the Customer, or notify the Customer of the Company's decision to waive the inspection.

2.2.5 **Cable Installation.** The Company shall install, splice and terminate all Company primary cables. The Company will also install all padmount equipment, such as transformers, switchgear and cable enclosures, and make all electrical connections (including grounds) therein.

3 Trenching

3.1 **Adherence to Drawings.** The ducts shall be installed along the route specified on the Drawings. Straight routes shall be maintained unless specified otherwise on the Drawings. Turns and bends that are introduced for purposes of avoiding physical obstructions shall be made within the limits specified either on the Drawings or by approval of the Company Representative.

3.2 **Easements and ROW.** Deviations outside the boundaries of the associated easement or right-of-way are not allowed. Problems concerning the use of the easement or right-of-way shall be referred to the Company Representative for resolution.

3.3 **Joint Trenching.** Clearances stated in the National Electric Safety Code shall be observed as a minimum (ref. SPEC 1). The use of a joint trench with other utilities is acceptable, provided the utilities involved (including the Company) agree to its use and their individual placements within the trench. Local utility clearance requirements shall prevail when their requirements exceed the minimum NESC separations.

3.4 **Final Grade.** As a general rule, approximate final grade within 6 inches should be established where possible and conditions permit, before trenching is started.

3.5 **Burial Depths.** Standard burial depths are 36” of cover from final grade for conduits housing primary voltage cables and 24”-36” of cover from final grade for conduits housing secondary voltage cables. The Company Representative shall approve any exceptions to the specified burial depths. In those cases where these depths cannot be maintained along the entire route, the Company Representative may require means such as concrete encasement in order to protect the Distribution System.

3.6 **Trench Floor.** The trench floor shall consist of firm, well-compacted, undisturbed dirt, or backfill that is supplied for leveling or grading purposes. The bottom of the trench shall be leveled to plus/minus 2” in order to avoid “humps” in the conduit (especially in direct-buried conduit installations), and shall be at an elevation necessary to satisfy the standard burial depth requirements.

3.7 **Trench Width.** For direct buried single duct installations, the trench shall be a minimum 2” wider than the specified conduit diameter. For concrete-encased single duct installations, the trench shall be a minimum 4” wider than the conduit. Multiple duct installations of any kind shall maintain a minimum 2” spacing between each conduit in all dimensions, as well as between the conduits and the outside walls of the trench.

3.8 **Obstructions.** If rock or otherwise difficult trenching conditions are encountered which force the consideration of alternatives, the Company Representative shall be consulted. Where ducts are to be installed using directional boring techniques, the soil and surface conditions must be such that the solid materials encountered do not subject the duct(s) to undue stresses. The burial depths established previously shall be maintained.

4 Conduit Bends and Sweeps

4.1 **Bend Specification.** Bends shall be made of Schedule 40 PVC with belled or coupled ends. If couplings are used, they also shall be Schedule 40 PVC. All bends and couplings shall be UL listed and sunlight-resistant. The Company specifies the following manufactured bends for conduit:

24" radius bends at 90°
36" radius bends at 90°, 45° or 22½°
60" radius bends at 45°
120" radius bends at 45°

4.2 **Bend Radii.** All primary voltage conduit bends shall have a minimum radius of 36", and secondary voltage conduit bends shall have a minimum radius of 24". Larger radius bends, as specified above, may be required to accommodate longer pulls, larger cable sizes, field obstructions or future considerations, and shall be called out specifically by the Company on the Drawings.

4.3 **Bend Reinforcement.** Horizontal and vertical bends that require reinforcement for cable pulling purposes shall be so noted on the Drawings and shall be stabilized by means of concrete encasement (ref. SPEC 2).

4.4 **Sweep Bends.** Sweep bends may be formed with a combination of straight duct sections and 5° couplings. The couplings shall have a minimum radius of 36" (subject to approval by the Company Representative) and the overall sweep shall have a minimum bending radius of ten feet.

4.5 **Sweep Bend Stabilization.** Sweep bends must be staked to prevent opening of the couplings during installation. Care must be taken to prevent any duct deformation at the stakes. No other operations producing visible stress on the couplings shall be allowed. Visible stress exists when there is more than 2° of offset on the coupling or where significant in-line offset is observed.

4.6 **Conduit Caps.** All vertical bends penetrating grade, whether through any type of concrete or fiberglass pad, or at a terminal or riser pole, shall have their open ends closed off with duct plugs, conduit caps, or duct tape. This will serve as a deterrent to wildlife and will minimize the entry of moisture and solid debris. The pulling tape shall extend out the end of each bend regardless of its being capped, with the minimum 10 feet exposed.

5 Direct Buried Conduit Installations

5.1 Conduit

5.1.1 **Conduit Specification.** Electrical grade, rigid, nonmetallic, Schedule 40 PVC conduit with internal beveled ends in 3", 4" or 5" sizes, as specified on the Drawings, shall be installed. It shall be 90° C rated PVC and meet the latest revision of NEMA Standard TC2. The Company specifies lengths of either 10' or 20', with belled or coupled ends.

5.1.2 **Conduit Arrangement and Spacing.** Multiple conduit installations shall be such that they are all laid directly on the trench floor with a minimum 2" horizontal separation, not only between the ducts themselves but also between the outside ducts and the walls of the trench. The spacing allows for proper heat dissipation, while the horizontal arrangement helps eliminate backfill voids between the conduits that could result in settling and the collection of water. No two conduits shall be rolled or crossed in the trench midway between two endpoints.

5.1.3 **Conduit Joining.** Individual duct sections shall be joined with couplings and PVC cement to ensure a continuous, leak-free duct with a consistent internal diameter throughout. No internal protrusions or obstructions are allowed. All male sections shall be cut straight and beveled on the inside approximately ½" from ends to provide a smooth internal transition between pieces including pieces that are field cut. The Customer shall ensure that no foreign material enters the ducts to be joined. The end of the duct shall be plugged with approved end plugs whenever work on the duct installation is stopped.

5.1.4 **Pulling Tape Installation.** A flat pulling tape rated a minimum 2500 lbs. shall be installed in all completed duct sections, with a minimum of 10 feet left extending out each duct end. The tape shall be blown into the conduit after the duct section has been completed and the conduit cement is completely dry. During installation, the tape reel should be placed on a pay out stand in order to allow the tape to pay out flatly into the duct in a single continuous piece. Neither knots nor frays shall be permitted inside a duct section.

5.2 Backfilling and Compaction

5.2.1 **Local Ordinance.** Local codes or ordinances shall prevail when their requirements exceed the backfill requirements herein. Where street crossings or other areas supporting vehicular traffic are concerned, alternate backfill material may be used as prescribed by such codes or ordinances.

5.2.2 **Backfill Material.** Except as noted on the Drawings and Specifications, native soil free of rock and debris may be used as backfill material unless disqualified by the Company Representative. The soil shall pass through a 2" screen. ¼" minus limestone screenings may be used as an alternate to soil when backfilling.

5.2.3 **Voids and Foreign Matter.** Voids around the conduit(s) where water can collect shall be avoided. Any conditions that produce crushing pressures on the duct are unacceptable. Trenches shall be kept clear of foreign materials such as grease, hydrocarbons, wood, rotting vegetation, or other debris during the backfill process.

5.2.4 **Alternate Backfill Materials.** Where the quality of the excavated material could damage the installation and/or prevent adequate compaction (as with shale, rock, paving materials, cinders, sharply angled objects, or corrosive materials), a granular backfill of sand, ¼" minus

limestone screening, or flowable fill shall be used. In such cases, the backfill material shall be placed completely around the ducts in all directions in a thickness of at least 2".

5.2.5 **Compaction.** In undeveloped areas, the backfill shall be compacted to provide for supporting a man's weight as the trench is walked upon. Otherwise, in established areas, compaction shall be obtained with hand or mechanical tampers to provide densities of at least 90% of that of the undisturbed soil. Hydrotamping methods are not acceptable.

5.2.6 **Final Grade.** The backfill material shall be placed back in the excavation and compacted as necessary in approximately 18" lifts until final grade is re-established. The ducts shall be restrained to prevent movement, as required. No rock shall be placed in the backfill within 6" elevation of the topmost duct.

5.2.7 **Backfill Settlement.** Settlement of the backfill material above the duct(s) is an indicator of improper compaction. Whenever required, the Customer must re-establish final grade by placing additional backfill or by other means as appropriate.

5.2.8 **Resurfacing.** Pavements, sod, or other surfaces shall be replaced with materials corresponding to those removed unless the Company Representative approves substitute materials. Thickness, strength, and final appearance shall match the original materials as closely as possible.

5.3 Directional Boring

5.3.1 **Coilable Duct Specification.** In areas where surface obstructions make standard open trenching undesirable or cost-prohibitive, directionally boring a coilable duct provides a viable option to the Customer. The coilable duct shall be high-density polyethylene (HDPE) in sizes of 3", 4" or 5" nominal inside diameter, as specified on the Drawings. The Company specifies the following for coilable duct:

3" SDR-13.5 (0.259" min. wall) per ASTM D-1248
4" SDR-13.5 (0.333" min. wall) per ASTM D-1248
5" SDR-13.5 (0.413" min. wall) per ASTM D-1248

5.3.2 **Duct Markings.** The coilable duct shall be black with three UV-resistant red stripes extruded into the outside surface. The stripes shall have a thickness in the range of 10-15 mils and be 3/16" to 3/8" wide. The stripes shall be evenly spaced at 120° intervals around the circumference of the duct.

5.3.3 **Boring Depths.** Coilable duct shall be directionally bored at standard burial depths of 36" of cover for ducts housing primary cables and 24"-36" of cover for ducts housing secondary cables. The Company Representative shall approve any exceptions to the specified burial depths, up to a maximum 60" of cover from final grade.

5.3.4 **Duct Joining.** Sections of coilable duct shall be joined using fusion couplings. Where the coilable duct is to be joined with Company-installed PVC conduit, the Customer is to fuse a 24" straight piece of matching size PVC conduit to the coilable duct. Prior to fusing, the Customer shall make circumferential scores around the outside of the PVC conduit at the end that is to be installed into the fusion coupling. This will allow the fusion coupling to adhere to the dissimilar PVC conduit. A special epoxy is also available that joins the coilable duct with standard PVC couplings. The Customer shall confer with the Company Representative with regard to this epoxy.

5.3.5 **Vertical and Horizontal Bends.** All vertical bends shall be made using Schedule 40 PVC bends with belled or coupled ends as specified in Section 4. Under no circumstances shall a vertical bend be fabricated by "sweeping" it up to grade using the guided boring machine. The vertical bend shall be joined directly to a 24" straight piece of matching size PVC conduit, which is installed to transition between the bend and the coilable duct. Horizontal bends, however, may be swept using the guided boring machine. In places where the bend radius is too small for this, a PVC bend shall be installed between two 24" straight PVC transition sections.

5.3.6 **Connections into Vaults and Manholes.** Bored coilable duct shall end 4'-5' from a new vault or manhole. This coilable duct shall then be transitioned to the same size PVC before connecting into the structure. The transition to PVC shall be made using the techniques described in Section 5.3.4. If the vault or manhole already contains energized Company-maintained cables, the installation, including the straight PVC transition piece, shall stop roughly 10' from the structure or at a location otherwise determined by the Company Representative (ref. Section 5.4.7). The Company shall pick up the installation at this point and tie it into the vault or manhole.

5.4 Vaults, Splice Boxes and Accessories

5.4.1 **Material Provisions.** The Company shall make available a number of underground structures for purposes of splicing primary and secondary voltage cables in areas that do not require a traffic rating. The Company specifies a number of different sizes for use in Customer-installed situations, depending on the number and sizes of cables involved (ref. SPEC 3, 4, 4A and 5). Provided that arrangements are made in advance with the Company Representative, the Customer may pick up items such as these for a specific project (ref. Section 2.1.6).

5.4.2 **Restricted Areas and Protection.** Under no circumstances shall any of these non-traffic rated structures be located in an area subject to vehicular traffic. The restricted areas include parking lots, street shoulders, chat surfaces and any other location onto which a vehicle could temporarily pull over. In those cases where vehicular traffic poses a potential threat to these structures, the Customer shall install protective bollards around them in the form of either concrete-encased railroad rails or concrete-filled 4" pipes (ref. SPEC 6), the quantities and locations of which shall be indicated on the Drawings.

5.4.3 **2 x 4 Splice Box.** The 2 x 4 splice box (ref. SPEC 3) is intended for concealed use, that is, it does not have a permanent access way for an individual. An electronic marker shall be laid flat inside for future locating purposes when it becomes necessary to cover it before the Company installs the cable. The splice box does not have a floor, nor any knockouts, couplings or pulling eyes built into the end walls. Conduits up to a 4" maximum diameter shall be brought in through drilled holes in the small end walls only, so as to avoid tight turning radii.

5.4.4 **3 x 5 and 4 x 8 Vaults.** The 3 x 5 and 4 x 8 vaults (ref. SPEC 4, 4A and 5) each have two PVC couplings built into each end wall, in 4" sizes for the 3 x 5 and 5" sizes for the 4 x 8. Couplings not used shall be end capped. Each has knockout capability along the sidewalls. They also all have threaded Richmond inserts for installing pulling eyes, and floor holes for draining water. (The Company shall install the iron grates over these drain holes.)

5.4.5 **Pit Excavation.** Each of the structures shall be installed in a pit that has been excavated for standard conduit depths of 36" for primary cable. Each structure shall be installed on a leveled 10" high base of 1" clean rock for draining purposes. Any overdig shall also be

filled with 1” clean rock that has been leveled and tamped to firm wherever the earth has been disturbed.

5.4.6 **Conduit Connections (New Vaults).** Conduits shall be placed onto the couplings, through the concrete knockouts or into the polyethylene-drilled holes as required. Conduits placed through knockouts or drilled holes shall extend 6” into the vault. Conduits brought through knockouts shall be grouted or mortared at the concrete interface, while those brought through drilled holes shall be caulked at the poly interface.

5.4.7 **Conduit Connections (Existing Vaults).** The Customer shall not install new conduits directly into a vault or splice box that already contains energized Company-maintained cables, regardless of the structure’s location on or off Customer property, unless arrangements to that effect are made with the Company Representative. When the Drawings specify that Customer-installed conduits are to be brought into such a structure, the Customer shall stop the conduit installation roughly 10’ from the structure, or at a location otherwise determined by the Company Representative. The Company shall pick up the installation at this point and tie it into the vault or splice box.

5.4.8 **Riser, Frame and Cover.** Each precast concrete vault requires a 6” concrete riser to be set in the rectangular hole in the vault’s roof. This riser is “notched” for the 24” x 42” cast iron frame and cover that completes the vault’s access way. Sloped grades shall be accommodated by bricking and mortaring between the riser and the vault roof on three of the four sides. The frame shall be sealed to the riser with mortar in order to prevent tipping it when the cover is open on its hinges.

6 Concrete-Encased Conduit Installations

6.1 Conduit and Arrangement of Ducts

6.1.1 **Conduit Specification.** Electrical grade, rigid, nonmetallic, Schedule EB (Encased Burial) PVC conduit in a 5" diameter size only, shall be installed. It shall be 90° C rated PVC and meet the latest revision of NEMA Standard TC6. The Company specifies lengths of either 10' or 20', with belled or coupled ends. All male sections shall be cut straight and beveled on the inside approximately ½" from ends to provide a smooth internal transition between pieces including pieces that are field cut.

6.1.2 **Duct Arrangement.** The duct formation required between any two endpoints shall be shown in detail on the Drawings as determined by the Company Representative on the basis of field conditions or other considerations. However, wherever possible, the Company shall specify an arrangement consisting of two columns (i.e. two ducts across) and up to six rows (ref. SPEC 6). The two-column layout facilitates their being tied into traffic-rated manholes.

6.1.3 **Deviation from Drawings.** Any number of field conditions may warrant deviating from the duct formation specified on the Drawings, such as obstructions, poor soil conditions, the need for a shallower trench, etc. In such cases, the Company Representative shall approve the deviation prior to its being executed.

6.1.4 **Conduit Joining.** Individual duct sections shall be joined with couplings, but no PVC cement is necessary, as the concrete is sufficient to hold the individual sections together. No internal protrusions or obstructions are allowed. The Customer shall ensure that no foreign material enters the ducts to be joined.

6.1.5 **Installation Stoppage.** If the installation is stopped temporarily for any reason, or if the Customer installation is completed midspan for the Company to marry up to later, the end of all the ducts in the formation shall be plugged with approved end plugs. In addition, if the Customer ducts are to be encased and the trench backfilled for the Company to expose later, a plywood bulkhead shall be installed hard against the ends of the plugged ducts in order to minimize the amount of Customer backfill that spills into the Company trench.

6.1.6 **Amount of Cover.** At least 36" of cover above the ducts in the topmost row shall be maintained wherever possible. However, when more shallow cover is unavoidable, the Company may require measures beyond concrete encasement (such as steel plating, etc.) in order to protect the ducts.

6.1.7 **Duct Formation at Manholes.** Concrete encased duct banks shall enter and exit traffic-rated manholes in one-column or two-column formations, regardless of whether their matrices are "rolled" horizontally in midspan, or modified in any way.

6.1.8 **Pulling Tape Installation.** A flat pulling tape rated a minimum 2500 lbs. shall be installed in all completed duct sections, with a minimum of 10 feet left extending out each duct end. The tape shall be blown into the conduits after the duct section has been completed. During installation, the tape reel should be placed on a pay out stand in order to allow the tape to pay out flatly into the duct in a single continuous piece. Neither knots nor frays shall be permitted inside a duct section.

6.2 Blocks, Spacers and Bond Wire

6.2.1 **Blocks and Spacers (General).** The conduits in the duct bank shall be arranged in the trench in a tight, orderly matrix arrangement with the use of blocks and spacers. Blocks and spacers are duct supports and spacing guides that maintain the 2" clearance required between individual ducts and between the ducts and the trench floor. They are made of concrete and as such, become an integral part of the overall duct formation (ref. SPEC 6).

6.2.2 **Approved Supplier.** The Company's approved supplier of blocks and spacers is Lemay Concrete Block (7900 Reilly, P.O. Box 82811, St. Louis, MO 63111, 314-638-9940). Alternate non-concrete spacers may be substituted, but only with the approval of the Company Representative. Note that any alternate block or spacer shall maintain a strength of 2000 PSI and the minimum 2" clearance required around each duct.

6.2.3 **Block Arrangement.** The blocks shall be placed beneath the bottom row of ducts, directly on the trench floor, which will allow for a 2" layer of concrete underneath the ducts. Another set of blocks shall be placed in an inverted position over the top row of ducts. This will serve as a pouring guide for ensuring that a minimum 2" concrete layer is achieved at the top. In addition, the extra weight will help prevent the conduits from "floating" as the encasement is being poured.

6.2.4 **Spacer Arrangement.** The spacers shall be placed in between each row of ducts, which will allow for a 2" layer of concrete completely around each individual conduit.

6.2.5 **Block and Spacer Grouping.** Blocks and spacers shall be placed such that two are used to support each 10' section of duct – one situated 2' off each end. For 20' sections, blocks and spacers shall be placed in groups of three – one situated 2' off each end, and the third situated directly in the center. Each manufactured bend shall be supported with one block/spacer directly in the center, with the exception of the 120" radius bends at 45°, which shall be supported with two – one situated 2' off each end.

6.2.6 **Block and Spacer Overlap.** Each block and spacer is made to accommodate only two ducts. In duct arrangements of more than two columns, blocks and spacers shall be placed such that they "overlap" the ducts in each row. That is, one set of blocks/spacers shall support the first and second conduits in each row, the second set over shall support the second and third conduits, and so on to the end of each row.

6.2.7 **Bond Wire Location.** A bare 4/0 AWG, tinned copper, 19-strand, soft-drawn conductor shall be installed in the duct bank along its entire length for purposes of establishing a continuous ground reference. It shall be situated in the center of the bottom row of ducts and laid directly atop each block in between the two bottom conduits they support. The encasement shall be poured directly over and completely encapsulate the bare bond wire.

6.2.8 **Bond Wire Ends.** The bond wire shall be brought into each traffic-rated manhole in sufficient length to "drape the tail" onto the floor from whatever elevation it enters with the ducts. Where the Drawings indicate a bond wire coming up through the inside of a switchgear fiberglass pad, it shall be brought up in sufficient length to extend the "tail" to the closest inside corner from wherever it emerges with one of the ducts. The Company shall make all final bond wire connections at these endpoints.

6.3 Concrete and Backfilling

6.3.1 **Concrete Specification.** The ducts themselves shall be encased using either a 2½-sack fly ash (preferred) or a 4½-sack standard concrete mix. This encasement shall be a 3/8" minus (a.k.a. "Meramec P-gravel" or "Torpedo") aggregate mix and attain a minimum 28-day strength of 2000 PSI (ref. SPEC 6).

6.3.2 **Encasement Reinforcing.** The high granular nature of the concrete encasement mix shall facilitate the Company's need to be able to chip at the concrete as required, in order to expose ducts containing energized cables. Under no circumstances shall the duct bank encasement be reinforced with any foreign bonding agent or material such as steel rebar or the like.

6.3.3 **Amount of Cover.** The concrete encasement shall be poured to at least 2" above the top row of ducts. (The upper edges of the inverted blocks placed over this top row of ducts shall be used as a guide.) The top of this encasement shall be at least 36" below final grade.

6.3.4 **Backfill Materials (Traffic Areas).** For duct banks in a traffic area, i.e. alley, street or highway (including a shoulder or other right-of-way), the layer above the duct encasement shall be one of either ¾" minus granular or flowable fill, up to 11" of final grade. Acceptable flowable fill is a 2-sack standard concrete mix. On top of that shall be a 9" street base layer of either 3-sack fly ash (preferred) or 4-sack standard concrete mix. The street base shall be a ¾" minus (a.k.a. "Meramec C-gravel") aggregate mix and attain a minimum 28-day strength of 2400 PSI. The final 2" shall consist of an asphalt layer as appropriate.

6.3.5 **Backfill Materials (Non-Traffic Areas).** If the duct bank is in a non-traffic area, the backfill above the duct encasement shall be either the native spoil (assuming it is free of rock and debris and passes through a 2" screen), a granular sand or ¼" minus limestone screening, or flowable fill (ref. Section 5.2). If the duct bank is in a parking lot, the backfill above the duct encasement shall, at a minimum, be consistent with the subgrade composition of the rest of the lot.

6.4 Manholes and Accessories

6.4.1 **Application and Approved Supplier.** Traffic-rated manholes shall be called out on the Drawings in those cases where either the Company requires the conduits entering and exiting to be concrete encased, or a vault in a direct buried conduit installation would otherwise be subject to vehicular traffic. The Company specifies three different sizes for use in Customer-installed situations, depending on the number and sizes of cables involved (ref. SPEC 8, 9 and 10). Champion Precast, Inc. (2441 Hwy 61 North in Troy, MO 63379, 573-384-5855) is the Company's approved supplier of all traffic-rated manholes.

6.4.2 **General Description.** All traffic-rated manholes are made of steel-reinforced concrete and are precast in only two pieces each. The walls are 6" thick and form an elongated octagon in the plan view. They have a pulling eye installed 6" above the floor in each end wall, a 12" diameter sump hole centered in the floor, and a 36" diameter opening centered in the roof for the manway.

6.4.3 **Pit Excavation.** In order to regulate the height of the manway, the excavation shall be such that the 4 x 10 is set on a floor leveled at 7'6" below final grade, and the 6 x 13 and 6 x 17 are set on a floor leveled at 9'6" below final grade. Any deviation from these setting elevations shall be indicated on the Drawings or approved by the Company Representative.

The excavation floor shall be leveled with a 6" layer of crushed rock or flowable fill prior to setting the manhole.

6.4.4 **Backfill Material.** After the manhole is set, the excavation shall be backfilled with flowable fill, a weak 2-sack cement (a.k.a. "grout") mix. This eliminates voids, develops a "seal" between the two manhole pieces, and facilitates the Company's being able dig it back out (if necessary in the future) in order to bring additional ducts into the manhole once it contains energized cables.

6.4.5 **Manhole Neck and Extensions.** The manhole neck is constructed to extend the entryway from the roof of the precast structure to the surface above. With the manhole set at a standard depth, there will be roughly 2' in which to build up the neck. In such a case, a combination of 6" and 3" thick concrete ring sections (ref. SPEC 11) shall be stacked atop the manhole roof. The frame and cover shall be placed directly atop the last ring (ref. SPEC 12).

6.4.6 **Manholes Set Extra Deep.** For manholes that for any reason are set extra deep, the neck shall be built up using 48" diameter 14 gauge corrugated steel pipe with rolled ends (ref. SPEC 12). The pipe shall be stood up on its end, directly atop the manhole roof. A 10" high frame shall be formed out atop the roof and around the base of the pipe at least 5' square, using 2" x 12" lumber. This pipe "foundation" shall be poured using either a 4.8-sack fly ash (preferred) or 7-sack standard concrete mix with a ¾" minus (a.k.a. "Meramec C-gravel") aggregate and a minimum 28-day strength of 4000 PSI. A similar 10" high "collar" shall be formed out and poured flush with the top of the corrugated steel pipe. It shall be reinforced with four #3 reinforcing steel bars overlapping on all sides and poured with the same concrete mix as the foundation at the base of the pipe. A 6" or 3" concrete ring section shall be stacked atop the pipe collar, and the frame and cover place directly atop the ring.

6.4.7 **Manhole Frame and Cover.** The Company specifies a cast iron frame and lid with a 36" opening to cover the entrance to the manhole (ref. SPEC 13). They are traffic-rated and combine for over 650 lbs., meeting or exceeding the American Association of State Highway and Transportation Officials (AASHTO) specification H-20. If finer grade adjustments need be made, a frame extension of either 1¾" or 2¼" can be used atop the frame prior to the lid being set.

6.5 Tying Ducts into Manholes and Manhole Bays

6.5.1 **End Wall Duct Configurations.** The far end walls of each manhole are 18" wide and contain "knockout" panels for purposes of tying in the conduits. Encasements of up to six conduits (in two columns and three rows) can be brought into the ends of a 4 x 10, while up to ten conduits (in two columns and five rows) can be brought into the ends of a 6 x 13 or 6 x 17. Under no circumstances shall a duct bank be brought into a manhole through either sidewall.

6.5.2 **Conduit Connection (Existing Manhole).** The Customer shall not install new conduits directly into a manhole that already contains energized Company-maintained cables, regardless of the manhole's location on or off Customer property, unless arrangements to that effect are made with the Company Representative. When the Drawings specify that Customer-installed conduits be brought into such a manhole, the Customer shall stop the conduit installation roughly 10' from the manhole, or at a location otherwise determined by the Company Representative. The Company shall pick up the installation at this point and tie it into the manhole.

6.5.3 **Using End Wall Knockouts.** After a knockout is removed, plywood backing shall be braced directly against the inside wall over the hole to ensure a concrete pour that is flush. The conduits shall be slid into the manhole with straight couplings attached to the ends, until they butt directly up against the plywood. No holes shall be drilled into the plywood for the conduits. The couplings shall be sealed first with duct plugs in order to prevent the poured encasement from entering the ducts. A hole shall be drilled into the plywood backing and the 4/0 bond wire pulled through it in a sufficient length to drape the tail onto the floor.

6.5.4 **Encasing End Wall Ducts.** When the duct encasement is poured, the concrete shall be run up full against the plywood backing to re-establish a contiguous end wall in the manhole. The plywood shall not be removed until the concrete has completely set up.

6.5.5 **Bays and Duct Configurations.** The four diagonal walls of each manhole (the "wing walls") also contain knockout panels, intended for tying in conduits from a direction other than that in which the manhole is lined up. Such a knockout is used for the construction of a bay – a "telescoping outgrowth" of the manhole wall in a direction that lines up with that of the incoming duct bank (ref. SPEC 14). Encasements of up to four conduits (in two columns and two rows) can be brought into a bay of a 4 x 10, while up to eight conduits (in two columns and four rows) can be brought into a bay of a 6 x 13 or 6 x 17.

6.5.6 **Need for Manhole Bays.** The need for the construction of a bay in a manhole shall be determined by the Company and indicated on the Drawings. Under no circumstances shall a duct bank be brought into a manhole through the wing wall without the construction of a bay. The bay is imperative for cable training purposes, even if the angle of the wing wall already lines up properly with the incoming conduits.

6.5.7 **Wing Wall Knockouts and Bay Formation.** After the wing wall knockout is removed, a plywood form in the shape of a truncated pyramid shall be constructed, the base of which is slightly larger than the knockout hole. This form shall be inserted through the knockout opening from inside the manhole and braced against the interior edge of the knockout opening. The truncated plywood surface "telescoping" out of the wall shall be large enough and at such an angle that the incoming conduits can all butt up directly against it.

6.5.8 **Extending Manhole Bay Ducts.** The incoming conduits shall be slid into the bay with straight couplings attached to the ends, until they butt directly up against the truncated plywood surface. No holes are to be drilled into the plywood for the conduits. The couplings shall be sealed first with duct plugs in order to prevent the poured encasement from entering the ducts. A hole shall be drilled into the plywood and the 4/0 bond wire pulled through it in a sufficient length to drape the tail through the bay and onto the floor.

6.5.9 **Encasing Manhole Bay Ducts.** When the duct encasement is poured, the concrete shall be run up against the entire outer plywood surface of the bay to re-establish a contiguous manhole structure. The plywood form shall not be removed until the concrete sets up completely.

7

Steel-Encased Conduit Installations

7.1 Application and Excavation

7.1.1 **Application.** Steel-encased conduit sections shall be called out on the Drawings in those cases where the Company anticipates the need for a perpetually maintenance-free installation of multiple ducts, whether due to future inaccessibility, inability to disturb grade, or the requirements of a third party.

7.1.2 **Excavation Options.** The steel casing may be either be laid in an open trench or augered in (i.e. "tunneled") from a pit on one side, as the jobsite conditions permit. This decision shall be left up to the Customer, as the Customer shall have the responsibility for the restoration of whatever grade is disturbed in the installation.

7.1.3 **Augering Pits.** In the case where the installation is to be augered in, the Customer shall excavate the pits as required at each end of the encasement, stockpiling the excavated soil for later use as fill, if possible. The overcutting of the earth for the casing itself shall be limited to 1" greater than the outer casing diameter.

7.1.4 **Company Use of Pits.** If the Company will be completing the adjacent conduit installation at either end of the steel casing, the Customer shall plug the conduit ends after the encasement is complete, thus keeping out precipitation and debris until the Company can begin work on that side. The Customer shall arrange for the Company to use the existing pit and associated shoring to marry up the adjacent duct bank with the encasement, after which the Company shall backfill the excavation.

7.1.5 **Open Trench.** In the case where any part of the encasement is to be laid in an open trench, the Customer shall remove any soft, unsuitable soil from the casing bearing surface and replace it with stable, compacted, unfrozen soil or rock. Stable soil can be reused and imported as long as it is free of any organic materials and gravel larger than 3".

7.2 The Steel Casing

7.2.1 **Duct Configurations.** The Company specifies cylindrical steel casing installations for configurations of both eight and ten ducts, which are grouted in for purposes of heat conduction (ref. SPEC 15 and 15A). The number of ducts required as well as the total length of the casing itself and its exact location shall be determined by the Company Representative and indicated on the Drawings.

7.2.2 **Casing Dimensions and Welds.** The steel casing shall be ½" thick steel and 30" in outside diameter (ref. SPEC 15 and 15A). The installation shall be a continuous 30" steel casing with welded joints as needed to achieve the total length required. The welds shall be entirely circumferential in order to provide a complete containment of the injected grout.

7.2.3 **Casing Standpipes.** A 4" female threaded flange shall be welded atop each end of the casing for the installation of standpipes. The standpipes (not to exceed 2' in length) allow for both the evacuation of air during grouting and the viewing of the grouting progress at the two ends.

7.2.4 **Casing Guide Rails.** Light steel angles (approximately ½" x ½") shall be welded along the inside of the casing over its entire length. These shall serve as guide rails, ensuring that the conduit spacers both remain upright and refrain from "spiraling" as they are rolled into the casing.

7.2.5 **Preparation for Conduits.** The steel casing shall be inspected for cracks, incomplete welds and other discontinuities before any conduit assembly is installed. The inside of the casing shall be cleaned of all debris and dirt in order to ensure a suitable bond between the steel and grout.

7.3 Conduit, Spacers and Bond Wire

7.3.1 **Conduit Spacers.** The conduit shall be 5" Schedule 40 PVC conduit in either 10' or 20' lengths (ref. Section 5.1.1). The conduits shall be assembled, installed and held in place by plywood spacers uniformly arranged no more than 10' apart. The spacers shall be round ¾" plywood with a 27½" outside diameter (ref. SPEC 15 and 15A). The spacers shall have casters installed for rolling the conduit assemblies into the casing from one end. The spacers will hold the conduits in place inside the casing while the grout is being poured.

7.3.2 **Conduit Banding.** Small groups of conduit shall be bound together hard against and on both sides of each spacer with heavy tape or steel banding in order to prevent movement of the spacers while the assembly is rolled in. Roughly 10' of conduit shall be left extending out each end of the casing in order to allow room for pouring concrete end blocks prior to grouting.

7.3.3 **Bond Wire Location.** In order to establish a continuous ground reference through the casing, a bare 4/0 AWG, tinned copper, 19-strand, soft-drawn conductor shall be secured with tape to the bottom center conduit along its entire length. Securing it to the conduit is important for holding it in place and preventing the ends from being sucked back into the casing as the grout is placed. A notch shall be cut into each plywood spacer in this location in order accommodate the conductor. Roughly 10' of conductor shall be left extending out each end of the casing for connection to the attaching duct bank's bond wire.

7.3.4 **Casing End Caps.** End caps of dry mix aggregate concrete shall be placed at the ends of the casing in order to provide caps before the grout is placed. The excess lengths of conduit shall extend though these concrete end caps.

7.4 The Grouting Process

7.4.1 **Grout Motility.** The grout that encases the ducts is required to conduct the heat dissipated by the power cables from the ducts to the steel casing and on into the ground. Any voids in the grout will insulate against this thermal conductivity and hence must be prevented. To this end, the grout shall be motile enough that all entrapped air moves to the top and ultimately out the standpipes.

7.4.2 **Constitution and Additives.** The grout shall be screened through ¼" hardware cloth to ensure that no aggregate is allowed in it. Setting retardant additives may be used in the grout to improve motility, but these shall be minimized in order to maintain the thermal conductivity of the grout after setting. Under no circumstances shall the use of calcium chloride or any other setting agent accepted.

7.4.3 **Outside Pouring Conditions.** The grout shall not be poured when the outdoor temperature is below 40° F or when freezing temperatures or lower are expected before final set. The grout shall be at or above 50° F when delivered and while being pumped. It shall be pumped continuously in order to prevent curing and the establishment of voids before the pour is completed. However, the grout shall be ordered one truckload at a time to ensure that fresh grout is always being poured.

7.4.4 **Standpipe Capping.** The 4” standpipe will allow the air to escape out of the casing while the grout is poured, and will also provide pressure as the grout rises in the standpipe. A 4” cap shall be available to cap the first of the two standpipes to fill up, while the second continues to bleed air.

8

Terminal Poles and Risers

8.1 **Customer Responsibility.** The Customer's responsibility at terminal (i.e. "riser") poles, regardless of voltage, includes installing the riser bend(s), extending the conduit(s) above grade, and backfilling the excavation. The Company will extend the conduit riser(s) up and attach to the pole. All secondary voltage riser cable (less than 600V) will be installed by the Customer, while all primary voltage riser cable (greater than 600V) will be installed by the Company. The Company will terminate riser cables overhead in all cases.

8.2 **Riser Bend Location.** The Company Representative shall determine the proper location of the riser bend(s) on the pole (i.e. the quadrant) and specify this location on the Drawings. In the case where a riser bend is to be extended by the Customer to a location requiring pole setting, replacement or alteration by the Company, the extension shall not be made until the pole work is completed, unless other arrangements are made with the Company Representative.

8.3 **Bend and Stub Specification.** The Customer shall take special care to extend the conduit(s) out of the ground at the particular pole quadrant designated on the Drawings. The conduit bend(s) brought up at the riser pole shall be rigid Schedule 40 PVC as specified in Section 4.3. Each bend shall be buried below grade in its entirety, with a short conduit stub (Schedule 80 PVC or equivalent) penetrating the surface to at least 6" above grade at the pole. The stub(s) coming out shall be squared and plumb in order to facilitate extending the riser(s) up the pole.

8.4 **Pole Clearance.** For direct buried conduit installations, the conduit(s) shall penetrate the grade with 6" of clearance between it and the pole (ref. SPEC 16). For concrete-encased conduit installations, the conduit shall penetrate the grade "hard against" the pole for the sake of extending the encasement to at least grade level (ref. SPEC 16A).

8.5 **Concrete-Encased Riser.** Conduit risers that are to be concrete-encased shall be encased using a fiber concrete-forming tube sized for the diameter of the conduit being installed (ref. SPEC 16A). The tube shall be cut lengthwise and tabs bent back for purposes of nailing to the pole and completing the form. Pole steps shall also be driven into the base of the pole (one on each side of riser) prior to cementing in order to hold the encasement against the pole.

8.6 **Concrete-Encased Riser Elevation.** For concrete-encased risers in non-traffic areas, the top of the encasement form shall be at least up to grade, with the Schedule 80 conduit stub (ref Section 7.2 above) extending 6" above grade. In possible traffic areas, the top of the encasement form shall be at least 18" above grade, with the conduit stubbed 6" above that (Schedule 80 is not required this case).

8.7 **Drainage Pit.** In those cases where the Company recognizes the potential for water drainage problems by virtue of a terminal pole's location, a drainage pit shall be installed at the base of the riser bend (ref. SPEC 17). Such problems can arise when the equipment to which the cable is to be connected sits at a lower elevation than that of the riser bend. Water entering the riser from above shall drain through a 30" long corrugated conduit section into a pit of 1" clean gravel directly below.

9 Equipment Pads

9.1 General Considerations

9.1.1 **Material Provisions.** The Company shall make available various fiberglass and precast concrete pads for equipment such as transformers, switchgear and cable junction enclosures in order to maintain uniformity and quality control of these items (ref. SPEC 18, 18A, 18B, 18C, 19, 20 and 21). Provided that arrangements are made in advance with the Company Representative, the Customer may pick up items such as these for a specific project (ref. Section 2.1.6).

9.1.2 **Customer-Poured Pads.** In lieu of utilizing a Company-provided concrete pad, the Customer may elect to pour his own pad (ref. SPEC 18). Customer-built pads shall be formed out and reinforced according to the layout and dimensions on the attached Specification Drawings (ref. SPEC 18A, 18B and 18C).

9.1.3 **Pad Location and Protection.** The location of all padmount equipment shall be indicated on the Drawings. For service and maintenance reasons, such equipment shall be truck-accessible and located as close as possible (up to a maximum 10' away) to a permanent surface intended for normal vehicular traffic, which the Customer shall provide if necessary. In those cases where normal vehicular traffic poses a potential threat to Company equipment, the Customer shall install protective bollards around it in the form of either concrete-encased railroad rails or concrete-filled 4" iron pipes (ref. SPEC 6). The quantities and locations of the bollards shall be indicated on the Drawings and shall adhere to the clearance requirements outlined on the attached Specification Drawings for each pad type.

9.1.4 **Pad Orientation.** Just as important as the pad's location is its orientation at that spot. The pad's orientation shall be specified on the Drawings, taking into account the clearances necessary to install, open and operate the equipment, as well as the approach of all associated conduits (ref. SPEC 22). The Customer shall note the pad's orientation and set it, as well as arrange the conduit bends, accordingly.

9.1.5 **Number and Spacing of Bends.** The conduit bends brought up through the openings in the pads shall be rigid Schedule 40 PVC (ref. Section 4.1). The Customer shall carefully arrange the conduits to penetrate the openings according to the spacing indicated on the Specification Drawings for the pad in question. The Customer shall also limit the number of conduits penetrating each opening to the maximum number shown and arrange them symmetrically within each opening to facilitate the training and termination of multiple cables.

9.1.6 **Bends through Existing Pads.** There will be situations in which the Customer is required to bring new conduits up and under existing pads that house energized Company equipment, such as transformers. In such cases, the Customer shall either make arrangements through the Company Representative or contact the Distribution Operating Department through the Call Center (ref. the *Ameren Missouri Electric Service Manual*) to have the equipment opened, de-energized and/or covered.

9.1.7 **Concrete Pad Backfilling.** All concrete pads shall be installed level and at grade, with the earth beneath tamped to 90%. Backfilling with ¼" limestone screenings underneath concrete pads is highly recommended to stabilize the earth beneath them and prevent settling.

9.1.8 **Concrete Pad Settlement.** Settlement of padmount equipment and other structures is an indication of improper compaction. All charges associated with correcting such adverse

conditions shall be re responsibility of the Customer. Once the Company installs its equipment on the pad, the Company may not allow the Customer to correct any deficiencies directly. In such a case, and at the Company's discretion, the Company shall correct the deficiency and pass its charges on to the Customer.

9.2 Fiberglass Pad Installations

9.2.1 **Fiberglass Pad Elevations.** Fiberglass pads shall be installed in excavations that will allow their load-bearing surfaces at the top to sit at 6" above final grade for switchgear (ref. SPEC 25) and 4" above final grade for cable junction enclosures (ref. SPEC 21). The area of the excavation that bears the pad shall be tamped and then leveled with a carpenter's level.

9.2.2 **Ground Rod Sleeves.** Prior to backfilling a fiberglass switchgear pad, four 1" or 2" diameter PVC sleeves shall be installed vertically at each of the four inside corners of the pad in order to facilitate the Company's being able to drive 8' ground rods through them later, when the switchgear is set. The sleeves shall be 4' in length, installed 6" off the inside of each corner, and penetrate 6" above the final grade inside the pad. To this end, the fiberglass pad shall be situated in its final location over the conduit bends before the sleeves are driven.

9.2.3 **Fiberglass Pad Backfilling.** Fiberglass pads shall be stabilized in order to prevent them from shifting during backfilling. Backfilling shall begin with either flowable fill or a tamped layer of ¼" limestone screenings both inside and outside the pad, up to the appropriate level indicated on the Specification Drawings for the pad in question. Acceptable flowable fill is a 2-sack standard concrete mix. Provided the pad is not situated in a paved area, the rest of the exterior shall be backfilled with loose material and foot-tamped. The area around the fiberglass shall not be backfilled with large chunks of material or rocks, nor shall there be excessive tamping close to the sides of the pad, as its sides will tend to bow inward.

9.2.4 **Concrete-Encased Bends.** When the conduits coming up through the fiberglass pad are to be concrete encased, the concrete used in the conduit encasement shall not, under any circumstances, be substituted for the flowable fill or ¼" limestone screenings used in backfilling the inside of the pad. However, if flowable fill is used in backfilling the inside of the pad, it can be used for both the backfill and the encasement of the bends coming up through the pad opening.

9.2.5 **Conduit Bend Height.** The conduit bends shall be cut off below the fiberglass pad's load-bearing mounting flange by the length indicated for the pad and conduit size in question (ref. SPEC 20 and 21) in order to make room for cable training and terminations.

10

Cable and Services

10.1 **Primary Voltage Cables.** All primary voltage (greater than 600V) cable will be provided, installed, owned, and maintained by the Company in the Conduit System that is installed by the Customer. The only exception to this would be where primary cable is installed downstream of a primary meter, in which case the Customer would be responsible for installing, owning and maintaining it.

10.2 **Secondary Cable Ownership.** All secondary voltage (less than 600V) distribution cable serving more than one customer or building tenant shall be specified by the Company representative on the Drawings. It shall be provided and installed in the Conduit System by the Customer, and the Company will assume ownership of and maintain the cable after it is energized, provided it meets the specifications outlined in Section 10.3. In the case where the Customer elects to install a secondary cable that does not meet these specifications, the Customer shall assume ownership and maintenance responsibilities for it after it is energized. Such a cable shall be tagged as "customer owned" at both ends.

10.3 **Secondary Cable Specifications.** Secondary cables for which the Company will assume ownership and maintenance responsibilities after energization shall be restricted to 600V type XLPE USE, XHHW, THW and THHN/THWN insulation as listed below:

2-3/0 x 1-1/0 Aluminum or 3-3/0 x 1-1/0 Aluminum
2-350 x 1-4/0 Aluminum or 3-350 x 1-4/0 Aluminum
2-500 x 1-4/0 Copper or 3-500 x 1-4/0 Copper

Any cable exposed to sunlight at the top of a pole shall be ultraviolet (UV) resistant. All new USE cable meets this requirement. All the other acceptable insulation types above must have black-colored insulation to qualify for UV resistance.

10.4 **Single Tenant Services.** The service cable to a single tenant building or to a single tenant in a multi-tenant building shall be installed, owned and maintained by the Customer from the meter out to the transformer or other Point of Delivery designated by the Company.

10.5 **Transformer Secondary Cables.** When the Company's designated Point of Delivery is a transformer, the Customer shall install the cables only after the Company has installed the transformer. It shall be the Customer's responsibility to mark the cables he installs and make them ready for termination.

10.6 **Pre-Bussed Tap Boxes.** Among the options for a distribution point in multi-tenant buildings is a sealable, pre-bussed tap box, typically mounted on the outside building wall. The box shall be equipped with adequate cable bending and cable termination space, and lugs that accommodate 500 MCM incoming cable sizes. Combination or ganged meter centers are also a satisfactory alternative to pre-bussed tap boxes. The *Ameren Missouri Electric Service Manual* can be consulted for more details.

11 Inspection and Approval

11.1 **Deviation from Drawings.** All Customer-installed facilities shall be installed per Company Drawings. Any proposed field changes to the Conduit System layout as indicated on the Drawings shall have prior approval from the Company Representative.

11.2 **Interpretation of Specification and Drawings.** Where an interpretation of this Specification or clarification of the intent of any Drawing is required, the determination of the Company Representative shall prevail.

11.3 **Conduit System Inspections.** Conduit System installations by the Customer shall be subject to inspections by the Company on a daily basis prior to backfilling, embedding in concrete, or otherwise covering or concealing. The Customer shall notify the Company Representative with at least one full working day's advance notice before the start of Conduit System construction or the installation of material, thus allowing for the inspection of materials and workmanship by the Company. The decision to actually inspect or not shall be at the discretion of the Company.

11.4 **Conduit System Rejection.** Any Customer materials and/or workmanship failing to meet the requirements of this Specification, or Conduit System installations either performed without prior notice to the Company Representative or that fails to allow the Company to readily pull in its primary cable(s), shall be subject to rejection. Any work that is rejected shall be corrected to the Company's satisfaction at the Customer's expense.

11.5 **"As Built" Drawings.** The Company Representative shall maintain an "as built" set of Drawings showing all changes, additions and deletions to the project. Field changes not covered by the original Drawings shall be clearly noted on the "as built" Drawings.

11.6 **Depth of Cover Deviations.** When the depth of cover of the Customer's installation exceeds the design value by 50% or more, or is less than the design value by any margin, the Customer shall provide the Company Representative with the actual depth, which shall then be noted on the "as built" Drawings.

APPENDIX - Underground Specification Drawings

Drawing Number	Drawing Description
SPEC 1	Underground Lines Construction – Joint Trench Minimum Clearances (NESC)
SPEC 2	Conduit Structures – Underground Bend Restraint
SPEC 3	Underground Structures – 2’ x 4’ x 2’ Deep Polyethylene Splice Box
SPEC 4	Underground Structures – 3’ x 5’ x 42” Deep Precast Concrete Vault
SPEC 4A	Underground Structures – 3’ x 5’ x 42” Deep Polyethylene Vault
SPEC 5	Underground Structures – 4’ x 8’ x 4’ Deep Precast Concrete Vault
SPEC 6	Conduit Structures – Standard Duct Construction
SPEC 7	Manholes Structures - 3 Way Precast 10’6” x 14’0”
SPEC 8	Manholes Structures – 6’0” x 17’6” Straight Precast Manhole
SPEC 9	Manholes Structures – 4’0” x 10’0” Straight Precast Manhole
SPEC 10	Manholes Structures – 6’0” x 13’0” Straight Precast Manhole
SPEC 11	Manhole Structure Accessories – Precast Concrete Ring Sections
SPEC 12	Manhole Structure Accessories – Manhole Necks
SPEC 13	Manhole Structure Accessories – 36” Manhole Frame and Cover
SPEC 14	Manhole Structure Accessories – Standard Bay Construction (Wing Wall)
SPEC 15	Conduit Structures – Conduit Spacer for 30” Steel Casing (8-Duct Configuration)
SPEC 15A	Conduit Structures – Conduit Spacer for 30” Steel Casing (10-Duct Configuration)
SPEC 16	Cable Terminals – One or More Risers on Standoffs
SPEC 16A	Cable Terminals – One Riser for Cable in Concrete-Encased Conduit
SPEC 17	Conduit Structures – Conduit Drainage Pit
SPEC 18	Pad Structures – Padmount Transformer and Cable Enclosure Material Spec
SPEC 18A	Pad Structures – Single Phase Padmount Transformers (25 kVA to 167 kVA)
SPEC 18B	Pad Structures – Three Phase Padmount Transformers (75 kVA to 750 kVA)
SPEC 18C	Pad Structures – Three Phase Padmount Transformers (1000 kVA to 2500 kVA)
SPEC 18D	Three Phase Padmount Transformers - 1500 - 3000kVA, 34.5kV (Poured-in-Place)
SPEC 19	Pad Structures – Three Phase Secondary/Service Cabinet
SPEC 21	Pad Structures – 3-Way & 4-Way Three Phase Primary Cable Enclosure
SPEC 22	Underground Lines Construction – Required Clearances for Padmount Equipment
SPEC 23	Underground Lines Instruction - Customer Installed Pad Installations, Protective Barrier Rail Installation
SPEC 25	Underground Equipment - Switching - Padmounted Primary Switchgear, Composite Pad
SPEC 26	Equipment - Switching - Padmounted - 3 Phase, 35kV, Vacuum Type