ORDINANCE 2022-57
AN ORDINANCE AMENDING THE UNDERGROUND
POWER CONSTRUCTION STANDARDS AND SPECIFICATIONS

WHEREAS, the Washington City Council adopted the Underground Power Construction Standards and Specifications, (December 2015 Revision); and

WHEREAS, Washington City desires to amend the Underground Power Construction Standards and Specifications within the city; and

WHEREAS, The Underground Standards for the Power Department have been completely revised and updated; and

WHEREAS, These standards are used by the department as well as the Pre-qualified Contractors that developers hire for the initial system installation to help assure our distribution system is as safe and reliable as possible.

BE IT ORDAINED BY THE CITY COUNCIL OF WASHINGTON CITY, UTAH

I. The Washington City Power Underground Construction Standards October 2022 is hereby approved and adopted by Washington City.
II. Miscellaneous.
    a. If any provision or clause of this Ordinance or the application thereof to any person or entity or circumstance is held to be unconstitutional or otherwise invalid by any court of competent jurisdiction, such invalidity shall not affect any other section, provision, clause or application hereof, and to this end the provisions and clauses of this Ordinance are to be severable.
    b. This Ordinance supersedes or repeals the provision(s) of any ordinance(s) or resolution(s); that is (are) inconsistent with the provisions of this Ordinance.
    c. This Ordinance shall take effect immediately upon publication or posting, as required by law.

PASSED AND ORDERED POSTED on this 26th day of October, 2022.

Washington City

Kress Staheli, Mayor

Attest by:

Tara Pentz, City Recorder

Washington City
Feels Like Home

Washington City Power
Underground Construction Standards

OCTOBER 2022

TABLE OF CONTENTS

1.0 - General Preface

1.1 Purpose

The Washington City Power Department has prepared and approved this set of standards and specifications for the purpose of maintaining a safe, consistent, and reliable underground power distribution system. These standards are required to be used by anyone who is involved with design or installation of underground power distribution systems within Washington City limits.

We recognize that you may require personal assistance from our staff, and we encourage you to contact us by calling Washington City Power to discuss the electric distribution system and service requirements with us. It is the desire of Washington City Power and the City's building department to provide you, the customer (developers, contractors, owners, etc.), with safe, reliable electric service. In order to avoid unnecessary repetition, the "Power Department" as used in the following pages shall mean Washington City Power Department (WCP).

The requirements are intended to apply to new developments. As a general rule, if the matter in question is not presented herein, then it is not allowed unless approved by the Power Department. Any power required for private use (i.e. light, sprinklers, etc.) shall be metered.

1.2 Codes and Ordinances

It is necessary that the construction of new or remodeled installations conform to applicable provisions of the Nation Electrical Code (NEC), National Electrical Safety Code (NESC), and State of Utah Electrical Service Regulations, as well as City and County ordinances and codes. This includes OSHA rules both during construction and maintenance.

1.3 Changes or Conflicts In Requirements and Guidelines

Some of the information in this section is based on the aforementioned governmental codes and ordinances as well as Washington City Power (WCP) specific requirements as stated herein. These requirements and guidelines are issued with the intent of complying with all applicable codes, ordinances, regulations and tariffs; however, in the case of conflict, the appropriate regulation, tariff, code, or ordinance will supersede the interpretation offered in this manual. In addition, these requirements are subject to change in the event that the governing codes, ordinances, regulations, or tariffs are changed. The Power Department should be consulted in case of doubt on the applicability of any item.

In the event these standards and specifications are revised or changed, proper notice will be given to anyone that the revisions or changes may affect A determined phase-out period or arrangement will be made for anyone who may have warehouse/pre-purchased equipment that becomes obsolete due to the revision or change.

Exceptions to this standard and its contents can only be made after review by the Power Department Director. Any exceptions will be on a case-by-case basis and will not affect the overall intent of these standards as they are written.

1.4 General Requirements

The purpose of this standard is to give a general overview of the most important rules set forth by the Washington City Power Department (WCP). This standard is only meant to give developers, contractors, and individuals basic guidelines; further reading in this manual will be required to obtain the information needed. These standards and specifications will be used as a reference for all underground power distribution system inspections, which are required as part of the Washington City Policy – “Installation of High Voltage Equipment”. During underground power distribution installation, a Power Department Inspector will approve all conduit installation, trench backfilling, wire installation pulling, and terminations. Installations that do not meet these standards will not be accepted until the differences are corrected.

1.5 Fees

Power Impact Fee Table Impact Fee Table 2021

Other Fees
Connection and Other fees will be accessed based on current City policy and schedules.

2.0 Application and Design Standards and Processes

2.1 Application for Service

It is important that the Power Department office be provided as early as possible with accurate load information and the date when the customer will require service, so all necessary arrangements for the service may be completed. Developer is responsible for procurement and installation of all equipment and materials required for a complete distribution system installation. **The City's stock of maintenance materials is not available for developer installations.** The Power Department is available to provide advice on service requirements and related problems relative to electric energy utilization for new, existing, and reconstructed installations. The Developer will be held liable for any damage to Power Department equipment. When conditions are encountered during construction that require changes in the initial agreed upon system layout and service arrangements, the Power Department must be consulted so mutually satisfactory alternative arrangements can be made. Adequate notice must be given to the Power Department and approval granted regarding changes or additions.

2.2 Types of Service Available

The electric service available is 60 hertz (cycles), alternating current, single or three-phase. The secondary voltages and connections available are given below:

A. Underground Service Secondary Voltages
    - Single-phase, 120/240 volt, three-wire, grounded
    - Three-phase, 208Y/120 volt, four-wire, grounded, wye
    - Three-phase, 480Y/277 volt, four-wire, grounded, wye

2.3 Approval or Service

It is required that an residential/commercial electrical installation be approved by the electrical authority having jurisdiction (WASHINGTON CITY BUILDING DEPARTMENT) as stated herein, before it can be energized by the Power Department. The service will be energized by the Power Department only after all service requirements and inspections have been met.

2.4 Permanent Service Connection

Only authorized Power Department employees shall make the permanent (or temporary) connection or disconnection of the Power Department's electrical service to a building, structure or subdivision interconnections.

2.5 Work Activity Near High Voltage Overhead Power Lines

No person or thing may be brought within 10 feet of any high voltage overhead line unless: The responsible party has notified the Power Department or Utility operating the high voltage line of the intended activity; and the responsible party and the Power Department or utility have completed mutually satisfactory safety precautions for the activity; and the responsible party has made prior arrangements to pay the Power Department or Utility for the mutually satisfactory safety precautions (if applicable). The Power Department recommends a minimum of 3 business days notice to be given before any work near its lines is scheduled to begin. Actual time required will be determined by WCP on a case by case basis.

2.6 Requirements of Subdivision and Commercial Areas

The intent of this policy is to set forth the Developer's installation requirements and to outline specific installation standards. Along with requirements indicated in this section applicable requirements as indicated in other sections of this document apply to commercial and residential developments.

Where a development within the service area of the City is to be subdivided into residential or commercial lots and has been approved by the appropriate Planning and Zoning Boards, the electrical distribution system will be installed underground in accordance with the City's connection fee and line extension policy. The subdivision Developer shall provide the City with the easements necessary for the most efficient installation of the required distribution system. All electrical systems installed by the Developer shall be front lot construction unless otherwise approved by the Power Department.

The following sections serve as a guide for specific requirements of commercial and residential developments; however, the developer is responsible for coordinating with the Power Department to ensure that the intents of this policy are met.

2.7 Staff and Developer Meeting

For those who desire to rezone and/or develop property, the City holds a Staff and Development Review Meeting on each Wednesday morning (excluding Holidays). The meetings begin at 8:30am and time for discussion and review is scheduled in 1/2 hour increments, with the last scheduled time being at 11:00am (with an ending time at 11:30am). Staff representing the Community Development Department (both Planning & Zoning and Building Divisions), Public Works Department (streets, sewer, water and stormwater), Power Department (for reviews in the Washington City service area) and Fire Department will participate at the meetings (unless they are called out for emergencies or other pressing business). The meetings are informal and time may be scheduled to get feedback from staff on a proposal, to review a concept plan, or to make sure all application materials are in order prior to formal submission of an application. The deadline for being placed on the agenda is 11:00am each Tuesday. Please call (435) 656-6325, the Planning and Zoning Division, to be placed on the next available agenda.

2.8 Application

For commercial, industrial, residential subdivisions, mobile home parks and apartment complex applications, the request for service shall include a plot plan indicating desired service type and size. (i.e: panel size, voltage, landing, location, etc.) Commercial or industrial plot plans should show preferred service and meter locations and a single-line diagram of the overall electrical system. The request must show all load information; for commercial developments load information should include lighting, receptacle, water heating, cooking, electrical heat, air conditioning, and motor loads, plus sufficient information on equipment operations to allow the kilowatt demand of the load to be estimated. The Power Department shall review the drawings and return the drawing set marked **"approved"** or **"unapproved"** with an indication of the required changes.

2.9 Contractor Training

Only pre-approved contractors shall perform work on the City's system. Any contractors or employee's working in the (WCP) service area shall be trained in Washington City Power (WCP) Underground Standards and policy before being approved to work power cables and equipment. Card holding supervisors shall be onsite for all work by non carded employees. A $100.00 fee per person shall be required before attending a training class. Annual training shall include:

A. Class instruction on underground standards
B. Instruction on underground termination tools and methods
C. Instruction on proper equipment installation
D. A written underground standards test
E. A practical test on underground terminations

Upon completion of the course, individuals shall receive a workers compliance card allowing them to conduct approved work in the Washington City Power area. **Cards will have a two (2) year expiration date. During that two year period the contractor must complete two (2) jobs in the (WCP) area to keep their card current.** At time of expiration, card holders will need to participate in a Underground Standards and Policy update course for card renewal. Card holders not working in the (WCP) area for extended periods of time may have their cards added to the suspended list. All suspended cards will have to go through the recertification process including the fee. Washington City Power shall have all authority to adjust requirements as determined by the Power Director an or City Council.

2.10 Contractor Warranty

All electrical work installed by contractors within the City of Washington's power area shall have **one (1) year** contractor warranty submitted to the power department upon approval of final construction.

*Before final approval, **all contractors** shall supply all invoices and other documentation regarding power equipment, street lights and other power fixtures installed during construction*

in the Washington City Power area so proper warranty dates can be recorded. Documentation of all primary cable pulls shall also be provided. This shall include pulled cable tension and date of installation, wire size, and length of pull. Contractor cable tension form and contractor equipment form can be accessed at https://washingtoncity.org/services/power under the documents tab - ***Contractor Cable/Tension Form*** ***and*** ***Contractor Equipment Form****.*

2.11 Easements Required

Before any power system design approval, the property owner and/or developer will be required to grant Washington City the proper easements and right-of-way. These will be shown on the as builds when submitted.

The standard requirements are as follows:

- Residential
    - 10’ on the front of each lot or parcel
    - If required, 7.5’ on the side and back of each lot or parcel
- Multi Building or Condominium
    - 10’ around the perimeter of each phase of the project
- Commercial
    - 15’ on the front of each lot or parcel
    - 7.5’ on the side of each lot or parcel
    - And where required for utility installation

Note: Additional easements may be required based on specific project and location needs

2.12 Common Areas

The equipment (i.e: transformers, vaults and switches) will be placed along access roads as per standards. If placement along access roads cannot be accomplished as determined by Washington City Power, equipment will be placed with at least 10 feet of clearance from any permanent structure, fencing or obstruction to allow for proper operation and maintenance of the equipment.

All power equipment will be designed and installed as per the location drawings contained in these specifications and standards in order to assure equipment falls within the established right of way and easement and to maintain consistency of equipment placement throughout the City.

3.0 Distribution System Installation Standards

3.1 Trenching

A. Call Before You Dig

Utah Law Section 54-8A-1 through 54-8A-11 requires the Blue Stakes One Call Location Center be notified at least two working days prior to excavation. The excavation must not be started until locations have been made. Blue Stakes One Call Location Center can be contacted by calling either 811 or 1-800-662-4111 or scheduled on line at https://www.bluestakes.org/requests/

B. Trenching

The developer is to provide the trench for all required conduit systems and, following installation of the conduit by the developer, backfill to meet Power Department requirements. All electrical contractors shall be certified by the Power Department (WCP) to install conduit, cable and equipment in the Washington City Power area. Final grade is to be established prior to the installation of the power system unless approved by the Power Department.

C. As Builts

As-built drawings will be submitted for review 48 hours before final inspection. Electronic submission of plans in PDF format is prefered. Prior to energizing any new construction, the corrected electronic as-built drawings shall be submitted to the City. These as builts shall include equipment location, GPS coordinates of equipment, lighting fixtures, Utility easements and other items as required by the Power Department (WCP).

D. Depth

The property owner is responsible at their own cost to ensure that proper burial depth clearance listed below is maintained even after excavation of the property. Any questions on impaired burial depths should be immediately brought to the attention of the Power Department. Under certain conditions, with prior Power Department approval, cable/conduit systems may be buried with less cover provided that mechanical protection is installed by the Developer to the Power Departments specifications.

Conduit Depth - Table 1

	INSTALLED UNDER PAVED SURFACE		ALL OTHER LOCATIONS	
	Direct Buried Conduit	Concrete Encased 3" Top ,Sides and bottom	Direct Buried Conduit	Concrete Encased 8" top 6"sides
SCH 40 PVC Conduit With Secondary Cables	**36 Inches**	See Note*	36 Inches	See Note*
SCH 40 PVC With Primary Cables	**48 Inches**	See Note*	48 Inches	See Note*

*Note: If, in a particular installation, burial depths less than those permitted by the table above are not possible, reduced burial depths must be approved by the City Power Department.

1. **Secondary cable shall be buried 36" to the top of the conduit**
2. **Primary cable shall be buried 48" to the top of the conduit**

All backfilling and compaction of power trenches shall comply with this section:

3. **Concrete-Encased Plastic Conduit**
   i. For approved conduit locations that are unable to make required depths A ¾" minus 2500 PSI mix as per ASTM C94 specifications. In all cases, a Type 2 modified or Type 5 cement will be used. It should be wet enough to flow easily into the spaces around conduits but not so fluid as to float the conduits. Concrete shall be spaded or vibrated to ensure that the spaces around the conduits are filled. The material used to backfill trenches containing concrete-encased steel or plastic conduits shall be spoil from the trench unless specific backfill requirements exist.
   ii. **Drying Time for Concrete Before Backfilling**
   Backfill shall not be placed in trenches containing concrete-encased conduits until the concrete has been allowed to set up for at least 24 hours.

Minimum allowable burial depths for direct buried and concrete-encased conduits are shown in conduit Table 1 above.
Concrete encased Conduit CO130 Conduit Spacers

E. Trenches

Width - All trenches meet OSHA requirements. Primary/secondary combined trenches shall be a minimum of 18 inches wide at the bottom. Trenches 12 inches wide will be approved for single service only.

F. Backfill

Trench Detail - Conduit Installation Details (CO101, CO105, CO120, CO125)
The developer will be responsible for backfilling trenches they provide. When conduits are direct buried or concrete encased, the bottom of the trench into which the conduits are placed shall be free from rocks exceeding 1 inch in their largest dimension. When the trench bottom contains rocks exceeding this size requirement, the trench shall be excavated 6 inches deeper than the burial depth required for the conduits and then backfilled with 10 inches of sand to be placed on top of conduits. Where the trenches cross the structural fill, typical of road crossings, the trench backfill shall consist of like kind structural fill.

G. Compaction

All trenches shall be compacted during the conduit installation process. All primary trenches and all road crossing trenches (including secondary) shall be compacted to 95% compaction and tested of the maximum dry density as determined by ASHTO T-99 (standard). Place and compact backfill and fill materials in layers of 8 inch maximum lifts. Thinner lifts may be required depending on materials and compaction effort.
Before compaction, moisten and aerate each layer as necessary to provide optimum moisture content. Compact each layer to the required percentage of maximum dry density or relative dry density for each area classification specified below. Do not place backfill or fill material on surfaces that are muddy, frozen or contain frost or ice. All primary and secondary conduit systems shall have placement of red warning tape 12

inches below final grade. The tape shall be of the type specific for the application. Place backfill and fill materials evenly adjacent to structures, piping and equipment to required elevations. Prevent displacement of raceways and equipment by carrying material uniformly around them to approximately the same elevation in each lift (8").

H. Areas Under Structure, Building Slabs, Walks and Steps, Pavements, Power Equipment, Driveways

Scarify and compact top 8 inches of subgrade and each layer of backfill or fill material to **95 percent maximum** density for friction-cohesive material.

I. Other Areas

Scarify and compact top 6 inches of subgrade and each layer of backfill or fill material to 90 percent maximum density for friction-cohesive soils. The Contractor is responsible for the ultimate success of the compaction effort and overall project quality control.

J. Subsidence

Where subsidence occurs at electrical installation excavations during the period 12 months after the project completion, the contractor must remove the surface treatment (i.e: pavement, lawn or other finish), add backfill material, compact to specified conditions, and replace surface treatment. Restore appearance, quality, and condition of the surface or finish to match adjacent areas.

K. Joint Use Trenches

Typically, joint use between other utilities of power department trenches is not allowed unless approved by the Power Department (WCP). Any joint use between telephone, TV, and other electrical communication cables must be pre-approved by the Power Department and installed in accordance with the Power Department specifications. The Power Department normally will not install electrical cables in a common trench with non-electric utilities such as water, gas, and sewer, unless unusual conditions such as adverse soil or route restrictions exist. All such installations require the prior approval of the Power Department

Joint Use Clearances **CO140 Conduit Installation - Typical Joint Use Trench**

Clearance to Other Underground Utilities

1. **Water: 5ft. horizontal, 2ft. vertical at crossings**
2. **Sewer: 5ft. horizontal, 2ft. vertical at crossings**
3. **Natural Gas: 10ft. horizontal, 1ft. Above or below where crossing**
4. **Cable TV: 1ft. horizontal, 6in. vertical above secondary**
5. **Phone: 1ft. Horizontal, 6in. vertical above secondary**

L. Shoring, Laying Back, Soil Placement and Retention

When employees must enter a trench to install conduits, the trench shall be shored or laid back and the spoil shall be effectively retained and placed back from the edges of the trench as required by local, state and national codes or ordinances to ensure that the employees are not subject to moving around or cave-ins.

3.2 Conduit Installation

A. Conduit Installation

1. Drawings

i. **CO200 Conduit Placement - Secondary Junction Box**

ii. **CO220 Single Phase Conduit and Pad Placement**

iii. **CO210 Conduit Placement - Primary Vault**

The Developer shall be responsible for cleaning conduits prior to installation of cables. ***Along with conduits extending to secondary junction boxes, each transformer pad shall have ten (10) foot conduit stub outs for interconnection to adjacent homes.*** This shall be prior to backfilling, the Developer must notify the Power Department for an inspection, following the inspection the Power Department shall issue a notice to proceed, allowing backfilling.

2. Grading of Conduits

When conduits are installed between basements, they shall be graded to drain towards the basements. The minimum slope necessary to accomplish this is 3 inches per 100 feet of conduit. Conduits shall be properly constructed having smooth walls and adequate size as determined by the overall cable diameter and recommended percentage of fill of conduit area.

3. Conduit Sizes

The Power Department requires the use of conduit for all underground primary and secondary cable installations, including lighting circuits. Rigid galvanized steel, IMC and gray electrical grade PVC schedule 40 (underground only) and approved aluminum and fiberglass conduit are acceptable materials for conduits installed by the developer.

i. All 90-degree bends shall be long sweeps for all conduit sizes.
   a. Fiberglass sweeps shall be 36” minimum radius with PVC schedule 40 coupler ends molded into the sweep to ensure proper seal of the conduit system.
   b. To reduce damage to PVC elbows, a wire rope shall be used to pull the cable through the conduit.
   c. Ninety degree (90°) upward bends will not be used for 600 AMP equipment ground sleeves. The straight conduit will run directly into the 600 AMP ground sleeve with no upward bend. The cable will be pulled into the ground sleeve and trained up to the equipment connections.

ii. 2” PVC with 24” radius 90-degree bends area allowed at residences of 200 AMP services or less. (120/240V)

iii. *All conduits shall be terminated at the open end with plastic bushings to prevent debris for plugging the conduit.*

iv. Heated bends for small angles are allowed, however heated bends shall have no deformation, burn marks or tanning of the conduit. Ovaling, tanning or other deformation of the conduit will not be allowed.

v. Service conduit shall include a 90-degree elbow fitting at the meter and a 45-degree elbow fitting at the secondary box or transformer.

vi. All 90-degree bends are to be long sweeps for all conduit sizes.

vii. All primary and secondary elbows are to be PVC for 2”, 3”, 4” and 6” conduits, steel elbows or fiberglass for 6” conduit for riser poles.

viii. Primary conduit sizes must be three (3) inches. Secondary conduit size shall be 2” for 4/0 runs and 3” for larger runs from transformers to secondary junction domes and 2” inches from transformer or dome or transformer to resident. 400 AMP residential service requires 3’ conduit.

ix. A 36” radius schedule 40 PVC, Rigid or IMC at residence and 36” radius schedule 40 PVC at dome or transformer is allowed.

x. All empty conduit shall have mule tape installed for future use.

xi. All underground metallic conduit must be tape wrapped with suitable tape for the application.

xii. All spare conduit shall have mule tape supplied and installed prior to approval.

xiii. All Primary 3-phase applications shall have 4 conduits installed per sizing Table 2. Three (3) conduits for the circuit conductors and one (1) conduit for the spare.

Table 2 lists recommended conduit sizes for the conductors shown. For applications other than those shown, contact the City Power Department.

TABLE 2
CONDUIT SIZES FOR SECONDARY CABLES
600V CABLE

Plastic Conduit				
Conductor Size	Number of Cables in Conduit			
AWG or MCM	1 Cable	2 Cables	3 Cables	4 Cables
#1/0	3"	3"	3"	3"
#4/0	3”	3”	3"	3"
350	3”	3"	3"	3"
500	3”	3"	3"	4"
750	3"	4”	6"	6"

CONDUIT SIZES FOR SECONDARY TRIPLEX MINIMUM SIZES NOTED

Conductor Size	
AWG or MCM	1 Cable*
#1/0	2"
#4/0	2"
350	3"
500	3"
750	3"

4. Conduit Spacers

When two or mCO130 Conduit Spacersore conduits are encased in concrete, base and intermediate spacers shall be used to maintain conduit spacing during installation of the concrete envelope. When five or more conduits are direct buried, base and intermediate spacers shall be installed to maintain conduit spacing during backfill operation. Conduit spacers shall provide a minimum edge

to edge separation between conduits of 3 inches.
CO130 Conduit Installation - Concrete Encased

5. **Conduit Repair**
   If after installation a conduit is damaged due to construction or excavation, a full stock length (usually 10 foot segments) will be used to repair damaged sections. Repair collars will not be allowed.

B. Riser Pole Conduit

1. All 3 phase risers shall be constructed from approved fiberglass or aluminum conduit unless approved by the power department (WCP).
2. Conduits for single phase riser poles shall be rigid steel or approved fiberglass conduit.
3. If fiberglass conduit is used for riser installation, the riser elbow shall also be fiberglass.
4. Risers shall be constructed up the pole 10', the remainder of the riser shall be built by (WCP) qualified personnel. Contractor to provide all materials needed to complete the riser installation.
5. Riser conduits shall continue up the pole from the elbow to within the last 10 feet of rise.
6. The riser pole conduit shall be straight and supported with an unistrut system. Any crooked or misaligned conduits will not be accepted.
7. 750 AL 3-phase risers feeding switches from an overhead line shall have bridge switches supplied by the contractor and installed on the overhead side of the connection.
   i. WCP Bridge Switch model number: Siemens LER294PY (SWT-00300) or approved equivalent.
8. All steel conduit below grade shall be plastic coated or wrapped with a 10 mils moisture barrier tape.
9. Rigid riser conduits shall be bonded to the pole ground in accordance to **RP100** and **RP300**
10. A ground rod shall be installed on all riser poles for the purpose of grounding.
    i. Fiberglass risers do no require grounding
11. Material (conduit, standoff brackets, etc.) for a completed installation to be provided by the developer.
    Drawings
    RP100 Typical Single Phase Conduit Riser
    RP300 Typical Three Phase Conduit Riser

C. Directional Boring (HDD)

Before a directional bore is attempted to install a power conduit, the contractor(s) doing the bore must contact the Power Department to conduct an on-site job briefing to discuss the work to be performed. Upon approval from the Power Department, contractor(s) may be permitted to bore in underground electrical conduit when digging in a conduit is not feasible, or if property damage is a concern. A bore pit must be dug at the beginning and at the end of a bore, to the correct depth depending on the voltage to be installed.

The conduit must either be gray in color or black with a red stripe and must maintain a minimum depth for the length of the run; after conduit is installed, a rigid wrapped metal or fiberglass sweep elbow must be installed on both ends of the conduit. ***The contractor(s) must write down the depth of the bore every fifteen (15) feet. If this can not be accomplished, a tracer wire must be installed to verify depth prior to the Power Department accepting the power conduit.***
NOTE: After fusing the HDPE conduit, the bead created from the fusion process must be reamed and removed from the inside of the HDPE conduit for a non-obstructed path before conductors can be installed.

i. *Minimum Depth: Primary 6', Secondary 3'*
ii. *Approved Coupling: Shur-lock II or equivalent*
iii. *Conduit: HDPE 11. Must be gray in color or black with red stripe*

3.3 Cable Installation

This standard outlines installation details for primary and secondary cables used in underground distribution.

A. Burial Depth
All cable installation shall comply with Section 3.1 of this standard. ***Direct buried cables will not be accepted by the City, all cable shall be installed in approved sized conduit.***

B. Secondary Conductor Loading Guidelines
Cable Loading - 600V

Aluminum or Copper-Clad Aluminum			
Table 3 **Allowable ampacities of insulated conductors rated up to and including 2000 volts, 60℃ through 90℃ (140℉ through 194℉), not more than three current-carrying conductors in raceway, cable, or earth (directly buried), based on ambient temperature of 30℃ (86℉)**			
Conductor Size **(AWG or KCMIL)**	**60℃/140℉** **TW & UF**	**75℃/167℉** **RHW, THHW, THW, THWN, XHHW, USE, ZW**	**90℃/194℉** **TBS, SA, SIS, FEP, FEPB, MI, RHH, RHW-2, THHN, THHW, THW-2, THWN-2, XHH, XHHW, XHHW-2, USE-2 & ZW**
6	**40**	**50**	**55**
1/0	**100**	**120**	**135**
4/0	**150**	**180**	**205**
350	**210**	**250**	**280**
750	**320**	**385**	**435**

C. Main Primary Feeders

Where the connected single phase and three phase loads exceed 900 kVA per phase, a main trunk line feeder is to be used. Main underground trunk feeders shall use 750 kcmil aluminum conductors with ⅓ neutral cable. All main underground trunk feeders shall utilize 600 AMP vaults and switchgear. The connected load shall be divided so that it can be served with #1/0 feeders. All taps off of the main trunk feeders shall utilize 200A switchgear with a 200A fused switchgear device. All taps off of the main trunk system must be approved by the Power Department.

1. A #1/0 aluminum conductor with Full ampacity neutral cable is required where the connected single phase and/or three phase load is greater than 300 kVA but less than 900 kVA per cable.
2. If connected loads exceed 1800kVA per phase, multiple trunk and/or backbone feeders will be required.
3. The Power Department shall also consider future circuit load levels when approving proposed underground feeder cable sizes. ***Larger sizes than those outlined above may be required if the Power Department determines the larger size is needed to meet system requirements.***
4. Connection to existing backbone feeders off a switched connection point shall be sized by the Power Department Director based on future development potential.

D. Loop Feeds

The feeder circuits for a residential area will include a distribution loop when the connected load exceeds **115 kVA** for the entire development as described. As indicated in the loading guidelines listed above: for each #1/0 cable as described, loads will not exceed 600 connected kVA per leg or 1200 connected kVA for the loop.
In projects that are to be constructed in phases, a loop feed distribution system will be established using the load limits defined in the above paragraph. These limits shall be met in areas where there may be a delay in development of subsequent phases.
Projects constructed in phases shall have a loop system and the loop will be completed prior to receiving permanent power.
All systems shall be installed with fuse coordination techniques and fuse sizing shall be done by the Power Department (WCP).

- **Two sets of fuses shall be supplied by the contractor per fuse switch bay. Fuse size will be decided by the Power Department (WCP).**

For all normally open points of a loop or end of radial feed system, arrestor elbows will be required to be installed. The Power Department (WCP) reserves the final right of approval for all conductor sizes and system looping configurations. Larger conductors and/or additional loop points may be required as determined by the Power Department Director in order to maintain proper system reliability and load transfer flexibility. Future loading levels and system configuration may also be considered by the Power Department to determine required cable sizes and switching configuration.

E. Cable Splices

This standard outlines installation details for primary and secondary splices used in underground distribution.

1. **Installation Instructions**
   Primary or secondary cable splices will not be allowed within conduit runs.
2. **Primary Cable Splices**
   i. Primary cable splices shall be done in approved locations prior to installation.
   ii. Primary cable splices shall be installed in accordance with installation instructions provided by the manufacturer.

iii. The concentric neutral conductors shall be connected together with compression connectors.
iv. After splice has been installed, the integrity of the jacket shall be maintained.

3. **Secondary Cable Splices**
   Secondary cable splices shall not be permitted on new installations, subdivisions and residential homes.
   Installation instructions for secondary cables are as follows:
   i. Remove cable insulation from cable ends to the dimension required for the compression connector being used.
   ii. Slide heat or mechanical shrinkable sleeve of appropriate size over one of the conductor ends until the bare conductor is visible.
   iii. Connect the conductor ends with the appropriate compression connector.
   iv. Slide the heat shrinkable sleeve along the cable until it is over the compression connector.
   v. Apply heat to the heat shrinkable sleeve until it shrinks in a size to encapsulate and seal the cable ends and the compression connector.
4. **Moisture**
   When splices are to be installed on a cable(s) that have been exposed to moisture, the cables must be cut back 10' or until the moisture is eliminated.

F. Primary Cable Installation Guidelines

1. All conduit and bends will be installed and backfilled before any wire is pulled.
2. On long pulls, the pull-out manhole shall be rigged whenever possible, to accommodate an adequate amount of cable for splicing and racking; such that the cable may be pulled into the manhole without the taking of hitches on the cable sheath or jacket.
3. In highly congested manholes or where cables must be bent sharply to permit pulling, a feed-in tube shall be used for pulling cable. This will rescue tensions and prevent damage to the cables being pulled and to other adjacent cables.
4. Single conductor cables must be installed one cable per conduit and conduit must be nonmetallic as per requirements.
5. Before making a pull, conduits shall be cleared and free of dirt, rocks, etc.
6. Wire rope shall be used to pull cables in nonmetallic conduits. Installation methods which eliminate damage to the conduit and associated elbows shall be used. Any damaged conduit or elbows shall be replaced before acceptance by the Power Department (WCP).
7. Cable pulling compounds shall be used to facilitate pulling of primary and secondary cables.
8. Compounds shall be suitable for the conduit and cable installation types being used.
9. When two or more cables (secondary) are pulled into one conduit, they shall be pulled at the same time.
10. Primary cables shall not be installed in the same conduit with secondary or communication cables.
11. Primary or secondary cables shall not be pulled into plastic conduit until all conduit joints made using plastic conduit cement have been allowed to dry for at least ½ hour.
12. Cable pulling tensions shall be recorded and submitted to WCP using the Contractor Cable Tension Form

G. Multiple Primary Circuits in One Trench

1. When the cables comprising two primary circuits (whether single, two, or three-phase) are installed in a common trench the horizontal separation between the two circuits (closet cable to closet cable) shall be **12" minimum**.
2. When the cables of a secondary service are installed in the same trench the minimum vertical separation shall be 8".

H. Bending Radii for Primary Cables

The minimum bending radii for both single and multiple primary conductor cables are as shown in Table 4.

Table 4 MAXIMUM BENDING RADIUS AS A MULTIPLE OF CABLE DIAMETER OVERALL DIAMETER OF CABLE, INCHES		
1" AND LESS	1" TO 2"	2" AND OVER
12 - 15 X Diameter	15 X Diameter	15 X Diameter

I. Cable Caps

This standard details requirements applicable to cable end caps to seal the ends of primary and secondary cables.

1. **Temporary Caps**

   Cable end caps are available for temporarily sealing the ends of primary and/or secondary cables during the period of time between installation of the cables and completion of splices or terminations and during yard storage. In no case shall the cables be left uncapped or unprotected.

   Installation

   i. Cut the end of the cable to be capped off the described length (square cut).
   ii. Determine the appropriate cable and cap.
   iii. If the cable to be capped is concentric neutral cable, remove the concentric neutral wires from the cable end that is to be capped.
   iv. Push the end cap onto the end of the cable until the mastic in the cap surrounds the cable end.

2. **Permanent Caps**

   When the ends of primary and/or secondary cables are to be capped and then buried, left in a manhole or switchgear, etc. for future use they must be capped with cable end caps.

   Installation

   i. Cut the end of the cable to be capped off to the desired length (square cut).
   ii. Determine the appropriate cable end for primary and secondary cable.
   iii. Slip the cable end over the cable end.
   iv. Heat the cable end cap thereby causing it to shrink in diameter and conform to the cable end. This will totally seal the cable end against environmental conditions.

Both the temporary and permanent cable end caps have a voltage rating of 600 volts and must not be used to cap energized primary cables.

J. Cable Identification

This specification details the standard method to be used for marking primary and secondary underground cables to indicate the general direction from which each cable extends from a given site.

It also details a method for identifying individual phases in multi-cable primary and secondary cable systems.

Primary and secondary cables shall be marked with one tag indicating direction or exit from underground facilities (i.e: vaults, primary junction boxes, service holes, manholes, secondary junction boxes, transformers, or splice boxes). This tag shall indicate(**CM100-1 CM100-2**)**:**

1. The direction of the cable run
2. Length of cable run
3. Name of the next point of connection IE TR0001
4. All tagging must be approved by the Power Department Inspector
5. All equipment will be numbered as per GIS guidelines. Numbers will be given to contractors for labeling of equipment.
6. **Secondary runs shall be tagged with the address of the customer served, direction of feed and length of run.**
    i. Lot numbers shall not qualify as addresses

K. Phase Identification

1. When individual phases in a primary or secondary multi-cable installation are to be identified, bands of black tape shall be used. Each phase shall be identified as follows: **BLACK** for “A” phase, **RED** for “B” phase, **BLUE** for “C” phase. Where multiple bands are used, separate bands by one tape width. Tape used for phase identification shall be at least three layers of tape thick.
2. Any form of cable identification will not replace color coding requirements. Cable tagging will provide a means of identifying underground cables throughout their length. Specifically, this requirement includes the following:
    i. Cable phases should be tagged on all terminal poles to correspond with the established overhead phase ID.
    ii. Care should be taken during the installation of the underground tagging system so that the cable phase identification integrity is maintained.
    iii. The correct phase tag number should be placed on the cable whenever the cable is accessible such as in enclosures or splice boxes.
3. Phasing should be indicated on the construction sketch so that this information can be placed on the permanent maps. This will include, but not be limited to:
    i. Phase identification of cables serving individual transformers.
    ii. Phase identification of cables at all junction points.
    iii. Cable tags must be changed whenever the cable system is changed.
4. The tape used for phase identification shall be placed at a convenient and easily visible spot near the point of entrance and exit of cables from a given site. Care shall be taken when tape is placed on concentric neutral primary cables to ensure that the tape is placed over the concentric neutral conductors and that contact between the semiconducting shield under the concentric neutral conductors and the marking tapes is minimized.
5. **Do not shortcut or forget safe working procedures**. Regardless of the accuracy of cable labeling, it cannot be relied upon when working and handling cables. The energized status of any individual cable **must be tested** by proper

phasing and testing techniques. Proper cable grounding procedure must be followed.

L. Accessing Energized Equipment

1. Only Washington City Power personnel shall have access to any energized equipment including but not limited to: transformers, switches, primary vault enclosures, secondary boxes and street lights.
2. Transformer and other equipment openings should be scheduled with the Power Department (WCP) a minimum of 48 hours (2 working days) in advance. The information required will be: address, lot number, name, company, phone number and requested time.

M. Maximum Safe Work Loads for Pulling Lines

1. When pulling cables into conduit, the pulling line used shall have a safe working load rating (minimum) equal to the maximum allowable pulling line tensions shown in tables 5 and 6 for the type and size of cables being pulled.
2. ***An approved hydraulic pressure cable tension monitoring system shall be used on all pulls where the conductor wire cannot be pulled by hand.*** *Documentation of all primary cable pulls shall also be provided. This shall included contractor equipment form can be accessed at https;//washingtoncity.org/services/power under the documents tab*
    a. ***Contractor Cable/Tension Form***
    b. ***Contractor Equipment Form***
3. When primary or secondary cables are pulled into straight conduit runs, the pulling line tension shall not exceed the values shown in Tables 5 and 6.
4. When primary or secondary cables are pulled into conduit runs including bends or sweeps, the maximum pulling line tension shall not exceed 300 times the radius of curvature of the bend or sweep with the smallest radius expressed in feet.

TABLE 5
MAXIMUM ALLOWABLE PULLING LINE TENSIONS (LBS)
CONCENTRIC NEUTRAL, URD, PRIMARY CABLES

Conductor Size and Type (1, 3)	1 - Cable Per Conduit	
	Pulling Eye	Pulling Grip (2)
#1/0 AWG AL	635	635
#4/0 AWG AL	1270	1000
750 MCM AL	4500	1000

Notes:

1) Maximum allowable pulling line tensions are determined by the strength of the conductor and are not affected by cable voltage rating, etc.
2) The maximum allowable pulling line tensions shown assume the use of a grip on each cable. If one grip is used for all cables, reduce the values shown by 33%.
3) Verify all pulling tensions with the cable with the cable manufacturer. Do not exceed manufacturer recommendations.

TABLE 6 MAXIMUM ALLOWABLE PULLING LINE TENSIONS (LBS) 600 VOLT, SECONDARY CABLES						
Conductor Size and Type	1 Cable per Conduit		3 Cables per Conduit		4 Cables per Conduit	
	Pulling Eye	Pulling Grip	Pulling Eye	Pulling Grip (1)	Pulling Eye	Pulling Grip (1)
#1/0 AWG AL.	635	635	1270	1270	1905	1905
#1/0 AWG Cu.	845	845	1690	1690	2535	2535
#2/0 AWG AL.	800	800	1600	1600	2400	2400
#2/0 AWG Cu.	1065	1000	2130	2000	3195	3000
#4/0 AWG AL.	1270	1000	2540	2000	3810	3000
#4/0 AWG Cu.	1700	1000	3400	2000	5100	3000
350 KCMIL AL.	2100	1000	4200	2000	6300	3000
350 KCMIL Cu.	2800	1000	5600	2000	8400	3000
500 KCMIL Cu.	4000	1000	800	2000	12,000	3000
Notes: (1) The maximum allowable pulling line tensions shown assume the use of a grip on each cable. If one grip is used for all cables, reduce the values shown by 33%.						

N. Underground Service Conductors

1. Burial Depth
    i. Minimum burial depths for service conduits shall be 36 inches.
2. Trench Requirements
    i. See Section 3
3. Trench Bottoms
    i. When conduits are directly buried or concrete encased, the bottom of the trench into which the conduits are placed shall be free from rocks exceeding 1 inch in their largest dimension. When the trench bottom contains rocks exceeding this size requirement, the trench shall be excavated 6 inches deeper than the burial depth required for the conduits and then backfilled to the required burial depth with sand or screened backfill.
4. Trench Backfill
    i. Direct Buried Plastic Conduit
        a. At least 6 inches of 1-inch minus backfill shall be placed over the conduits. The remaining backfill shall be spoil removed from the trench unless specific backfill requirements exist.
    ii. Service Conduit
        a. Service conduit installations shall be carefully designed (length, number of bends, bend radii, etc.) to ensure that the underground service conductors can be pulled into them without damage.
    iii. Conductor Type
        a. All Underground service conductors shall be type USE.
    iv. Protection
        a. Underground service conductors shall be protected from physical damage, by installation in conduit (PVC schedule 40 or better). When underground service conductors are pulled in conduct, care shall be taken to ensure that they are not damaged during the pulling operation.

v. Splices
    a. Underground service conductors shall not be spliced. A grounding electrode shall be connected, via grounding electrode conductors, to the underground service conductors (grounded conductors only) on the line side of and/or within the service disconnecting means.

vi. Size
    a. The underground service conductors shall have adequate ampacity to carry the load requirements of the premises served by the conductors. The Power Department requires that all services less than 124 Amps be served by #1/0 aluminum conductor and services between 125-199 Amps be serviced by #2/0 Aluminum conductor. 200 Amps and above, the service conductor will be #4/0 Aluminum conductor. Larger sizes may be required if the service size exceeds the ampacity ratings of the sizes indicated in Section 3.3, Table 3.

3.4 Street Lighting

A. General

It is the policy of the Washington City Power Department that all street lights erected in the Washington City power area, whether in a public easement, in an easement to be dedicated to the City within the City limits, in a new or proposed subdivision or in building projects requiring street improvement, the following shall be adhered to.

B. Warranty

All contracted electrical work within the City of Washington shall have a one (1) year contractor warranty submitted to the Power Department upon approval of final construction. The contractor shall supply at final all invoices and other documentation regarding street lighting equipment and other power fixtures so proper warranty dates can be recorded prior to completion of the project. Washington City Power street lighting will be owned and maintained by the Power Department (WCP). Conduit systems for street lighting wiring shall be installed by contractors/developers in accordance with this document.

C. Private Streets

The Power department will provide electric power for street lights at no cost. **Private streets shall have a metering point installed for street light power.** All metered points of delivery for decorative street lights shall include a disconnect with overcurrent protective device(s) or breaker(s). The rating of the over current protection shall be compatible with the current rating of the wiring connected to the device. The disconnect shall be service entrance rated, tamper proof equipped with provisions for locking, installd in a NEMA 3R enclosure and mounted on a building wall or substantial wood or steel post. The disconnect and appurtenant facilities shall be installed in accordance with the applicable articles of the National Electric Code (NEC).

D. Non-Standard Lights

If a homeowner' association or similar party will agree in writing to maintain a proposed streetlight system, nonstandard street lights may be installed with a power metering point for all lighting fixtures. A contract for maintenance may be entered into with the City for nonstandard street lighting. Any contract for maintenance whether public or private streets must be approved by the City Council and the Power Department Director to ensure public safety. Maintenance concerns will be addressed to the Council by the Power Director upon application to the Council for any nonstandard street light installation. Previous review and approval of nonstandard lighting fixtures does not warrant installation. All nonstandard lighting fixtures shall be reviewed and approved on a site by site basis.

E. Ownership

The Power Department (WCP) will own and maintain the conduit systems, poles and fixtures after the street light installation is completed. The conduit systems shall extend from the power department (WCP) padmounted transformers or secondary junction boxes to street light locations. The contractor/developer shall be responsible for proper routing and placement (burial depth, excavation, bedding, backfill and compaction) of conduits and for the location of conduit end points (stub ups) at padmounted transformers and/or secondary junction boxes and street light locations. In the event that additional street lighting is requested, a cost estimate will be presented to the customer or group of customers having an interest. The cost for the installation and inspection shall be paid in full prior to the installation.

F. Approved Standard Lighting

Approved fixtures can be used for installations as directed by the Power Department Project Manager. Layouts for Washington City Power standard street light installations will be prepared by Washington City.

All standard lighting shall be 3K Dark Sky approved LED fixtures

Standard lighting- Standard Approved Lighting Fixture List.pdf

Lighting general requirements - Lighting General Requirements.pdf

G. Procedures and Responsibilities

1. The lights shall be mounted on an aluminum or galvanized steel, single member arm pole designed to withstand 100 mile-per-hour wind (certified). All poles shall have an access hole at or near the base for access to the wiring. The overhang shall not exceed 25% of the mounting height. The following is the guideline to be used for plat preparation.

Road Width	Mounting Height	LED Min Wattage	Pole Spacing
35-45'	35'	125	250-300'
46-62'	40'	155	250'

Road Width	Mounting Height	LED Min Wattage	Pole Spacing
63-72’	40’	185	250’

i. This may be subject to change as determined by the Power Department Project Manager as per any safety requirements or instructions.
ii. All arms shall be 2 ¾” O.D. (2” pipe) laminar mounting. All poles shall be anchor base poles and the foundation design shall be adequate for the length of the pole and the arm that’s being installed, the soil conditioner and the 100 mile-per-hour winds.
iii. All street lights will be LED as per City Requirements.

2. Where streetlights are placed in the sidewalk or back of sidewalk, the foundation base will be made level with the sidewalk grade.
3. All decorative post style street lights shall have a secondary junction box installed no further than 10 feet from the light. All secondary junction boxes within 5 feet of a roadway shall be traffic rated boxes.
4. All decorative lights shall be fused at the base of the pole with the appropriate size fuse.
5. Breakaway bolts are required when the pole is placed within 4 feet of the curb and gutter. Where curb and gutter do not exist, transportation clear zone requirements will be met.

H. Street Lighting Conduit Requirements

The contractor/developer shall be responsible for the installation of street lighting conduit systems extending from transformer or secondary junction boxes to lighting fixture locations. Conduit sizes and burial depths shall conform to the (WCP) section 1 of this standard.

I. Street Light Installation

Commercial areas shall be required to place conduit to light City streets bordering their development.

Street Light Installation **SL200 Street Light - Wiring**

J. Street Light Footing Specifications

A typical footing specification is included with these specifications. However, the customer is responsible for assuring that any given footing will meet the wind load levels at a given site as well as soil conditions.

Street Light Footing **SL100 Street Light - Footing Specification**

K. Streetlight Wire Size

Street lights connected to a specific wire size shall meet the following guidelines.

SECONDARY WIRE SIZE FOR STREET LIGHTS 120/240 VOLT - SUBDIVISION		
# LIGHTS	MAX DISTANCE FROM SOURCE	URD Triplex
1	400’	#10 Romex
2	1000’	#2 Triplex
3	1200’	#2 Triplex
4	1200’	#2 Triplex
5	1200’	#2 Triplex
6	1200’	#2 Triplex

3.4 Equipment Placement and Clearances

A. General

Placement of all lines, equipment and facilities shall meet all applicable codes and policies.

B. Lines and equipment shall be placed within easements and must maintain required clearances to buildings and other installations.

C. Equipment shall be placed and installed to allow for safe operation of the equipment Equipment shall be installed and maintained to prevent equipment damage to allow access at all times.

D. Standard drawings show typical installation requirements.

GE101 Transformer Distances - Single Phase
GE102 Transformer Distances - Underground Cables
GE103 Transformer Distances - Commercial Buildings
GE105 Pad Mounted Equipment Clearances
GE110 Erosion Prevention

4.0 Metering and Service Requirements

4.1 General Requirements

The power source is defined as a transformer or secondary box. Conduit installation shall follow Section 3 of this standard.

A. Service Equipment

1. **Continuous Current Rating**
   All services shall be metered. All service equipment shall have a minimum current rating of 60 ampere.
2. **Short Circuit Current Rating**
   Service equipment and its overcurrent protective devices shall have short circuit current ratings greater than or equal to the short circuit current available at their supply terminals.
3. **Service Disconnecting Means**
   All service disconnecting means will be located on the outside of the building in a readily accessible location. When multiple switches or circuit breakers are used as the disconnecting means, their combined current rating shall not be less than 60 amperes.

B. Temporary Power

Place the temporary pedestal 2 to 3 feet off the corner of the junction box at a 45 degree angle to the sides to avoid hitting conduit going to and from the junction box. The pedestal should be buried deep enough that it won't fall over if a man were to push on it. Use direct burial rated cable in conduit going out of the pedestal into the ground. The cable trench should allow for at least 24 inches of cover over the cable. Once inside the junction box there should be 3 feet of cable coiled up to make the connection. Transformers require 4 feet of coiled cable in the bottom of the transformer. The pedestal wires must be stubbed into the junction boxes and transformers for connection to be made.

C. Tapping holes in boxes or basements is prohibited unless approved by the Power Department (WCP). Contact the Power Department (WCP) for placement and opening of transformers. (see Section 2.5 for accessing energized equipment)

1. All outlets shall be GFCI protected, including the 50 Amp circuit and have weatherproof covers.
2. Temporary services may not be placed on utility poles.
3. For a temporary aerial service pedestal, contractors will need to contact WCP for placement.
4. The pedestal shall be inspected by the jurisdiction in accordance with the latest edition of the NEC.
5. Upon approval of the City, the Power Department shall connect the temporary service.

4.2 Residential Metering

This standard outlines minimum requirements for the service equipment, service conductors, etc., purchased and normally installed by the customer from the secondary junction box to and including the meter.

A. Drawings

Residential Service **US103 Residential Service Requirements - Side View**

B. Application

This standard shall be used as a guideline for determining whether or not the service equipment, service conductors, etc. , that comprise the secondary service meet all applicable National, State and Local codes and ordinances and the City Power Department requirements.

1. **Service Connection Criteria**

   Underground services shall no be connected to the City's Power Department system until:

   i. Inspections and connections requiring a minimum of 48 hours notice on each are complete. Connections will be made based on current WCP workload.

   ii. The Building Department Inspector has certified that the service is in compliance with applicable local, State and National codes and policies. All service installations shall comply with the latest edition of the NEC.

2. **Service Equipment**

   i. The panel shall be labeled by UL or other approved third party agency.

   ii. The panel shall be labeled as "suitable for service equipment".

   iii. The panel shall be an exterior panel for use in any exterior installation.

   iv. The panel shall have 36" clear working space in front of the panel. No gas meters or other structures.

   v. **ALL** buildings shall have an exterior main disconnect.

   vi. The circuit breakers shall be approved for the panel (see label on panel).

   vii. The circuit breakers shall not exceed the conductor rating.

   viii. 240 volt circuit breakers shall be molded case breakers with integral handle ties.

   ix. Multi-wire circuits shall have handle ties on the breakers.

   x. Cable bundling over 12" requires reduction in ampacity of circuit breaker.

   xi. Primary main panel grounding is to a ufer grounding electrode, if available. At least 1 ground rod is required at all service entrances. If no ufer is available, primary grounding is to 2 ground rods.

   xii. When a metal underground water pipe system is available on the premises, the water pipe system and the ground rod shall be used as a secondary grounding electrode, at least 20' shall be visible in the ground and the Grounding Electrode Conductor (GEC) clamp shall attach to the water line in the first 5' entering the house.

   xiii. The location of the meter base shall be on the side of the house closest to the power source and no more than 10 feet from the front wall. Base

must be located in front of any fence constructed on property to meet accessibility requirements. Disconnects shall be free from obstructions and are not allowed behind fences, walls or other barriers. Keep shrubs, and landscaping from obstructing access to the meter.

xiv. Never install the meter over window wells, steps in stairways, or in other unsafe or inconvenient locations.

xv. The service entrance equipment shall be constructed and installed so that the vertical distance from the ground level to the centerline of the meter is a minimum of 48 inches to a maximum of 72 inches. (66" preferred)

xvi. The meter shall have 30" of horizontal clearance (15" both directions) from the centerline of the meter socket for safe working clearance.

xvii. Underground Services
To prevent the riser pulling out of the meter base during settling of the ground, the conduit must be anchored to the foundation using unistrut, ⅜ inch bolts and anchors, and a unistrut clamp.

xviii. Overhead Services
   a. The mast shall be braced if over 36" high
   b. Mast height shall provide for required service wire clearances.
   c. Approved weather heads shall be required
   d. 18" of conductor required out of the weatherhead
   e. The conductors out of the weatherhead shall be arranged into a drip loop.
   f. The mast shall enter the main panel with a Meyers hub securely fastened to the panel and building structure in two places.
   g. If the mast entry into the panel is a dry location, double lock nuts may be used with a bond bushing on the interior.

3. **Meter Clearances** **US110 Meter Clearances - Underground Service**

C. Commercial Metering

1. Metering equipment and service location shall be approved by the Washington City Power Department
   i. Metering equipment shall be installed in an approved metering enclosure, meters shall not be installed on transformers.
2. Main disconnect shall be located on the outside of the building within 5' of the meter socket.
3. Disconnects shall be labeled with permanent plaques identifying circuits within the enclosure.
4. Washington City Power shall be given keys or codes to access their metering equipment before certificate of occupancy will be issued.

D. Working Space and Clearances

Access and working space shall be provided and maintained around all electrical equipment to permit ready and safe operation and maintenance of such equipment in accordance with this section.

Thinking **US115 Panel Clearances**

1. A level standing and working surface 36” X 36 shall be provided in front of all meters, permitting access to the meter.
2. Equipment, piping and ducts foreign to the electrical installation shall not be placed in the shaded areas extending from the ground to a height of 6 feet above the panelboard enclosure, or to the structural ceiling, whichever is lower.
3. The working space shall be clear and unobstructed from the ground to a height of 6.5 feet or the height of the equipment, whichever is greater.
4. The working space shall not be used for storage.
5. Panelborads, service equipment and similar enclosures shall not be located in bathrooms, toilet rooms, clothes closets or over steps of a stairway.

E. Meter Height

The height of the meter base shall be 5 feet, plus or minus 12 inches at the center of the meter opening. The Power Department (WCP) will determine the exact location of meters that do not meet the criteria established in this manual. If the customer is unsure if the meter location is acceptable, the Power Department should be contacted. The location of the electrical service point on the customer’s premises is an important consideration. Consult the Power Department to determine the point of attachment for overhead service drops and underground service laterals.

F. Metering Provisions

1. Typical requirements for meter mounting provisions for residences are shown on drawings included in this specification. When meter mounting provisions differ from those shown are required, specific metering provision requirements shall be detailed by the City Power Department.
2. The meter mounting provision must be installed in a true vertical plane.
3. Meter mounting provisions with extruded or cast aluminum meter jaws shall not be used.
4. Meter standard single phase service 200 amps or less uses a regular self-contained 200 amp, 4 jaw meter base. Above 200 amp through 400 amp services, a 4 jaw meter base with a by-pass handle is required. This is a 120/240 volt service.
5. If the service is 120/208 volts, a 200 amp, 5 jaw meter base is required.
6. Meter lock rings shall be supplied by the contractor or temporary and permanent meter installation.

G. Installation

Underground services shall be installed in accordance with applicable City Power Department requirements and local, State and National codes and ordinances.

H. Equipment and Conductors

All equipment and conductors installed shall meet or exceed applicable City Power Department requirements and local, State and National codes and ordinances.

I. Service Equipment Maintenance and Ownership Responsibility

All electrical devices, conduits, boxes, conductors, service entrance equipment. Mobile

home service pedestals, etc., located on the load side of the connection point of the City's service entrance or service drop conductors to the customers service conductors or service entrance equipment shall be installed and maintained by the customer at their own expense. The only exception is the City-installed metering equipment used to meter electrical load.
Please refer to the attached drawings detailing ownership of various service entrance types. Questions of ownership responsibility should be directed to the City Power Superintendent. (**US103, US320, US330, US331**)

4.3 Apartments and Condominiums

A. Disconnects

Buildings shall have a main building disconnect in accordance with the NEC

1. Each apartment shall have an individual disconnect rated per its load calculations.
2. Service equipment and its overcurrent protective devices shall have short-circuit current ratings greater than or equal to the short-circuit current available at their supply terminals.

B. Mounting Heights

1. Single Horizontal Row of Meters

When meters for an apartment or condominium can be mounted in a single horizontal row, the vertical distance from the ground level to the centerline of the meters shall be 4 feet (minimum) to 6 feet.

2. Multiple Rows of Meters

When meters for an apartment or condominium must be mounted in two or more horizontal rows, the vertical distance from the ground level to the centerline of the top row of meters shall be 6 feet (maximum) and the distance from the ground level to the centerline of the bottom row of meters shall be 3 feet (minimum).

Type of Installation	**Minimum Meter Height**	**Maximum Meter Height**
Single Meter Socket	**4'**	**6'**
Outside with multiple stacked meter sockets	**3'**	**6'**
Potential (VT) & Current Transformer (CT) Cabinet	**4'**	**5'**
*height is measured to the center of the meterfrom the floor or final grade		

C. Labeling Meter Bases

Meter bases shall be numbered according to apartment/condominium numbers as recorded on the official plat. **Approved permanently attached outdoor rated placards are acceptable**, markers and paint are not permitted. Meter connection to each apartment/unit must be verified with the Power Department (WCP) representative prior to energizing the meter.

D. Ownership and Maintenance Responsibility

1. Underground Service Conductors

When a condominium or apartment building is supplied through one set of underground service conductors, they shall in general be owned and maintained by the City Power Department from the transformer, secondary junction box, etc., to the point of delivery to the customer.

E. Secondary Cable Loading

All secondary loading shall meet all NEC code requirements. The ampacity of allowed secondary conductor sizes is indicated in Table 7 (From NEC Table 310-16).

TABLE 7
AMPACITY OF INSULATED WIRE
THREE CONDUCTORS IN RACEWAY
0-2000 VOLTS

SIZE AWG/MCM	COPPER	ALUMINUM
	RH RHW THW THWN	RH RHW RUH THW THWN
#1/0	150	120
#2/0	175	135
#4/0	230	180
350	310	250
500	380	310

Written approval from the Power Department is required, prior to installation, for alternative meter socket location when:

i. Conditions prohibit placing the meter case within ten feet of the front of the building.
ii. Alley-fed services have access for meter reading
iii. Metering pedestals or poles are used
iv. Other special conditions exist

On service changes, the old main breaker must be saved for the inspector. Where no increase in amperage is paid for, the same size service must be used.

4.4 Services Over 400 AMP

A. Current Transformers (CT)

1. All Current Transformers shall be GE RevenueSense 600:5 750X133112 for services 401A - 1000A.
2. CT's for services greater than 1000, sizes to be determined by the Power Department (WCP)
3. Current Transformers shall be sized and installed in accordance with Washington City Power policies.
4. Current Transformer enclosures and meter bases shall be pre-approved by Washington City Power.
    i. Drawings of the proposed service and details of metering equipment for services rated over 400 amps shall be submitted to Washington City Power for approval prior to equipment manufacture and installation.
5. All enclosures shall be CT ready without on site fabrication or retrofit.
6. Installation in the transformer cabinet shall be prohibited.
7. All CT meter sockets shall have a test switch or approved self shunting meter base
    i. Test switch shall be a 10 position unit- **Example TESCO 909510-c**
8. All CT wiring shall be inspected and approved through Washington City Power.
9. Installation shall be in accordance with the latest version of NEC.
10. Installation of CT wiring within the meter socket and enclosure shall be completed by the Power Company (WCP) qualified employees.

B. CT Location

The location of the CT enclosure and meter base shall be readily accessible. For CT services the customer shall provide and install:

1. A 13 terminal pre wired meter socket enclosure with test switches. (Milbank catalog # UC4323-XL-101) or approved equivalent.
2. The meter shall be located on the non-hinged side of the current transformer cabinets. **Meter sockets shall not be located above or below the CT enclosure.**
3. A current transformer cabinet must be weather-tight, NEMA 3R-rated metallic cabinet, securely mounted on a rigid surface. The door shall be hinged and capable of being sealed. The cabinet shall be sized in accordance with Current Transformer Cabinet Requirements. The top of the CT cabinet shall not be more than 6 feet above front nor less than 3' 6" from ground level.
4. An approved current transformer mounting base shall accept bar-type current transformers only. No alteration of the transformer mounting base is allowed.
5. The customer must furnish all lugs and connect conductors to the link and the load terminals of the current transformer mounting base.

CT Cabinet Requirements Current Transformer Cabinet: Wall and Post Mounted Installations					CT Mounting Base
Type of Service	C.T Enclosure	Minimum Cabinet Dimensions			
		Width	Height	Depth	EUSERC #
Single-Phase, 3 Wire 400-800 Amps	EUSERC 316	24”	48”	11”	328A, 328B
Three-Phase, 4 Wire 401-800 Amps	EUSERC 316	36”	48”	14”	329A, 329B
A larger cabinet is required if both the line and load conductors enter and exit from the bottom of the can. For Services over 800 AMps, contact Washington City Power.		48”	48”	14”	

Note: CT metering installation will not be allowed on the transformer.
(See MT100, MT110, MT120)

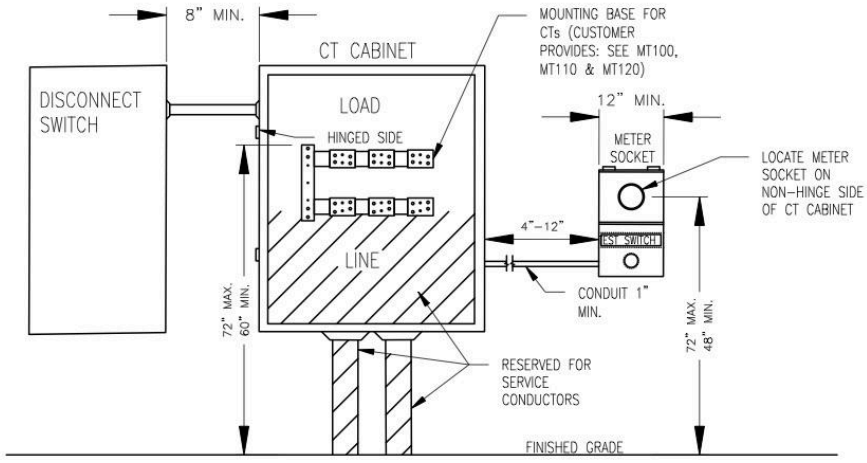
C. Service Disconnect

All single phase, three phase and CT services shall be protected with a main disconnect located on the exterior of the building and readily accessible to Washington City Power and emergency crews.

1. Disconnect shall be sized to match service requirements.
2. Meters must be installed at the closest point possible to the designated power service line as indicated on approved plans.
3. Any changes to this requirement shall be approved in writing by the Power Department (WCP).
4. Residential services over 400 amps shall be C.T. metered with the base mounted where it is readily accessible for the meter technician.
    i. Note: Any single-phase service over 400 amps will need to be pre-approved by the Washington City Power Department prior to installation. A detailed drawing and proposed equipment will need to be submitted for review and approval.
5. Three-phase metering of any service 400 amps or less requires a regular self-contained 7 jaw meter base with bypass handle.
6. Any commercial service over 400 amps will be metered with current transformers and enclosure installed on the exterior of the building.

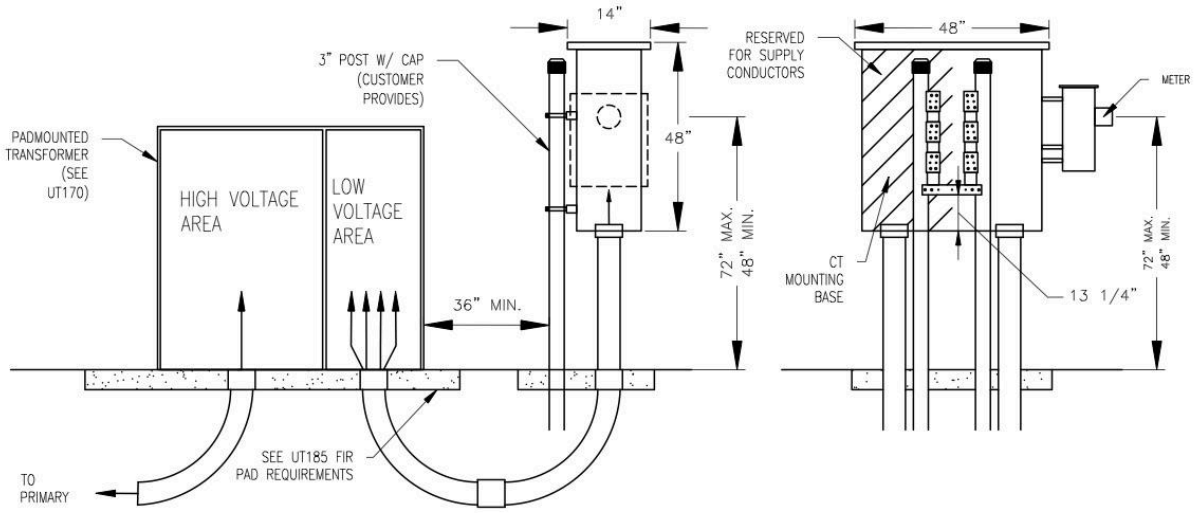
MT300 CT Installation - Typical CT Metering Detail

TYPICAL 800A MAX. CT METERING INSTALLATION



THE CABINET IS EXCLUSIVELY FOR UTILITY METERING EQUIPMENT. THE CT CABINET CONSISTS OF TWO PARTS, THE ENCLOSURE AND THE MOUNTING BASE FOR THE CURRENT TRANSFORMERS.

CT METERING FOR FREE-STANDING INSTALLATIONS, 600V, 800A MAX. (APPROVAL REQUIRED)



CUSTOMER WILL FURNISH AND INSTALL ALL MATERIALS (POSTS, HARDWARE, CONDUIT, FITTINGS, CONCRETE PAD, DEPTH SUFFICIENT TO SUPPORT THE METERING)

NO.	REVISION	DATE
A	UPDATE	07/01/22

ICPE CONSULTING ENGINEERS
1145 E. South Union Ave.
Midvale, Utah 84047
(801) 255-1111
(801) 566-0088

THE CITY OF
WASHINGTON, UTAH
CONSTRUCTION STANDARDS
CURRENT TRANSFORMER INSTALLATION
TYPICAL CT METERING DETAIL

SCALE	DATE PLOTTED	DWG BY: ON
NTS	06/XX/22	MT300

5.0 15 kV Primary Power Equipment Specifications

5.1 Equipment Installations - General

This standard outlines installation details for primary equipment (transformers, switchgear, primary junctions, manholes, splice boxes, etc.) used in underground distribution.

A. Equipment and Pad Installation

1. The ground sleeve shall be installed with the top being no less than 2” above finish grade.
2. Finished grade shall drain away from the transformers, switchgear, primary junctions, manholes, splice boxes, etc. unless deemed unfeasible. An alternate drainage plan shall be submitted and approved by the Power Department (WCP).
3. Pad shall be graded and compacted to 95% to prevent settling.
4. All required conduit shall be in place before compaction of fill.
5. No fill or landscaping material shall be allowed to contact power equipment.
6. All material shall be retained per **GE110 Erosion Control**
    i. If the rear slope measurement is over 18” the slop shall be retained on both sides and the back.
7. All grading shall be performed by the developer.
8. All single phase padmount transformers that are placed as loop feed or may at some time need to change ground sleeve. **Concast FC-40-44-24-2618(5) or FC-42-42-24-1326(6)** or approved equal. See **UT190 Single Phase Pad Installation** detail sheet.
9. All three-phase transformers will be placed on the transformer pad detail shown on Drawing **UT185**. The pad may be pre-constructed or poured in the field. Any field design must be inspected before concrete is poured to ensure rebar support.

B. Location

1. Primary equipment shall be located such that adjacent obstacles such as fences, buildings, etc. Do not interfere with operation, installation or maintenance of the enclosures.
2. Clearance in front of all primary equipment shall be 10FT. Planting of trees, shrubs, or gardens that interfere with the safe operation of the enclosure shall be removed.
3. Equipment shall be stenciled on the outside of the door in white exterior automotive paint.
    i. Equipment stenciled marking shall be no less than 1 inch letters.
    ii. Stenciling shall include equipment number, direction, length of feed, and end point of cable.
4. Equipment number shall be provided by the Power Department (WCP) for installation on the center of the equipment.
5. The Power Department will confirm equipment ID during the final inspection.

C. Equipment Guidelines

Switching and/or fusing equipment will be required to maintain proper system reliability and load transfer and backup capabilities. Sketches provided with this standard show

"typical" installation situations, however, they are not intended to address all configurations that may be encountered. The Power Department must approve all proposed cable sizes and system switching configurations. Required cable sizes and switching configurations of a given installation will be at the Power Department's sole discretion.

1. **Grounding/Neutral Bus**
   A #4/0 copper neutral bus shall be provided for all 600 A equipment.
   A #2/0 copper neutral bus shall be provided for all 200 A equipment.
2. **Loadbreak Elbows and Insulating Receptacles**
   Primary junction installations, which include load break elbows and/or insulating receptacles, shall be operated before the installation is energized to ensure that there is no interference from concentric neutral conductors, adjacent elbows, etc.
3. **Switches**
   Test and operate all switches in fused, primary junction installations to ensure that adjacent obstacles such as fences, walls etc. do not interfere with the switch operating handle.
4. **Location**
   Primary junction installations shall be located such that adjacent obstacles such as fences, buildings, walls, etc. do not interfere with operation, installation and maintenance of the installation.

5.2 Primary Vault and Junction Specifications

A. Primary Vaults must meet the following specifications:

1. All 3 phase primary vaults shall be approved single piece fiberglass (Nordic Fiberglass ND683054MG-PA71-X-X) or equivalent
   i. Minimum height 42"
   ii. Minimum width 45.5" at base
   iii. Minimum length 76" at the base
2. Penta head bolts on lid
3. Double locking mechanism
4. Hot galvanized mounting plate
5. All hardware including hinges to be stainless steel

B. Vaults Shall Include:

Three four-point junctions installed Cooper #2637164C13M, standoff bracket and necessary receptacles.

1. A #4/0 copper neutral bus shall be provided for all 600 AMP equipment
2. A #2/0 copper neutral bus shall be provided for all 200 AMP equipment
3. Transformer basements, ground sleeve basements and switch basements shall be graveled with 6" of pea gravel.

C. 200 AMP Primary Junction

This standard outlines installation details for 200 ampere, 15kV loadbreak junctions used in underground distribution.

Drawings - 200 AMP Vault (PV105, PV110)

1. **200 AMP Installation**
   Installation of 200 AMP loadbreak junctions shall only be done by Power Department certified contractors, who insure that:
   i. 200 ampere, 15kV loadbreak junctions shall be fiberglass primary enclosures or approved equivalent.
   ii. All elbows and taps will be supplied from approved sources
   iii. Single piece fiberglass primary enclosure with junction mounting bar and ground bar
   iv. (PDI Catalog Number CJP-10-49-L2-MG-4026)
   v. Conduit is installed in accordance with section 3.2 of this standard
   vi. Primary cable is installed in accordance with section 3.3 of this standard
   vii. #4 copper wire shall be installed to ground the 4 point brackets with tank taps. The DR Caps, and Standoffs shall also use this ground. The #4 ground shall be connected to the #2/0 copper on the left and right side of the vault. Two (2) connection points
   viii. A #2/0 copper grounding bar shall be installed for bonding and grounding of equipment
   ix. 2 - 8' ⅝" ground rods shall be installed inside the 200 AMP junction
   x. All work shall be inspected, tested and approved by the Power Department (WCP) before energizing
2. **200 AMP Terminations**
   i. All primary cable terminations shall be installed according to manufacturer's specifications
   ii. All 200 AMP elbows shall be loadbreak rated
   iii. All 15 kV loadbreak elbows shall be **Eaton LEJ215-CC-06-T for 1/0 cable or LEJ215-cc-09-T for 4/0 cable or approved** equivalent
   iv. All elbow stinger terminations shall be of the shear bolt type or approved equivalent
   v. Loadbreak elbows shall have test points provided
   vi. All elbows shall have the pull down jacket seal or approved equivalent
   vii. Elbows shall be hot stick compatible with reinforced pulling eyes
   viii. All silicon used during elbow and tap installation will be supplied from one of the following manufacturers and will match the stock number: Blackburn (#5SL), Dowel Corning or approved equivalent.
3. **Current Ratings**
   All tests shall be conducted in accordance with IEEE STD. 386 (Current Standard)
   i. 200 A continuous current
   ii.
   iii. Switching 10 operations at 200 A RMS at 14.4kV
   iv. Fault Closure 10,000 A RMS symmetrical at 14.4 kV for 0.17 sec after 10 switching operations
   v. Short Time 10,000 A RMS symmetrical at 14.4 kV for 0.17 sec. 3500 A RMS symmetrical for 3.0 sec

D. 600 AMPS Primary Junction

This standard outlines installation details applicable to 15 kV, 600 ampere splice-tap configurations used in underground distribution systems.

1. 600 AMP Installation

600 ampere, 15kV elbows and taps must be installed in primary enclosures. They are not suitable for direct burial. All elbows and taps will be supplied from one of the following manufacturers and will meet the current City standard.

Installation of a 600 AMP loadbreak junction shall only be done by Power Department certified contractors, who insure that:

i. Conduit is installed in accordance with section 3.2 of this standard
ii. Primary cable is installed in accordance with section 3.3 of this standard
iii. All Tee bodies shall be Richards MFG Co Part number 62CSHT2Q23 or approved equivalent.
iv. All primary cable terminations shall be installed according to manufacturer's specifications.
v. All cables shall be identified in accordance with Section 3.3 of this standard
vi. A #4/0 copper grounding bar shall be installed for bonding and grounding of equipment
vii. 2 - 8' ⅝" ground rods shall be installed inside the 600 AMP junction

E. Voltage Ratings

All tests shall be conducted in accordance with IEEE STD. 386 (Current Standard)

1. Standard Voltage 15kV
2. Minimum Corona level shall be 11
3. Maximum phase to phase 14.4kV
4. Maximum phase to ground 8.8kV

F. Testing Before Energizing

Operate loadbreak elbows and insulating receptacles before energizing 200 ampere, 15kV loadbreak junction installations to ensure that:

1. They can be operated without interference from concentric neutral conductors, adjacent elbow, etc. This includes putting elbow in the stand off position to normal operating position
2. The mounting location of the loadbreak junction is such that rings and covers or doors of primary enclosures, adjacent junctions etc. do not interfere with their operation.
3. Phasing on buss shall be left source to right load; left A phase to right C phase.

5.3 Riser Disconnect Switches

All 600 AMP circuits tied to overhead lines shall be equipped with in line disconnects supplied by the developer on the riser side of the feed.

A. Siemens Bridge Switches: LER294PY
B. Aluma-Form Switches: HDS-900A-LT-15S-110-N75-L with ¾ hanger

5.4 Secondary Junction Installation

This standard describes the installation of secondary junction boxes and mobile home park meter pedestals.

A. Drawings
1. **Secondary Junction Box (SJ100, SJ105)**
2. **1 Phase Transformer Grounding (UT105)**
3. **3 Phase Transformer Connections (UT170)**

B. Burial Depths
1. Secondary Junction Boxes
    i. All secondary boxes shall be the above ground tombstone style
        a. Exception: Street Lighting boxes dedicated only to street lighting services may be a flush mount style.
    ii. Top of secondary junction boxes shall be installed with base 2 inches above final grade.
    iii. All conduits shall stop 2” minimum above bottom grade for water control.
    iv. All secondary junction boxes shall be locked with pedestal equipment locks. Standard tumble-type locks or other devices are no approved for this application.
    v. Mobile home park metering pedestals shall be installed to the depth indicated on the pedestal.

5.5 Single-Phase Padmounted Distribution Transformer

A. General

This specification outlines the electrical characteristics and the mechanical features of single-phase, 60 Hz, oil filled padmounted, deadfront, compartmental-type distribution transformers with separable insulated high voltage.

1. Standards
    i. All transformers shall be constructed and tested in accordance with the latest revision of IEEE C57.12.00, C57.12.38, C57.12.90, C57.12.28 and the applicable NEMA standards.
    ii. Transformer shall meet the DOE 2016 Efficiency Standards.
    iii. No used or remanufactured material or components will be acceptable.
    iv. Western Underground Committee Standards.

B. Ratings

1. Kilovolt Ampere Ratings
    i. The Standard kVA ratings shall be one of the following:
        1. 25 kVA, 37.5 kVA, 50 kVA, 75 kVA, 100 kVA, or 167 kVA as required.
    ii. These standard kVA ratings are continuous and based on not exceeding whether a 65℃ average winding temperature rise or an 80℃ hot spot temperature rise. The temperature rise of the insulating oil shall not exceed 65℃ when measured near the top of the tank.
2. Voltage
    i. The high voltage rating shall be 12470Y/7200 volts. The low voltage rating shall be 240/120 volts. Unless otherwise directed by the City (WCP).
3. Tap Ratings
    i. The transformers shall be equipped with: 2 - 2 ½% taps above and 2 - 2 ½% taps below normal operating voltage. All taps shall be full capacity taps.
4. Basic Impulse Insulation Level
    i. The basic impulse insulation level (BIL shall be 95 kV).

C. Construction

1. General
    i. All transformers shall consist of a transformer tank and a high and low voltage cable termination compartment. These components shall be assembled as an integral, tamper proof and weatherproof unit for mounting on a pad. The transformer shall meet the requirements for tamper resistance as set forth by the Western Underground Committee. There shall be no exposed bolts, screws or other fastening devices which are externally removable. There shall be no opening through which

foreign objects such as wires or rods might be inserted to contact live parts.

ii. Transformers shall comply with the requirements of IEEE 57.12.28.

2. High and Low Voltage Compartments
   i. Access to the high and low voltage compartment shall be through a hinged door suitable for locking with a padlock.
   ii. The high-voltage segment of the compartment shall contain the high voltage terminations and be provided with an elbow accessory parking stand. High-voltage will be of the loop type configuration.
   iii. The low-voltage segment of the compartment shall contain the low-voltage terminations.
3. Tank
   i. All transformer tanks shall have sealed tank construction and sufficient strength to withstand a pressure of 7 PSI gage without permanent distortion.
   ii. A tank that has sealed tank construction is one that seals the tank from the atmosphere.
   iii. The tank shall remain effectively sealed for a top oil temperature range of -5℃ to 105℃.
4. Main Cover
   i. Welded main cover construction shall be provided.
   ii. The main door shall be secured with a penta-head fastening bolt and locking provisions as required by IEEE C57.12.28. Door fastening hardware shall be made of stainless steel or silicon bronze.
5. Low-Voltage Terminations
   i. The electrical characteristics of the completely assembled low-voltage terminations shall be:
      1. Insulation Class - 1.2 kV
      2. BIL - 30 kV
      3. One minute withstand - 10 kV
   ii. The terminals of the low-voltage terminations shall be as shown in Figure 4A of IEEE C57.12.38 - latest revision (spade terminations).
   iii. All low-voltage terminations shall be externally bolted to facilitate field replacement.
6. High-Voltage Terminations
   i. All high-voltage terminations shall be 15 kV class bushings or wells and inserts suitable for use with 15 kV class loadbreak elbow connectors respectively.
      NOTE: All loadbreak bushing inserts shall be provided with the transformer
   ii. All high-voltage terminations shall be externally bolted to facilitate field replacement.
   iii. The high-voltage terminations shall be of the loop configuration.
   iv. The number, location and arrangement of the high-voltage terminations shall be as shown in Figure 2 of the IEEE C57.12.38 - latest revision.

7. Neutral Connections
    i. The H2 end of the high-voltage winding shall be connected to the transformer tank internally and this connection shall be securely grounded to the tank and shall be independent of all other connections.
    ii. The low-voltage neutral shall be a fully insulated bushing. A stainless steel ground pad shall be provided on the outer surface of the tank. A removable ground strap shall be provided and connected between the low-voltage neutral bushing and the ground pad.
8. Core and Windings
    i. One piece core construction is denied. Where other construction is used, minimum assembly joints shall be provided. For approved two part cores. The core shall be held together with bands and torqued bolts. Crimped banding is not acceptable for ratings over 50 kVA.
    ii. Copper or aluminum winding conductors are acceptable.
    iii. Core material may be either silicon steel or amorphous.
    iv. Core losses shall be minimized by the core material and core construction.

9. Insulation
    i. All insulating paper used as layer insulation in transformer coils shall be coated on both sides with a thermosetting adhesive and properly cured prior to impregnating with oil, or the coils shall be wound with primary conductor containing a thermosetting adhesive that when properly cured will form an effective bond.
    ii. Insulating/cooling fluid within the tank shall be electrical grade mineral oil or a natural ester fluid.
    iii. All fluids shall be certified and indicated on the nameplate to be less than 1 part/million PCB content.
    iv. Fluids other than mineral oil shall have submitted with the quotation completed chemical and electrical characteristics and a statement of being non-PCB.
10. Ground Connection
    i. The tank shall have two welded stainless steel ground pads attached on the secondary side of the tank, near the bottom of the tank, clear of secondary bushings and attached conductors.
    ii. The grounding pads shall be free of paint and shall be 7/16 inch deep and threaded for a ½" 13 NC grounding stud connector.
    iii. The tank shall have a grounding strap between the cover and the tank.

D. Accessory Equipment

1. High-Voltage Protective Fuses
    i. All transformers shall be equipped with externally removable, oil immersed, expulsion fuse, in a loadbreak bayonet suitable for hot stick operation. This fuse shall be in series with an under oil partial range current limiting fuse. The fuse shall be coordinated to ensure that the current limiting fuse will only operate on faults internal to the transformer.

The current limiting fuse used shall have an interrupting rating of 50,000 amperes (minimum) symmetrical.

2. Pressure Relief Device
    i. Each transformer shall be equipped with a self-actuating pressure relief device to relieve slow pressure buildup and to automatically vent when pressure reaches +/- 10 PSIG and reclosed when pressure falls to +/- 6 PSI.
3. Rolling, Lifting, and Mounting Facilities
    i. The transformer base shall be arranged for rolling to two directions - parallel to and at right angles to one side of the transformer.
    ii. The transformer shall be equipped with lifting provisions of adequate strength and size and arranged on the transformer to permit lifting of the completely assembled and oil filled unit.
    iii. An internal flange shall be provided at the base of the high and low-voltage compartment to provide means for mounting the transformer on a pad.
4. Instructional Nameplate
    i. An instruction nameplate shall be located in the low-voltage segment of the high and low-voltage compartment and shall be readable with cables in place.
    ii. If the nameplate is mounted on a removable part, the manufacturer's name and the transformer serial number shall be permanently affixed to a non-removable part.
    iii. The instructional nameplate shall conform to Section 9.4 of American National Standard Publication C57.12.00 - latest revision.

E. Testing

1. All transformers shall be tested in accordance with the requirements of IEEE C57.12.90 - latest revision. All transformers shall be capable of withstanding short circuit tests.

F. Finish

1. The paint System shall meet or exceed the requirements of IEEE C57.12.28.
2. The transformer shall be given a durable, corrosion resistant, green or tan outdoor finish capable of meeting or exceeding the EEi finishing requirements.
3. All transformer surfaces in contact with the pad shall be designed or treated to minimize corrosion.

G. Shipping and Labeling Instructions

1. Transformers shall be shipped on pallets.
2. A shipping tag indicating the kVa size, manufacturer, voltage ratings, serial number and purchaser's order number shall be attached to all transformers.

H. Loss Criteria

1. All transformers shall meet or exceed DOE-2016 efficiency and loss standards.
2. Transformers that do not meet the loss requirements shall not be accepted.

3. All actual tested loss data and statement of compliance with DOE 2016 will be transmitted to the Washington City Power Department within 5 days after shipment of the transformers.

I. Vendor Evaluation

1. Vendor evaluations, as well as loss evaluations, will be used to determine the low bidder. Delivery dates will be of prime concern during the bid evaluation. A penalty of 20 percent will be assessed to all foreign manufactured transformers.

J. Exceptions

1. Exceptions to this Specification shall not be accepted. Any exceptions shall be noted in the proposal.

K. Warranty

1. Manufacturer shall warrant to Purchaser that the apparatus or services to be furnished hereunder shall be of the highest quality and free from defects in material, workmanship, and title and will be of the kind designated in the pertinent purchase order. The Manufacturer's warranty shall be effective for a period of twelve (21) months after the date of shipment to Purchaser.
2. The manufacturer shall guarantee that all transformers furnished under this specification are of first class material and workmanship throughout, that they have been tested in accordance with this specification, and that the results of the tests comply with the requirements of this specification, and , in lieu of other claims against it, agrees to replace or repair:
    i. Any transformer found to be defective in material or workmanship or found not to be in compliance with the requirements of this specification before or during installation of the transformer.
    ii. Any transformer failing during normal and proper use within the manufacturer's guarantee period which shows defects of material or workmanship.

5.6 Three-Phase Padmounted Distribution Transformer

A. General

This specification outlines the electrical characteristics and the mechanical features of deadfront outdoor three-phase, 60 Hz, oil immersed, self-cooled padmounted, compartmental-type distribution transformers with separable insulated high voltage connectors.

1. Standards
    i. All transformers shall be constructed and tested in accordance with the latest revision of IEEE C57.12.00, C57.12.34, C57.12.28, C57.12.90, and the applicable NEMA standards.
    ii. Transformers shall meet the DOE 2016 Efficiency Standards.
    iii. No used or remanufactured material or components will be acceptable.
    iv. Western Underground Committee Standards.

B. Ratings

1. Voltage and Kilovolt-Ampere Ratings
    i. The standard kVA ratings shall be one of the following:
        a. 75 kVA, 112.5 kVA, 150 kVA, 225 kVA, 300 kVA, 500 kVA, 750 kVA, 1000 kVA, or 1500 kVA as required.
    ii. These standard kVA ratings are continuous and based on not exceeding either a 65℃ average winding temperature rise or an 80℃ hot spot temperature rise. The temperature rise of the insulating oil shall not exceed 65℃ when measured near the top of the tank.
2. Voltage
    i. The high voltage rating shall be 12470Y/7200 volts. The low voltage rating shall be 208Y/120 V or 480Y/277 V as required, unless otherwise directed and approved by the City (WCP).
3. Tap Ratings
    i. The transformers shall be equipped with: (2) 2-½ percent taps above and (2) 2-½ percent taps below normal voltage. All taps shall be full capacity taps.
    ii. Tap changing to be through the wall in the high voltage connection compartment for external to tank adjustment.
    iii. Taps shall have the positions of the changer clearly marked to indicate actual voltage on the primary, or a % of above and below normal primary voltage.
    iv. Taps shall be operable only with the transformer de-energized.
4. Basic Impulse Insulation Level
    i. The basic impulse insulation level (BIL) shall be 95 kV.

C. Construction

1. General
    i. All transformers shall consist of a transformer tank and a high and low-voltage cable termination compartment. These components shall be assembled as an integral, tamper proof and weatherproof unit for mounting on a pad. The transformer shall meet the requirements for tamper resistance as set forth by the Western Underground Committee. There shall be no exposed bolts, screws or other fastening devices which are externally removable. There shall be no openings through which foreign objects such as wires or rods might be inserted to contact live parts.
    ii. Transformers shall comply with the requirements of IEEE C57.12.28.
2. Tank
    i. Transformer tank shall be suitable for outdoor installation. The tank shall be of construction that effectively seals the tank interior from the atmosphere but will allow entry for service.
    ii. Construction of the seal shall maintain the integrity of the seal over an operating oil temperature range of -5℃ to 105℃.
    iii. Tank construction shall be such that it has sufficient strength to withstand a pressure of 7 PSI gauge without permanent distortion.
3. High and Low Voltage Compartments
    i. The high and low-voltage cable termination compartment shall:
        a. Be compartmentalized into high-voltage and low-voltage segments by a suitable barrier.
        b. Include two doors, one for the high-voltage segment and one for the low-voltage segment. These doors shall have stainless steel hinges and pins and three-point latching with provisions for padlocking. Unlocking the padlock shall permit access to the low-voltage segment of the terminating compartment only. Access to the high-voltage segment of the terminating compartment shall not be attained until an additional fastening device has been released.
        c. Meet the dimensional requirements of Figure 12 of IEEE C57.12.34 latest revision.
        d. The high-voltage compartment shall be equipped with accessory elbow parking stands for each elbow.
4. Termination Arrangement and Dimensions
    i. The termination arrangements and dimensions of Figures 8,12, and 14 of IEEE C57.12.34 latest revision shall be applicable to this specification.
5. High-Voltage Terminations
    i. Configuration - The configuration of the high-voltage terminations shall be Loop Feed (IEEE C57.12.34 latest revision).
    ii. Type - The high-voltage terminations shall be 15 kV calls bushing or wells and inserts suitable for use with 15 kV class loadbreak elbow connectors respectively. The continuous current rating shall be 200 A.

NOTE: All loadbreak bushing inserts shall be provided with the transformer.

6. Low-Voltage Terminations
    i. Terminals - The terminal of all low-voltage terminations shall be as show in Figure 15A of IEEE C57.12.34 latest revision.
    ii. Configuration - The configuration of the low-voltage terminations shall be as shown in Figure 8A (staggered) of IEEE C57.12.34 latest revision.
    iii. Secondary low-voltage bushings shall include a full capacity neutral (grounded conductor) bushing.
    iv. The electrical characteristics of the completely assembled low-voltage bushing and termination shall be:
        a. Insulation Class: 1.2kV
        b. BIL: 30kV
        c. One Minute Withstand: 10kV
7. Fusing Equipment
    i. Transformers shall be equipped with externally removable, oil immersed, expulsion fuses in loadbreak bayonets in series with under oil partial range current limiting fuses.
    ii. All under oil fuses shall be easily accessible through a large “hand hole”. The hand hold shall be large enough and placed in such a location that all internal fusing elements will be “within” the hand hole area. In no case shall the hand hole be smaller than 10 inches by 12 inches unless approved by the City (WCP). The hand hole cover shall be tamper-resistant and its locking device shall be accessible from inside the high-voltage or low-voltage transformer compartment.
    iii. The transformer shall be equipped with an under oil **partial range current limiting fuse**. The bayonet expulsion fuses and backup current limiting fuses shall be coordinated to ensure that the current limiting fuse will only operate on faults internal to the transformer. The current limiting fuse used shall have an interrupting rating of **50,000 Amp (Minimum) symmetrical.**
8. Core and Windings
    i. All wye-wye connected transformers shall have four or five-legged core construction or shall otherwise include provisions to prevent excessive tank heating. The core construction or other provisions for preventing tank heating shall be adequate for unbalanced loading conditions of one or more of the primary phases of the transformer being energized from the same (single-phase) source.
    ii. One piece core construction is desired. Where other construction is used, minimum assembly joints shall be provided. For approved two part cores, the core shall be held together with bands and torqued bolts. Crimped banding is not acceptable for ratings over 50kVA.
    iii. Copper or aluminum winding conductors are acceptable.
    iv. Core material may be either silicon steel or amorphous.
    v. Core losses shall be minimized by the core material and core construction.

vi. Transformers shall be equipped with a common H.X. bushing with a copper grounding strap to the transformer case.

9. Insulation
    i. All insulating paper used as layer insulation in transformer coils shall be coated on both sides with a thermosetting adhesive and properly cured prior to impregnating with oil, or the coils shall be wound with primary conductor containing a thermosetting adhesive that when properly cured will form an effective bond.
    ii. Insulating/cooling fluid within the tank shall be electrical grade mineral oil or a natural ester fluid.
    iii. All fluids shall be certified and indicated on the nameplate to be less than 1 part/million PCB content.
    iv. Fluids other than mineral oil shall have submitted with the quotation complete chemical and electrical characteristics and a statement of being non-PCB.
10. Pressure Relief Device
    i. Each transformer shall be equipped with a self-actuating pressure relief device to relieve slow pressure buildup and to automatically vent when pressure reaches +/- 10 PSIG and recloses when pressure fails to +/- 6 PSI.
11. Mounting and Lifting
    i. Mounting shall be suitable for concrete pad mounting. Provide suitable anchorage brackets for seismic site class D.
    ii. The tank shall have lifting provisions of adequate strength, size and arrangement on the transformer to permit lifting the transformer in an upright position when filled with insulating fluid.
12. Grounding
    i. The tank shall have a welded stainless steel ground pad attached on the primary and secondary side of the tank near the bottom of the tank clear of the bushings and attached conductors (two pads total).
    ii. The grounding pads shall be free of paint and shall be 7/16 inch deep and threaded for a ½" 13 NC grounding stud or connector.
    iii. The tank cover shall have a grounding strap between the cover and the tank.
13. Accessories
    i. IEEE C57.12.34 standard accessories shall be provided.

D. Finish

1. The paint system shall meet or exceed the requirements of IEEE C57.12.28.
2. The transformer shall be given a durable, corrosion resistant, non-chalking, green outdoor finish capable of meeting or exceeding EEI finishing requirements.
3. All transformer surfaces in contact with the pad shall be designed or treated to minimize corrosion.

E. Shipping and Identification

1. Shipping

i. Transformers shall be shipped on pallets.

2. Identification
   i. The nameplates shall contain the manufacturers name, address, kVA, primary voltage, secondary voltage(s), % impedance, rated temperature rise, a wiring diagram indicating connections and voltages with polarity (additive or subtractive), losses (no load and full load), insulating fluid identification, and PCB content, weight when full, manufacturers part (catalog) number, and serial number unique to the transformer.
   ii. The name plates shall conform to IEEE C57.12.00 and C57.12.34 latest revision.
   iii. The nameplate shall be mounted on a permanently attached backing plate with welds or rivets. Removable nameplates or nameplates attached to removable parts will not be acceptable.

F. Testing

1. All transformers shall be tested in accordance with the requirements of IEEE C57.12.90 latest revision. All transformers shall be capable of withstanding short circuit tests.

G. Loss Criteria

1. All transformers shall meet or exceed DOE-2016 efficiency and loss standards.
2. Transformers that do not meet the loss requirements shall not be accepted.
3. All actual tested loss data and statement of compliance with DOE 2016 will be transmitted to the City Power Superintendent within five days after shipment of the transformers.

H. Vendor Evaluation

1. Vendor evaluations as well as loss evaluations will be used to determine the low bidder. Delivery dates will be of prime concern during the bid evaluation. A penalty of 20 percent will be assessed to all foreign manufactured transformers.

I. **Exceptions**

1. Exceptions to this Specification shall not be accepted. Any exceptions taken shall be noted in the proposal.

J. Warranty

1. Manufacturer shall warrant to Purchaser that the apparatus or services to be furnished hereunder shall be of the highest quality and free from defects in material, workmanship, and title and will be of the kind designated in the pertinent purchase order. The Manufacturer's warranty shall be effective for a period of twelve (12) months after the date of shipment to Purchaser. Terms of Manufacturer’s warranty shall be included in the bid proposal and will be criterion for evaluation of the proposal.
2. The manufacturer shall guarantee that all transformers furnished under this specification are of first class material and workmanship throughout, that they have been tested in accordance with this specification, and that the results of the

tests comply with the requirements of this specification, and, in lieu of other collins against it, agrees to replace or repair;

i. Any transformer found to be defective in material or workmanship or found not to be in compliance with the requirements of this specification before or during installation of the transformer.
ii. Any transformer failing during normal and proper use within the manufacturer’s guarantee period which shows defects of material or workmanship.

5.7 Single Conductor EPR Shielded Power Cable Rated 15 kV with Concentric Neutral, rated 105°, Type URD

A. General

1. This specification covers single-conductor with concentric neutral power cable insulated with an ozone and discharge resistant, flexible, rubber-like thermosetting dielectric EPR.
    i. The cable shall be suitable for use in wet and dry locations in conduit, underground duct systems, direct buried and aerial installations. The cable shall be rated 105℃ for normal operation, 140℃ for emergency overload operation and 250℃ for short circuit conditions. Emergency overload operation may occur for periods up to 1,500 hours cumulative during the life of the cable.
    ii. The cable is intended for operation at 60 Hz single phase or three phase (line-to-line) and shall be suitable for operation in ducts or direct buried installations in earth, for wet and dry locations, and in open air in sunlight.
    iii. All material and equipment specified within these standards and specifications will be American made. Non-domestic material will not be accepted.
    iv. After a line has been energized and a failure occurs on the line during the contractor's one year warranty period, the City will repair the failure and bill the responsible contractor for the time, material and equipment.
2. Operating Experience
    i. The medium voltage power cable supplied shall have a performance record demonstrating a minimum of twenty five (25) years successful operation experience in utility and industrial power cable applications.
3. Basic Construction
    i. 1/C Class B strand aluminum conductor, extruded semiconducting rubber conductor shield, EPR extruded Insulation, semiconducting rubber extruded insulation shield, copper concentric neutral wires and an overall jacket.
4. Industry Standards
    i. Cable shall meet or exceed the latest editions of the following industry specifications:
        1. ANS/ICEA S-94-649 " Standard for Concentric Neutral Cables Rated 5 through 46 kV"
        2. AEIC CS8 " Specification for Extruded Dielectric, Shielded Power Cables Rated 5 through 46kV"
        3. NEMA WC26 "Binational Wire and Cable Packaging Standard"
        4. ASTM B-8, B-231
        5. IEEE 400
        6. Federal Register, Section 10CFR50, Appendix B
        7. IEEE 48
        8. IEEE/IPCEA Power Cable Ampacities, IEEE S-135

5. Submittals
    i. Product Date: Submit manufacturer's data on electrical cable and connectors for use at the specified voltage. Submit certificate of compliance indicating that the cable has been tested in accordance with the reference standards and this specification and meets or exceeds minimum requirements.

B. Conductor

1. Conductor
    i. Uncoated soft aluminum wire, Call B, stranded compressed concentric round. Aluminum per ASTM B-231
    ii. Conductors shall meet the electrical resistance, diameter and tensile requirements of the reference standard.
    iii. FIlled stand conductors will also be acceptable.
2. Conductor Shield
    i. Extruded layer of semiconducting EPR or non-conducting thermosetting compound with a volume resistivity not in excess of 100 ohm meters at 105℃ shall be applied over the conductor. The compound shall have a minimum elongation after an air over test at 136℃ for 168 hours of 100% and a brittleness temperature not warmer than -40℃.
    ii. The shield shall be clean stripping from the conductor and inseparable bonded to the overlying insulation.
    iii. The thickness of the extruded conductor shield shall be as shown in Table 8.

Table 8	
Conductor Size - awg/kcmil	Min. Point (mils)
#8 - #4/0	12
250-500	16
500-1000	20

3. Insulation
    i. The insulation shall be based on a flexible thermosetting ethylene propylene elastomer (EPR).
    ii. The ethylene content of the elastomer used in the nominal insulation compound shall not exceed 72% by weight nor shall the insulation compound contain any polyethylene. Also, any processing agent utilized to mix the formulation shall be widely dispersed to prevent susceptibility to treeing. The insulation shall be compounded by the cable manufacturer in its own facility using a closed system to ensure maximum cleanliness. All ingredients shall be thoroughly mixed, screened and treated with accelerator or cross linking agent to ensure complete blending and uniformity of the final compound.

iii. The minimum average insulation thickness shall not be less than Table 9. The minimum thickness at any cross section of the insulation shall not be less than 90% of the specified minimum average thickness.

iv. The insulation shall be triple tandem extruded with the conductor and insulation shield to prevent intersurface contamination. The extrusion operation shall be performed by three separate in line extruded heads thereby permitting the measurement and accurate individual control of the wall thickness of each layer of compound as the cable is being manufactured.

Table 9				
Rated Voltage Phase to Phase kV	Conductor Size	Minimum Average Insulation Thickness mils - 133%	5 Minute ac withstand kV	15 Minute dc withstand kV
15	AWG	220	44	80

4. Insulation Shield

i. The meter insulation shield shall be an extruded thermoset semiconducting compound with a volume resistivity not in excess of 100 ohm-meters at 105℃ when tested per AEIC No. CS-8. The material shall be chemically and thermally compatible with the insulation.

ii. The extruded shield shall be clean stripping and shall have an adhesion tension to the insulation between 3 and 24 lbs./0.5 inch width when tested per ICEA S-94-649. This compound shall have a minimum elongation after an air over test at 136℃ for 168 hours of 100% and a brittleness temperature not warmer than -40℃.

iii. The thickness of the extruded shield shall be in accordance with the following:

Insulation Shield Thickness (mils)			
Minimum Insulation Diameter (Inches)	Min. Point	Max. Point	Max. Indent
0 - 1.000	30	70	15
1.001 - 1.5000	40	85	15
1.501 - 2.000	55	100	20

iv. The outer surface of the insulation shield shall be continuously printed with contrasting ink - “Semiconducting - Remove When Splicing or Terminating”.

5. Metallic Shield

i. The metallic shield shall consist of balanced and helical wrap of bare copper concentric neutral wires. They shall be applied directly over the insulation shield with a lay of 6 to 10 times the diameter over the wire.

ii. Neutral conductor shall be full sized for single phase feeders and one third for 3 phase feeders.

6. Jacket
   i. The overall jacket shall be black LLDPE (linear low density polyethylene) with 3 red strips spaced 120° apart.
   ii. The jacket thickness shall be as shown in the following:

Cable Diameter Before Jacket (Inches)	Jacket Thickness Minimum Average (mils)
0 - 1.500	50
Over 1.500	80

   iii. The minimum thickness at any point shall be not less than 80% of extruded the specified minimum average thickness jacket.
   iv. The overall jacket shall substantially fill the spaces between the concentric neutral wires and shall be free stripping from the insulation shield and concentric neutral.
7. Identification
   i. An identifying legend shall be printed on the outer jacket with contrasting ink repeated at two (2) foot intervals with unmarked surfaces not exceeding six inches. The legend shall provide the following information:
      1. Manufacturer name and plant code
      2. Conductor Size - wither AWG or kcmil
      3. AL
      4. Type of Insulation
      5. Voltage Rating
      6. Nominal Insulation Thickness
      7. Power Cable Symbol
      8. Year of Manufacture
      9. Sequential Footage at 2 FT Intervals
8. Production Tests
   i. All production tests per the electrical resistance requirements of ICEA-S94-649 Section 2.4.
   ii. Insulation Resistance test shall be performed in accordance with the requirements of ICEA-S94-649. Each cable shall have an insulation resistance not less than that corresponding to the insulation resistance constant of at least 50,000 megohms-1000ft. At 15.6℃.
   iii. A high voltage ac and dc test is performed in accordance with Part 9.12 of ICEA-S94-649 at the ac and dc test voltage given in Table 9.
   iv. Shield resistance is measured and recorded from end to end on the completed cable.
   v. Partial Discharge Test: Either a table showing the actual partial discharge level (background noise) or an X-Y recording graph will be furnished showing the partial discharge test results.

9. Quality Assurance
    i. The Cable shall be manufactured and tested under the control of a Quality Assurance program which meets the requirements of ISO 9001.
    ii. The Quality Assurance program shall demonstrate compliance with the above referenced criteria by having passed yearly Quality Audits conducted by outside independent organizations.
10. Packaging and Marking
    i. The cable shall be furnished in cutting lengths as single conductor.
    ii. The reels shall be substantially constructed non-returnable wood reels to safely carry the weight of the cables. Each reel of cable shall be protected with NEMA Level 2 covering. The bottom and top cable ends shall be properly secured to the reel.
    iii. There shall be no water or corrosion in the standard conductor of the completed cable when the reel is shipped. Each end of cable shall be capped and sealed watertight to prevent the entrance of moisture into the cable during transit or outdoor storage.
    iv. Reels shall be non-returnable, double layered, wood flanged typed, substantially constructed to afford proper protection of the cable during shipment and handling. Reels shall have a minimum drum diameter not less than prescribed in NEMA WC26.
    v. Each reel shall be marked with a weather-resistant label, securely attached to a flange of the reel and plainly stating the destination, purchaser's factory production lot identification number, date of manufacture, description of cable, length of cable on reel, and gross and tare weight of reel.
    vi. Reel size shall be such to carry an average of 2500 feet of cable per reel, unless specified lengths are noted. The length tolerance shall be +/- 10%.
11. Miscellaneous Bid Information Required
    i. Brief description of cable including size, number of conductors, stranding, shield type, type of insulation, catalog number, and manufacturer's plant location.
    ii. Indicate any requirements contained in this specification that the proposed cable will not meet, if any.
    iii. The manufacturer's certified test report of all production tests required by the referenced standards must be received by the Superintendent, Washington City Power Department, prior to accepting wire shipment. Maximum recommended pulling tensions for both the conductor and out jacket shall be provided.
    iv. Brief history of the number of years cable manufacturer can document that the cable being bid has successfully operated under utility power operations.
    v. A complete detailed copy of the warranty provided on cable being qualified.
12. Approved Manufacturers
    i. Okonite

ii. General Cable
iii. Kerite
iv. Or approved equal prior to installation

C. Execution: High Voltage Power Cable Installation Methods

1. General
    i. Contractor shall install electric conductors and cables as indicated, in compliance with manufacturer's written instructions, applicable requirements of NEC and NECA's "Standards of Installation ", and in accordance with recognized industry practices.
    ii. Primary cables shall not be pulled into concrete encased plastic conduit (Type DB) until all conduit joints made using plastic conduit cement have been allowed to dry for at least ½ hour.
    iii. When pulling cables into conduit, the pulling line used shall have a safe working load rating (minimum) equal to the maximum allowable pulling line tensions for the type and size of cables being pulled as recommended by the manufacturer. Cables shall be pulled into conduit with a pulling eye attached to the cable conductor or a pulling grip placed over the cable sheath, insulation or jacket.
    iv. When primary cables are pulled into straight conduit runs, the pulling line tension shall not exceed the values shown in the manufacturer's shop drawings.
    v. When primary cables are pulled into conduit runs including bends or sweeps, the maximum pulling line tension shall not exceed 300 lbs per foot of radius of curvature of the bend or sweep with the radius expressed in feet.
2. Cables Pulling in Conduit
    i. Whenever possible, pull cables so that bends in the conduit into which the cables are to be pulled are nearest to the feed-in end. This will result in minimum tension on the cables.
    ii. On long pulls, the pull-out manhole should be rigged whenever possible, so that an adequate amount of cable for splicing and racking may be pulled into the manhole without the necessity of taking hitches on the cable sheath or jacket.
    iii. In highly congested manholes or where cables must be bent sharply to permit pulling, use a feed-in tube for pulling in cables. This will reduce pulling tensions and prevent damage to the cables being pulled and to other adjacent cables.
    iv. Before making a pull, conduits must be clear and free of dirt, rocks etc. Pulling tension should be continuously monitored to ensure that damage to the cables will not occur. A mandrell of the proper size shall be pulled through the conduit prior to cable installation.
    v. Wire ropes shall not be used to pull cables in nonmetallic conduits unless all bends in the conduits are constructed using a bent length of steel conduit or steel elbows.

vi. Do not pull cable into duct or conduit until factory test reports of cable have been approved.

vii. Cables may be pulled by direct attachment to conductors or by use of basket weave pulling grip applied over cables. Attachment to pulling device shall be made through approved ball-bearing swivel connection. Cable may be pulled by using basket weave pulling grip, provided the pulling force does not exceed limits recommended by the manufacturer; if pulling more than one cable, bind them together with friction tape before applying the grip. For long pulls requiring heavy force, use pulling eyes attached to conductors. Do not exceed 1000 lbs. per grip when using basket weave grips.

viii. Do not exceed manufacturer's recommendations for maximum allowable pulling tension, side wall pressure, and minimum allowable bending radius. In call cases, pulling tension applied to copper conductors shall be limited to 0.008 lbs per circular mil of conductor cross-section area and 0.006 lbs per circular mil of conductor cross-section area for aluminum conductors.

ix. Pull in cable from the end having the sharpest bend (ie: bend shall be closest to reel). Keep pulling tension to minimum by liberal use of lubricant, and turning of reel, and slack feeding of cable into duct entrance. Employ not less than one man at the reel and one at the pull hole during this operation.

x. For training of cables, minimum bend radius to inner surface of cable shall be 12 times cable diameter.

xi. Where cable is pulled under tension over sheaves, conduit bends, or other curved surfaces, make minimum bend radius 50% greater than specified above for training.

xii. Use only wire and cable pulling compound recommended by the specific cable manufacturer, and which is listed by UL.

xiii. Seal all cable ends unless splicing or terminating is to be done immediately.

xiv. Support all cables in pullholes, concrete tranches, and similar locations by cable racks and secure to rack insulators with nylon cord and self-locking nylon cable ties. Place cable on separate insulator.

xv. Mule tape shall be installed in all unused conduit.

5.8 Dead Front Padmounted Metal Enclosed Switchgear Specification

A. General

1. The Power Department, Engineer, Inspector, or Power Superintendent shall determine the class of switchgear needed for each job. The switchgear supplied shall be a PME or PSE, 600 amp Dead Front Configuration, with 200 A Fused ways. These will be designed per individual needs.
2. The padmounted gear shall be in accordance with the one-line diagram, and shall conform to the following specification.
3. The padmounted gear shall consist of a single self-supporting enclosure, containing interrupter switches and power fuses, as indicated on the drawings, with the necessary accessory components, all completely factory-assembled and operationally checked.

B. Ratings

1. The ratings for the integrated outdoor style, manually operated, padmounted gear shall be as designated below.
    i. 14.4kV, Nominal
    ii. 17.5kV, Maximum
    iii. 95kV, BIL
    iv. 600 Main Buss Continuous, Amperes (as required)
    v. <u>Three Pole Interrupter Switches</u>
        a. 600 Continuous, Amperes
        b. 600 Load Dropping, Amperes
        c. 65,000 Peak Withstand Current, Amperes
        d. 14,000 One Second Short Time Withstand Current, Amperes, RMS Asymmetrical
        e. 36,400 Three-Time Duty Cycle Fault-Closing Amperes RMS Asymmetrical
    vi. Fused Ways
        a. 200E Maximum, Amperes
        b. 200 Load Dropping, Amperes
        c. Fuse Type, SM-20
        d. 14,000 Interrupting Symmetrical
    vii. Short-Circuit Ratings
        a. 32,500 Peak Withstand Current, Amperes
        b. 12,500 One Second Short Time Withstand Current, Amperes, RMS Asymmetrical
        c. 310 MVA Three-Phase Symmetrical at Rated Nominal Voltage
2. The momentary and two-time duty-cycle fault-closing ratings of switches, momentary rating of bus, interrupting ratings of fuses, and one-time duty-cycle fault-closing capabilities of the fuses with integral load interrupters shall equal or exceed the short-circuit ratings of the padmounted gear.

3. Quantity
    i. The Contractor shall install padmount switchgear of the quantity configuration and rating as required and approved by the Power Department or Power Superintendent.
    ii. The contractor will also supply two sets of fuses for each bay connected to the new development. Fuse sizing to be determined by the Power Department or Power Superintendent.
4. Certification of Ratings
    i. The manufacturer of the padmounted gear shall be completely and solely responsible for the performance of the basic switch and fuse components as well as the complete integrated padmounted gear assembly as rated.
    ii. The manufacturer shall furnish, upon request, certification of ratings of the basic switch and fuse components and/or the integrated padmounted gear assembly consisting of the switch and fuse components in combination with the enclosure.
5. Compliance With Standards and Codes
   The padmounted gear shall conform to or exceed the applicable requirements of the following standards and codes:
    i. All portions of ANSI C57.12.18, covering enclosure integrity considerations for tamper resistance.
    ii. Article 710-21(e) in the National Electrical Code, which specifies that the interrupter switches combination with power fuses shall safely withstand the effects of closing, carrying, and interrupting all possible currents up to the assigned maximum short-circuit rating.
    iii. All portions of ANSI, IEEE, and NEMA standards applicable to the basic switch and fuse components.
6. Enclosure Design
    i. To ensure a completely coordinated design, the padmounted gear shall be constructed in accordance with the minimum construction specifications of the fuse and/or switch manufacturer to provide adequate electrical clearances.
    ii. In establishing the requirements for the enclosure design, consideration shall be given to all relevant factors such as controlled access, tamper resistance, corrosion resistance, and resistance to entry of foliage, animals and airborne contaminants.

C. Assembly

1. Insulators
    i. The interrupter-switch and fuse-mounting insulators shall be of cycloaliphatic epoxy resin system with characteristics and restrictions as follows:
        a. Operating experience of at least 20 years under similar conditions.
        b. Adequate leakage distance established by test per IEC Publication 60507.
        c. Adequate strength for short-circuit stress established by test.
        d. Conformance with applicable ANSI standards.

e. Homogeneity of the cycloaliphatic epoxy resin throughout each insulator to provide maximum resistance to power arcs. Ablation due to high temperatures from power arcs shall continuously expose more material of the same composition and properties so that no change in mechanical or electrical characteristics takes place because of arc-induced ablation. Furthermore, any surface damage to insulators during installation or maintenance of the padmounted gear shall expose material of the same composition and properties so that insulators with minor surface damage need not be replaced.
f. Each insulator, bushing and bushing well shall be x-rayed to assure it is essentially void free. An alternate testing method may be used only by approval of the engineer.
g. Conductor rods of bushings and bushing wells shall be of all copper with silver flash at threaded studs.

2. High-Voltage Bus
   i. Bus and interconnections shall consist of aluminum bar of 56% IACS conductivity.
   ii. Bus and interconnections shall withstand the stresses associated with short-circuit currents up through the maximum rating of the padmounted gear.
   iii. Bolted aluminum-to-aluminum connections shall be made with suitable number of ½"--13 stainless steel bolts and washers and with two stainless steel spring washers per bolt, one under the bolt head and one under the nut. Bolts shall be tightened to an appropriate torque to assure a good electrical connection.
   iv. Before installation of the bus, all electrical contact surfaces shall first be prepared by abrading to remove any aluminum-oxide film. Immediately after this operation, the electrical contact surfaces shall be coated with a uniform coating of an oxide inhibitor and sealant.
   v. Tie bus, where furnished, shall consist of continuous, one-piece sections of aluminum bar with no intermediate splices. Flexible braid or cable shall not be used.

3. Provisions for Grounding
   i. A ground-connection pad shall be provided in each compartment of the padmounted gear.
   ii. The ground-connection pad shall be constructed of at least ¼" thick steel, which shall be nickel plated or stainless steel. The pad shall be welded to the enclosure, and shall have a short-circuit rating equal to that of the padmounted gear.
   iii. Ground connection pads shall be coated with a uniform coating of an oxide inhibitor and sealant prior to shipment.
   iv. A copper rod, connected to the ground connection pad, shall be provided in each termination compartment for switches and bus. The rod shall have a diameter no less than ⅜ inch and extend across the full width of

the compartment to allow convenient grounding of cable concentric neutrals and accessories, and shall have a short-circuit rating equal to that of the padmounted gear.

v. Continuous copper ground bus shall be provided across the full width of each termination compartment for fuses. For each fuse mounting, there shall be a ground ring made of ⅜ inch diameter copper rod bolted to the ground bus and placed to allow convenient grounding of cable concentric neutrals and accessories. Ground rings and bus shall have a short-circuit rating equal to that of the padmounted gear.

4. Bushings and Bushing Wells
   i. Bushings and bushing wells shall conform to ANSI/IEEE Standard 386.
   ii. Bushings and bushing wells shall be of a cycloaliphatic epoxy resin system with characteristics and restrictions as follows:
      a. Operating experience of at least 15 years under similar conditions.
      b. Adequate leakage distance for in-air application established by test per IEC Publication 507, “Artificial Pollution Test on High Voltage Insulators to be Used on AC Systems”.
      c. Adequate strength for short-circuit stress established by test.
      d. Conformance with applicable ANSI standards.
      e. Homogeneity of the cycloaliphatic epoxy resin throughout each bushing or bushing well to provide maximum resistance to power arcs. Ablation due to high temperatures from power arcs shall continuously expose more material of the same composition and properties so that no change in mechanical or electrical characteristics takes place because of arc-induced ablation.
   iii. Bushings and bushing wells shall be mounted in such a way that the semiconductive coating is solidly grounded to the enclosure.
   iv. Bushings rated 600 amperes continuous shall have a removable threaded stud so that the bushings are compatible with all 600-ampere elbow systems – those requiring a threaded stud as well as those that do not.
5. Termination Compartments
   i. Termination compartments for switches shall have bushings, and termination compartments for fuses shall have bushing wells to permit connection of elbows. The bushings and bushing wells shall be mounted on the interior walls at a minimum height of 33 inches above the enclosure base.
   ii. Termination compartments for bus shall have bushing wells to permit connection of elbows. The bushing wells shall be mounted on the interior wall at a minimum height of 25 inches above the enclosure base.
   iii. Termination compartments for bushings rated 600 amperes continuous shall be of an adequate depth to accommodate two 600-ampere elbows mounted piggyback, encapsulated surge arrestors or grounding elbows mounted on 600-ampere elbows having 200-ampere interfaces, or other similar accessory combinations without the need for an enclosure extension.

iv. Termination compartments for bushing wells rated 200 amperes continuous shall be of an adequate depth to accommodate 200-ampere elbows mounted on portable feed thrus or standoff insulators, or other similar accessory combinations without the need for an enclosure extension.
v. Termination compartments shall be provided with one parking stand for each bushing or bushing well. The parking stand shall be located immediately adjacent to the associated bushing or bushing well and shall accommodate standard feed thurs and standoff insulators, and other similar accessories.
vi. Each termination compartment for a switch shall be equipped with a viewing window to allow visual inspection of interrupter switch blades to allow positive verification of switch position.
vii. Each termination compartment for a set of fuses shall be equipped with a set of viewing windows to allow visual inspection of blown-fuse indicators.

D. Construction - Enclosure Including Outdoor Finish

1. Enclosure
   i. The enclosure shall conform to or exceed the requirements of ANSI/IEEE C57.12.28.
   ii. The padmounted gear enclosure shall be of unitized monocoque (not structural-frame-and-bolted-sheet) construction to maximize strength, minimize weight, and inhibit corrosion.
   iii. The basic material shall be 11-gauge hot-rolled, pickled and oiled steel sheet.
   iv. All structural joints and butt joints shall be welded, and the external seams shall be ground flush and smooth. A suitable welding process shall be employed to eliminate alkaline residues and to minimize distortion and spatter.
   v. To guard against unauthorized or inadvertent entry, enclosure construction shall not utilize any externally accessible hardware.
   vi. The base shall consist of continuous 90-degree flanges, turned inward and welded at the corners, for bolting to the concrete pad.
   vii. Gasketing between the roof and the enclosure shall guard against entry of water and airborne contaminants and shall discourage tampering or insertion of foreign objects.
   viii. The door openings shall have 90-degree flanges, facing outward, that shall provide strength and rigidity as well as deep overlapping between doors and door openings to guard against water entry.
   ix. An internal steel-enclosed compartment shall encase the interrupter switches and fuses for electrical isolation and protection from contamination. The compartment shall have a galvanized steel sheet floor to exclude foliage and animals. The floor shall have screened drain vents to allow drainage if the enclosure is flooded. The top of this compartment shall be gasketed to provide sealing with the enclosure roof.

x. Insulating barriers shall be provided in each switch and fuse compartment as required to achieve necessary insulation levels. This barrier system shall be constructed of fiberglass reinforced polyester (NEMA rated GPO-3).

xi. Lifting tabs shall be removable. Sockets for the lifting-tab bolts shall be blind-tapped. A resilient material shall be placed between the lifting tabs and the enclosure to help prevent corrosion by protecting the finish against scratching by the tabs. To further preclude corrosion, this material shall be closed-cell or open mech to prevent moisture from being absorbed and held between the tabs and the enclosure in the event that lifting tabs are not removed.

2. Doors

i. Doors shall be constructed of 11-gauge hot-rolled, pickled and oiled steel sheet.

ii. Door-edge flanges shall overlap with door-opening flanges and shall be formed to create a mechanical maze that shall guard against water entry and discourage tampering or insertion of foreign objects, but shall allow ventilation to help keep the enclosure interior dry.

iii. Doors shall have a minimum of two extruded-aluminum hinges with stainless-steel hinge pins, and interlocking extruded-aluminum hinge supports for the full length of the door to provide strength, security, and corrosion resistance. The hinge pins shall be secured in place to guard against tampering. Mounting hardware shall be stainless steel or zinc-nickel plated steel, and shall not be externally accessible to guard against tampering.

iv. In consideration of controlled access and tamper resistance, each door (or set of double doors) shall be equipped with an automatic three-point latching mechanism.

a. The latching mechanism shall be spring loaded, and shall latch automatically when the door is closed. All latch points shall latch at the same time to preclude partial latching.

b. A hex head socket wrench or tool shall be required to actuate the mechanism, in lieu of a pentahead actuator, to unlatch the door and, in the same notion, recharge the spring for the next closing.

c. The latching mechanism shall have provisions for padlocking that incorporate a means to protect the padlock shackle from tampering and that shall be coordinated with the latched such that:

- It shall not be possible to unlatch the mechanism until the padlock is removed, and
- It shall not be possible to insert the padlock until the mechanism is completely latched closed.

v. Doors providing access to solid-material power fuses shall have provisions to store spare fuse units or refill units.

vi. Each door shall be provided with a galvanized or stainless steel door holder located above the door opening. The holder shall be from view

when the door is closed, and it shall not be possible for the holder to swing inside the enclosure.

3. Roof
    i. The roof shall be constructed of 11-gauge hot-rolled, pickled and oiled steel sheet.
    ii. A heavy coat of insulating “no-drip” compound shall be applied to the inside surface of the center roof section to minimize condensation of the moisture theron.
    iii. Roof sections over termination compartments shall be liftable and hinged to allow room for cable pulling during installation. Each roof section shall require minimal effort to open and close and shall have a retainer to hold it in the open position.
    iv. A mechanical interlock shall be provided to ensure that the roof sections over the termination compartments are closed and secured before allowing full engagement of the door latching mechanism described in Section D.02(v).
    v. Roof sections over high-voltage compartments shall be bolted to the enclosure with no exposed fasteners.
4. Finish
    i. Full coverage at joints and blind areas shall be achieved by processing enclosures independently of components such as doors and roofs before assembly into the initized structures.
    ii. All exterior seams shall be filled and sanded smooth for neat appearances.
    iii. To remove oils and dirt, to form a chemically and anodically neutral conversion coating to improve the finish-to-metal bond, and to retard underfilm propagation of corrosion, all surfaces shall undergo a thorough pretreatment process before any protective coatings are applied.
    iv. After pretreatment, protective coatings shall be applied that shall help resist corrosion and protect the steel enclosure. To establish the capability of the finishing system to resist corrosion and protect the enclosure, representative test specimens shall satisfactorily pass the testing requirements as specified in IEEE Std C57.12.28 (latest revision) and as well as the following tests:
        a. 1500 hours of exposure to salt-spray testing per ASTM B 117 with:
            - Under film corrosion not to extend more than 1/32” from the scribe; and
            - Loss of adhesion from bare metal not to extend more than ⅛” from the scribe.
        b. 1000 hours of humidity testing per ASTM D 2247 with no blistering as evaluated per ASTM D 714.
        c. Ultraviolet accelerated weathering test, per C57.12.28 latest revision, tested per ASTM G53, evaluated per ASTM D523.
        d. Crosshatch adhesion testing per ASTM D 3359 Method B with no loss of finish.

e. 80-inch-pound impact adhesion testing per ASTM D 2794 with no chipping or cracking.
f. Simulated corrosive atmospheric breakdown (SCAB). SCAB test per C57.12.28 latest revision, per ASTM D1654.
g. 3000 cycles of abrasion testing per ASTM 4060 with no penetration to the substrate.
h. Gravelometer (per ASTM D3170). Tested per C57.12.28 latest revision, per ASTM D3170.

v. Certified test abstracts substantiating the above capabilities shall be furnished upon request.

vi. A resilient closed-cell material, such as PVC gasket, shall be applied to the entire underside of the enclosure bottom flange to protect the finish on this surface from scratching during handling and installation. This material shall isolate the bottom flange from the alkalinity of a concrete foundation to help protect against corrosive attack.

vii. After the enclosure is completely assembled and the components (switches, fuses, bus, etc.) are installed, the finish shall be inspected for scuffs and scratches. Blemishes shall be carefully touched up by hand to restore the protective integrity of the finish.

viii. The topcoat finish shall be, Munsell 7GY 3.39/1.5. A tan finish is also acceptable with approval from the Washington City Superintendent.

5. To Guard against corrosion, all hardware (including door fittings, fasteners, etc.), all parts subject to abrasive action from mechanical motion shall be of either nonferrous materials, or galvanized or zinc-nickel plated ferrous materials. Cadmium-plated ferrous parts shall not be used.

E. Basic Components

1. Interrupter Switches

i. Interrupter switches shall be enclosed in an inner steel compartment and shall be provided with bushings rated 600 amperes continuous to permit connection of elbows external to the switch compartment.

ii. Interrupter switches shall have a three-time duty-cycle fault-closing rating equal to or exceeding the short-circuit rating of the padmounted gear assembly. These ratings define the ability to close the interrupter switch twice against a three-phase fault with asymmetrical current in at least one phase equal to the rated value, with the switch remaining operable and able to carry and interrupt rated current. Tests substantiating these ratings shall be performed at maximum voltage with current applied for at least 10 cycles. Certified test abstracts establishing such ratings shall be furnished upon request.

iii. Interrupter switches shall be operated by means of externally accessible ¾” hex switch-operating hub. The switch-operating hub shall be located within a recessed stainless-steel pocket mounted on the side of the padmounted gear enclosure and shall accommodate a ¾” deep-socket wrench or a ¾” shallow-socket wrench with extension. The switch-operating-hub to pocket shall include a padlockable stainless steel access cover that shall incorporate a hood to protect the padlock shackle

from tampering. Stops shall be provided on the switch-operating-hub to prevent over travel and thereby guard against damage to the interrupter switch quick-make quick-break mechanism. Labels to indicate switch position shall be provided in the switch-operating-hub pocket.

iv. Each interrupter switch shall be provided with a folding switch-operating handle. The switch-operating handle shall be secured to the inside of the switch-operating-hub pocket by a brass chain or stainless steel cable. The folded handle shall be stored behind the closed switch-operating-hub access cover.

v. Interrupter switches shall utilize a quick-make quick-break mechanism installed by the switch manufacturer. The quick-make quick-break mechanism shall be integrally mounted on the switch frame, and shall swiftly and positively open and close the interrupter switch <u>independent of the switch-operating-hub speed</u>.

vi. Each interrupter switch shall be completely assembled and adjusted by the switch manufacturer on a single rigid mounting frame. The frame shall be of welded steel construction such that the frame intercepts the leakage path which parallels the open gap of the interrupter switch to positively isolate the load circuit when the interrupter switch is in the open position.

vii. Interrupter switch contacts shall be backed up by stainless steel springs to provide constant high contact pressure.

viii. Interrupter switches shall be provided with a single blade per phase for circuit closing including fault closing, continuous current carrying, and circuit interrupting. Spring-loaded auxiliary blades shall not be permitted.

ix. Interrupter switches shall have the capability established by test to perform switching duties which include interrupting load current up through the assigned live-switching rating, as well as transformer magnetizing currents associated with the applicable loads, and bale-charging current and line-charging current typical for distribution systems of the applicable voltage ratings as specified in IEEE C37.74. Supporting certified test abstracts shall be furnished upon request.

x. Circuit interruption shall be accomplished by use of an interrupter which is positively and inherently sequenced with the blade position. It shall not be possible for the blade and interrupter to get out of sequence. Circuit interruption shall take place completely within the interrupter, with no external arc or flame. Any exhaust shall be vented in a controlled manner through a deionizing vent. Arc extinction shall not rely on gasses generated by ablative action of the arc playing on any interrupter switch components or materials which will carbonize, deplete or otherwise erode such components and materials.

xi. Interrupter switches shall have a readily visible open gap when in the open position to allow positive verification of switch position.

xii. Ground studs shall be provided at all switch terminals. Ground studs shall also be provided on the ground pad in each interrupter switch compartment and on terminals and ground pad in any bus compartment.

The momentary rating of the ground studs shall equal or exceed the short-circuit ratings of the padmounted gear.

xiii. Cable guides shall be provided to help orient cables at switch terminals and bus compartment terminals.

F. **Fuses**

1. Solid Material Power Fuses
    i. Two sets of fuses shall be supplied by the contractor for each bay used. Sizing will be determined by the Power Director or Superintendent.
    ii. Fuses shall be disconnect style, solid-material power fuses, and shall utilize fuse-unit-and-holder construction. The fuse unit shall be readily replaceable.
    iii. Fusible elements shall be non-aging and non-damageable so that it is unnecessary to replace unblown companion fuses on suspicion of damage following fuse operation.
    iv. Fusible elements for fuse units rated 10 amperes or larger shall be helically coiled to avoid mechanical damage due to stresses from current surges.
    v. Fusible elements, that carry continuous current, shall be supported in air to help prevent damage.
    vi. Each fuse unit shall have a single fusible element to eliminate the possibility of unequal current sharing in parallel current paths.
    vii. Solid-material power fuses shall have melting time-current characteristics that are permanently accurate to within a maximum total tolerance of 10% in terms of current. Time-current characteristics shall be available which permit coordination with protective relays, automatic circuit reclosers, and other fuses.
    viii. Solid-material power fuses shall be capable of detecting and interrupting all faults up to and including the short circuit rating of the integrated padmounted gear assembly whether large, medium, or small (down to minimum melting current), under all realistic condition of circuitry, with line-to-line or line-to-ground voltage across the fuse, and shall be capable of handling the full range of transient recovery voltage severity associated with these faults.
    ix. All arcing accompanying fuse operation shall be contained within the fuse, and all arc products and gasses involved shall be effectively contained within the exhaust control device during fuse operation.
    x. Solid-material power fuses shall be equipped with a blown-fuse indicator that shall provide visible evidence of fuse operation while installed in the fuse mounting (must be visible without removing the fuse from its mounting).
    xi. Fuse type shall be S&C type SM-20 for system compatibility.
2. Fuse Mountings
    i. Fuse mountings shall be enclosed in an inner steel compartment and shall be provided with bushing wells rated 200 amperes continuous for elbow connection.

ii. Each fuse mounting shall be an integral part of a fuse handling mechanism that does not allow access to the fuse until the elbow for that fuse has been disconnected. To access a fuse it shall be necessary to:
    a. Disconnect the elbow for that fuse and move it to the appropriate parking stand.
    b. Actuate a mechanical interlock to unlock the fuse-access panel. It shall not be possible to disengage this interlock before the elbow is moved.
    c. Unloatch and then pivot/lower the fuse-access panel to electrically isolate the fuse so that it can be removed from the fuse mounting with a shotgun stick.

iii. The opening into the component compartment shall be covered by the fuse-access panel in both the open and closed positions to help prevent inadvertent access to high voltage.

iv. To protect the fuse-handling mechanism from corrosion, all mechanism parts shall be painted or made of corrosion-resistant materials, or otherwise be protected from corrosion. All latches and pivots shall be stainless steel or zinc-nickel-plated steel with nylon or plastic bushings.

v. Cable guides shall be provided in each termination compartment for a set of fuses, to prevent cables from interfering with rotation of the fuse-access panel.

G. Labeling

1. Warning Signs
    i. All external doors shall be provided with “Caution – High Voltage – Keep Out” signs.
    ii. The inside of each door shall be provided with a “ Danger – High Voltage – Keep Out – Qualified Persons Only” sign. The test shall further indicate that operating personnel must know and obey the employer's work rules, know the hazards involved, and use proper protective equipment and tools to work on this equipment.
    iii. Termination compartments shall be provided with “Danger – Keep Away – Hazardous Voltage – Will Shock, Burn, or Cause Death” signs.
2. Nameplates, Ratings Labels and Connection Diagrams
    i. The outside of each door (or set of double doors) shall be provided with a nameplate indicating the manufacturer's name, catalog number, model number, date of manufacture, and serial number.
    ii. The inside of each door (or set of double doors) shall be provided with a ratings label indicating the following:
        a. Overall padmounted gear ratings: nominal voltage, kV; maximum voltage, kV; BIL voltage, kV; power frequency, Hz; short-circuit peak withstand current, amperes, peak; short-circuit one-second short-time withstand current, amperes, RMS, symmetrical; and short-circuit MVA, three-phase symmetrical, at rated nominal voltage.

b. Main bus ratings; continuous current, amperes; peak withstand current, amperes, peak; and one-second short-time withstand current, amperes, RMS symmetrical.
c. Switch ratings: continuous current, amperes; load splitting current, amperes; load dropping current, amperes; peak withstand current, amperes, peak; one-second short-time withstand current, amperes, RMS, symmetrical; and three-time duty-cycle fault-closing current, amperes, RMS symmetrical and amperes, peak.
d. Fused type and ratings: maximum current, amperes and interrupting current, amperes, RMS, symmetrical.

iii. A three-line connection diagram showing the interrupter switches, fuses with integral load interrupter, and bus along with the manufacturer's model number shall be provided on the inside of each door (or set of double doors), and on the inside of each switch-operating-hub access cover.

H. Accessories

1. End fittings, refill units, for original installation, as well as one spare fuse unit, for each fuse mounting shall be furnished.
2. The switchgear shall come equipped with mounting provisions and provide for a window viewable fault indicator in each switch compartment.
3. A fuse handling tool as recommended by the fuse manufacturer shall be furnished.

5.9 Switch Basement Specifications

A. Switch Basement Specifications

1. The switch basement shall be the 6’ padmounted Switch Basement or approved equivalent.
   6’ padmounted Switch Vault (PJ525A, PJ525B, PJ525C)
2. Basement lid shall be installed with approved gasket materials.
3. Switch Basement shall have five 4” couplers and two 3” couplers installed per section.
4. Used conduit couplers shall be sealed with expandable foam after installation.
5. Approved pulling anchors shall be installed.
6. The ground sleeve shall include a permanent ladder inside the hatch opening.
7. The cover hatch shall be made of diamond plate steel or aluminum. The cover hatch shall be recessed into the concrete and have one piece boltless hinges.
8. 6 inches of pea gravel shall be installed in the basements before cable installation.
9. All cables pulled into a switch basement shall have a **full loop of cable** in the basement before termination to the switch bay.
10. Cables shall be arranged to lay flat on the ground and not cross or hang on other conductors.
11. All construction related debris shall be removed prior to approval.
12. Labeling and grounding shall be as indicated in **SG505 Padmount Switchgear Ground Sleeve**
    i. All cables shall be identified in accordance with this standard (**CM100-1**, **CM100-2**)
    ii. A #4/0 copper grounding loop shall be installed for bonding and grounding of equipment.
    iii. 2 - 8’ ⅝” ground rods shall be installed inside the switch basement.

6.0 Drawings

CM100-1	Cable Identification
CM100-2	Cable Identification
CO101	Conduit Installation Details
CO105	Conduit Installation - Direct Buried
CO120	Conduit Installation - Direct Buried 2 or 4 Conduits
CO125	Conduit Installation - Elbow Direct Buried
CO130	Conduit Installation - Concrete Encased
CO140	Conduit Installation - Typical Joint Use Trench
CO200	Conduit Placement - Secondary Junction Box
CO210	Conduit Placement - Primary Vault
CO220	Single Phase Conduit and Pad Placement
GE101	Transformer Distances - Single Phase
GE102	Transformer Distances - Underground Cables
GE103	Transformer Distances - Commercial Buildings
GE105	Pad Mounted Equipment Clearances
GE110	Erosion Prevention
MT100	CT Cabinet Requirements - Single Phase
MT110	CT Cabinet Requirements - 3 Phase Four Wire
MT120	CT Cabinet Requirements - 400-800 Amperes, 0-600 Volts
MT300	CT Installation - Typical CT Metering Detail
PJ525A	7’ X 10’ X 6’ Switch Basement Plan Views
PJ525B	7’ X 10’ X 6’ Switch Basement Elevation Views
PJ525C	7’ X 10’ X 6’ Switch Basement Cover Rebar
PJ525D	7’ X 10’ X 6’ Switch Vault Riser Rebar
PJ525E	7’ X 10’ X 6’ Switch Vault Cap
PV105	3 Phase Primary Vault Enclosure
PV110	Single Phase Primary Vault Enclosure
RP100	Typical Single Phase Conduit Riser
RP300	Typical Three Phase Conduit Riser
SG505	Padmount Switchgear Ground Sleeve
SJ100	Secondary Junction Box
SJ105	Large Secondary Junction Box
SL100	Street Light - Footing Specification
SL200	Street Light - Wiring
	Standard Approved Lighting Fixture List.pdf
US103	Residential Service Requirements - Side View
US110	Meter Clearances - Underground Service
US115	Panel Clearances
US320	Service Requirements - Mobile Homes and Trailers
US330	Service Requirements - Mobile Homes and Trailers
US331	Mobile Home Park Meter Pedestal
UT105	Single Phase Transformer Grounding
UT170	Three Phase Transformer Connections