CITY LIGHT & POWER

JOINT BASE LEWIS-MCCHORD

Electric Service Connection Standards Manual

2019 Edition R1

CLP SITE POINTS OF CONTACT

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REVISION TABLE

Date	Revision	Revision Description
5/31/2019	2019 R0	Initial Issue

Section 1.0 INTRODUCTION

The electrical distribution system portion of Joint Base Lewis-McChord's (JBLM) utility system was sold to City Light & Power, Inc (CLP) ("System Owner") as part of the U.S. Army's Utilities Privatization (UP) program in 2019. CLP is the sole provider of all relevant medium voltage electric utility services to the installation.

1.1 PURPOSE OF DOCUMENT

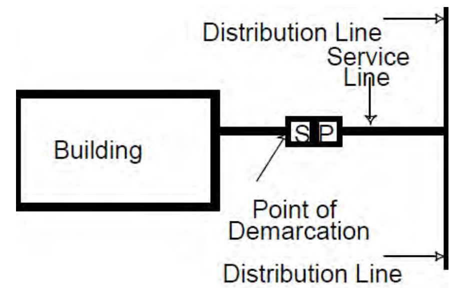
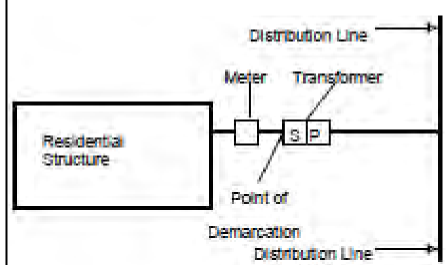
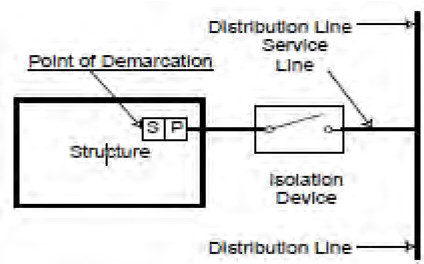
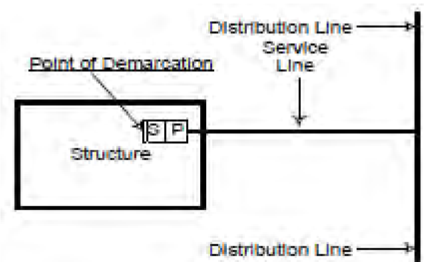
This manual contains guidance to establish successful interconnections to the CLP owned electrical system.

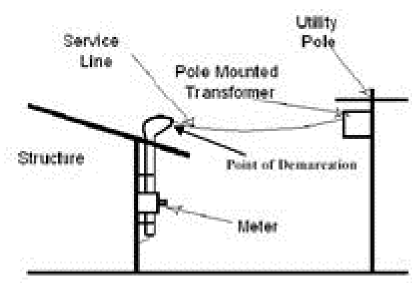
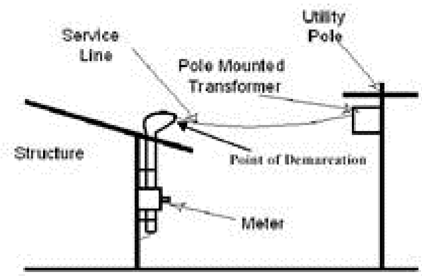
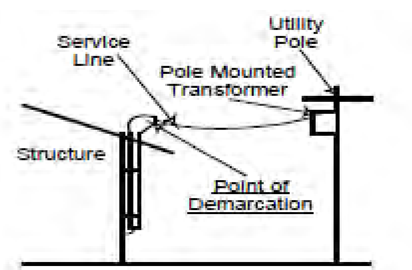
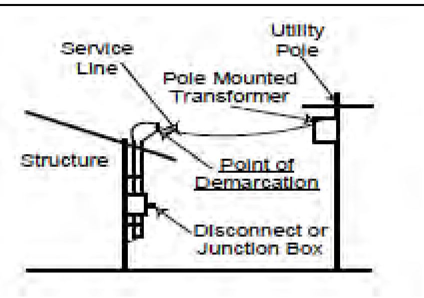
1.2 DEFINITIONS

Point of Demarcation (POD) – A point/location where ownership/liability changes from one party to another.

System Owner (SO) – City Light & Power JBLM, LLC.

1.3 POINTS OF DEMARCATION

Point of Demarcation	Applicable Scenario	Sketch
Point of demarcation is the transformer secondary terminal spade.	Pad-mounted transformer located outside of structure with underground service to the building with or without a meter.	
Point of demarcation is the transformer secondary terminal spade.	Residential service operated by the housing privatization contractor where a meter exists within 5 feet of the exterior of the building on an underground secondary line.	
Secondary terminal of the transformer inside of the structure.	Transformer located inside of structure and an isolation device is in place with or without a meter. *Note: Utility Owner must be granted 24-hour access to transformer room.*	
Secondary terminal of the transformer inside of the structure.	Transformer located inside of structure with no isolation device in place. *Note: Utility Owner must be granted 24-hour access to transformer room.*	

Point of Demarcation	Applicable Scenario	Sketch
Point of demarcation is the point where the overhead conductor is connected to the weather head.	Electric meter is connected to the exterior of the building on an overhead secondary line. *The Government will own the mast.*	
Point of demarcation is the point where the overhead conductor is connected to the weather head.	Residential services operated by the housing privatization contractor where a meter is connected to the exterior of the building on an overhead secondary line. *The Government will own the mast.*	
Point of demarcation is the point where the overhead conductor is connected to the weather head.	Pole-mounted transformer located outside of a structure with secondary attached to the outside of the structure without a meter. *The Government will own the mast.*	
Point of demarcation is the point where the overhead conductor is connected to the weather head.	A disconnect switch or junction box is mounted to the exterior of the structure with and without a meter. *The Government will own the mast.*	
Point of demarcation is the transformer secondary terminal spade.	Pole-mounted transformer with underground service to a building.	None.

Point of Demarcation	Applicable Scenario	Sketch
Point of demarcation is where the overhead conductor is connected to the service entrance mast.	Electric power is provided to a water facility via an overhead service drop. This configuration could be found at facilities dedicated to the water utility such as a water well, pump station, or storage facility.	None.
Point of demarcation is at the secondary terminal of the transformer.	Electric power is provided to a water facility via an underground service connection. This configuration could be found at facilities dedicated to the water utility such as a water well, pump station, or storage facility.	None.
Point of demarcation is where the overhead conductor is connected to the service entrance mast.	Electric power is provided to a wastewater facility via an overhead service drop. This configuration could be found at facilities dedicated to the wastewater utility such as a lift station or wastewater treatment plant.	None.
Point of demarcation is the secondary terminal of the transformer.	Electric power is provided to a wastewater facility via an underground service connection. This configuration could be found at facilities dedicated to the wastewater utility such as a lift station or wastewater treatment plant.	None.
Point of demarcation is at the secondary terminal of the transformer.	Electric power is provided to a street light circuit on non-utility use poles in privatized housing. This configuration could be found at both Lewis and McChord Service areas.	None.

1.1.0 UNIQUE POINTS OF DEMARCATION

Points of Demarcation	Sketch / Applicable Scenario
The secondary side of all 13.8 kV transformers.	Facilities and lighting on Gray Army Airfield
The secondary side of all 13.8 kV transformers.	Facilities and lighting on McChord Field Airfield
The source side of the Army-owned 13.8 kV regulators.	Army Central Substation (Lewis Service Area)
The source side of the Army-owned SF6 switcher.	Madigan Substation (Lewis Service Area)
The source side of the Army-owned 115 kV switcher.	South Substation (Lewis Service Area)
The load side of the TPWR-owned 115 kV SF 6 switcher.	Sequalitchew Substation (Lewis Service Area)
The connection point of 13.8 kV Bus B from oil circuit breaker. Bus A belongs to TPWR and parallel Bus B belongs to McChord. Bus A and B are within 8-feet of each other at the substation. Metering house equipment has separate ownership meters.	Main Substation (McChord Service Area)
The source side of the Army-owned 115 kV switcher.	Gingko Substation (McChord Service Area)
The source side of the Army-owned 13.8 kV regulators.	Army Central Substation (Lewis Service Area)
The Contractor shall assume responsibility from the air switch, including the line side feed to the air switch located near Building 121. The VA Hospital owns from the load side of air switch into the hospital.	VA Hospital
The Contractor shall assume ownership of the power feed to the traffic signal controllers. The point of demarcation is the source side of the traffic signal controller.	Traffic signal controllers
The Contractor shall be responsible for underground primary feed up to 13.8 kV terminations at the WADS Building 852 pad mounted transformer. The 13.8 kV primary 4160 V secondary pad mounted transformer at WADS Building 852 will be retained by the Government.	Western Air Defense Sector (WADS)
The line side of the fused cutout at Pole TA50P1.	Range 050 Puget Sound Energy-fed Pole Line
The line of the disconnect at Pole TA90P1	Range 090 Puget Sound Energy-fed Pole Line

Section 2.0 THREE STAGES OF CLP'S SERVICE CONNECTION PROCESS

To install a service connection efficiently, CLP recommends organizing the project into three distinct phases:

I. **Initiation**–Getting started.
II. **Design**–Preparing a detailed work plan.
III. **Construction**–CLP infrastructure installation and site restoration.

Each phase of the process includes requirements and coordination that will enable the project to advance to the next step. As with any construction project, informing CLP promptly of any changes to the requirement will allow our representatives to keep our customers informed if there are related scope changes.

All potential adds or modifications to existing electrical system due to new service connection requirements must be coordinated with CLP during customer's project conceptual design (Initiation). CLP must be integrated into the design of all medium voltage and low voltage electrical systems that are within the proximity of CLP points of demarcation. The preferred method for connecting new or modified electrical services to CLP-owned system is to request CLP to design and install the required infrastructure up to the CLP points of demarcation. This method will eliminate the potential for stranded assets that JBLM will need to maintain until they are properly conveyed to CLP. If the new service connection infrastructure is constructed by a third-party contractor, the new assets will not be owned or operated by CLP until the government conveys them to CLP. The conveyance of such assets is subject to CLP's inspection and acceptance. The conveyance may take years to be completed. In any case, the new infrastructure for the service connection must adhere to CLP specifications, safety requirements, and construction standards. If the infrastructure is built by a third-party contractor, CLP will require final design submittals for approval, field inspections, and final as-built drawings of the completed work. CLP will conduct design review, field inspections, and final connections to the new service at a cost to the customer. The customer must capture this cost to their project scope of work in an early phase of the design. Any fees associated with connecting contractor-constructed infrastructure to CLP's system must be negotiated with CLP during the Design phase.

In no event shall a contractor cap, connect to, or otherwise touch the System Owner's infrastructure without the System Owner's express written permission.

2.1 INITIATION

2.1.1 INITIATING A SERVICE CONNECTION

The service connection request begins with a **completed** Service Application (See Appendix A). In order for CLP to meet the service date, submit the completed Service Application as early as possible in your planning process.

Copies of the Service Application form are available on the JBLM Design Standards website.

For planning purposes, CLP is typically responsible for all medium voltage distribution lines on base. CLP owns the electrical distribution infrastructure, including poles, switches, and transformers. Refer to the Points of Demarcation (PODs) tables in Section 1.3—PODs are points on the utility system where ownership changes from the utility SO to the facility owner. They are physical points where CLP responsibility to construct and maintain ends and the service of the customer begins.

Note: Special POD rules apply to unique areas of JBLM. Please consult with a CLP or DPW Utilities Branch point of contact to identify proper points of demarcation.

Submit Site/Building drawings along with the Service Application. The Site/Building drawings shall include, at a minimum, the following information:

- A site plan showing water, sewer, storm drain, building line and preferred transformer location. Include driveways and street names.
- Quantity and Size(s) of transformer(s) requested.
- Single-line drawing of the primary power (existing and new) within the project site.
- Secondary voltage requirement. The following is the list of typical secondary voltages available at JBLM:
  - 1- Phase, 120/240V
  - 1- Phase, 240/480V, 3-wire
  - 3- Phase, 208Y/120V, 4-wire
  - 3- Phase, 480Y/277V, 4-wire

2.1.2 Planning The Service Connection

The formal planning process will begin after receipt of a **completed** Service Application.

Information obtained in the Service Application provides CLP an accurate description of the project, including the anticipated electrical requirements. Following are the steps CLP takes to process a newly submitted Service Application.

Step 1: Scoping

- **Review Supplemental Application Information**—which should include a complete set of plans (site, environmental, and architectural), load information, billing information, and any existing CLP infrastructure which may require relocating.
- **Site Walk**—to verify customer requirements and observe site conditions.
- **Identity Existing Utilities**—to avoid utility conflicts as soon as possible in the process.
- **Outline Scope of Work**—to identify requirements and tasks associated with the new service.
- **Specify Transformer**—as marked on the site plan. Preferred locations will be considered.
- **Develop a Period of Performance Schedule**—to ensure CLP can meet the service need date as proposed in the completed Service Application.

Step 2: Evaluating and Engineering

CLP will evaluate and determine if the existing electrical infrastructure is adequate to meet the new service request. CLP will then develop an engineering plan or preliminary routing sketch proposing the work plan to meet the needs of the request.

Step 3: Rough Order of Magnitude (ROM) Cost Estimating

CLP will estimate the job costs, labor, and materials required to complete the new service connection. CLP will then determine the appropriate charges for the work and compile a ROM cost estimate and scope of work. A preliminary routing sketch will incorporate the scope of work, reflect electrical components, and identify the proposed route for new construction (if required).

Step 4: ROM Proposal Transmittal

CLP will send the ROM estimate, scope of work, and preliminary routing sketch to the requester or customer project representative and CLP's Contracting Officer Representative (COR) in the DPW Utilities Branch.

Step 5: ROM Proposal Review

The Service Application requester or customer project representative will review the ROM Proposal. Upon acceptance the project representative or requester will formally notify CLP's COR in the DPW Utilities Branch of their intent to move forward with the ROM Proposal. This step will need to be completed before CLP or the Utilities Branch can proceed any further with the new service request. *Please note that anytime CLP is required to deviate from CLP's standard practices and procedures, the service connection requestor will be responsible for all additional costs. For example: design revisions, multiple designs, job scope changes, etc.*

Step 6: Contract Modification

CLP's COR will notify DLA-Energy of the accepted ROM Proposal and engage the customer to discuss funding. To simplify the funding process and for contract administrative purposes, military customers may choose to send funding for CLP's scope of work via Military Interdepartmental Purchase Request (MIPR) to DLA-Energy (UP contract administration). DLA-Energy can then modify the existing UP contract for CLP to complete the service connection work. Once the funding is received from the customer, DLA will issue a firm-fixed price RFP to CLP for agreed-upon scope of work and validate CLP's ROM Proposal based-on pre-negotiated rates.

2.2 DESIGN

Design Steps
Step 1: Validating

After CLP receives the FFP RFP from DLA-Energy, a CLP Representative will contact the requestor to confirm that the initial information is still accurate.

- **Transformer size**—confirm CLP has the correct transformer size (kVA). Has the load profile or panel size changed?
- **Transformer locations**—confirm CLP has the correct transformer location(s). Has the site layout or site condition(s) changed?
- **Detailed site plans**—confirm CLP has the final project site plans with all the other on-site utility lines located: fuel, water, sewer, telephone, electric, etc. Also confirm receipt of site plans with civil and environmental features. **Please notify CLP immediately if any detail of the plans requires a change.**

Step 2: Performing Initial Design

If required, CLP will prepare a detailed electric installation design, including the specific plans needed for our construction crews to perform the work. CLP may attend customers design review meetings for Design/Build and Design/Review/Build projects.

Step 3: Coordinating Design Documents, Permits, and Submittals

CLP will apply for necessary permits required for the installation of the new service connection as applicable. The time this takes varies, depending on the location and type of permit. Any subsequent changes to the execution of the contract, such as significant changes in connected load, voltage class, transformer location, or inadequate site conditions will delay our work and **may result in additional costs** for re-engineering, design, and/or construction and will have a negative impact on the planned service date.

Step 4: Delivering Final Design

Where full design is utilized, CLP will send a copy of the final CLP design drawing to the new service requestor for review and signature.

2.3 CONSTRUCTION

All personnel working on the installation of CLP electrical service lines are trained and certified. If a CLP-approved contractor does the construction work, a CLP inspector will monitor quality control on the site.

2.3.1 CONSTRUCTION STEPS

Step 1: Phasing and Scheduling

Make considerations early for power requirements to any existing and new facilities affected by construction. Temporary power installation and removal will require early coordination with CLP. During construction of CLP infrastructure outages will likely be required to tie into the system. CLP will advise the requester of outage impacts during construction in advance of mobilizing. The established JBLM outage request process will be followed to schedule outages. Scope and duration of the outage(s) are dependent upon the scale and scope of the new service construction. CLP is not responsible for planning and coordinating backup power (if any) to the job site during infrastructure construction.

Once the site is ready for primary infrastructure construction, notify CLP to schedule construction of your project or to monitor quality control over the electric installation. Contact the local CLP Installation Manager or Representative.

Step 2: Prepping Site

CLP will complete a Dig Permit in accordance with JBLM standard operating procedures.

Step 3: Verifying Site Conditions and Staging Materials

After all existing underground utilities are marked prior to CLP starting construction, CLP may need to dig test holes to verify the depth and location of underground lines to avoid damage during construction. Prior to starting construction CLP may stage new primary materials such as poles or transformers within the project site.

Step 4: Constructing and Installing

CLP will install the electrical lines and new infrastructure. Expect heavy equipment to be working on the job site. Crews from CLP or CLP subcontractor crews will install the new primary infrastructure.

Construction equipment may be left overnight. Holes and trenches left open during construction will be clearly marked, identified, and proper barriers will be installed.

2.3.2 SITE RESTORATION

CLP will restore grades where infrastructure is removed. CLP will avoid the disturbance of established lawns and pavement wherever practical. While CLP will make every reasonable effort not to disturb any existing paving, shrubbery, trees, plants, or lawn, it will not always be possible.

Once construction is complete, CLP will restore the affected areas of your property as promptly as possible.

- If a sidewalk or roadway section must be removed, temporary paving may be necessary. It may take several weeks before permanent paving is completed.
- Permanent paving may be delayed until weather permits.

The time required for restoration will depend on weather conditions and the extent of the disturbed area.

Section 3.0 RESPONSIBILITIES FOR ELECTRIC SERVICE

CLP utilizes Design and Construction Standards based off the latest Institute of Electrical and Electronics Engineers (IEEE), National Electrical Safety Code (NESC), and National Electrical Code (NEC) requirements. These standards and requirements are followed to decrease the likelihood of loss-of-life and/or equipment damage.

CLP requires all contractors/subcontractors to adhere to these standards.

3.1 STANDARDS GOVERNING INSTALLATION

Follow industry recognized standards set forth by IEEE, NESC, and NEC for all electrical installations. All service connections will be built to CLP design standards, see Appendix TBD. For connections not covered in these appendices, industry standards will be applied.

The NESC requires specific distances between utility facilities, such as overhead lines, and other structures. The distances vary based on the type of utility facilities and the type of structures being put up. It is the contractor/subcontractor’s responsibility to determine the distance requirements. Failing to do so creates a dangerous situation that can also be costly to the responsible party to remedy later.

CLP has an open-door policy for any questions customers, contractors, or subcontractors may have. The ultimate goal for CLP is to install an electrical system safe for everyone that will continue to operate many decades into the future.

3.2 ADDITIONS AND ALTERATIONS

CLP’s electrical system has definite capacity limitations and can be damaged by overloads. Therefore, it is everyone’s responsibility to notify CLP before increasing the load requirements or making alterations to the service entrance equipment. CLP will provide the proper equipment on the electrical system to serve the increased capacity.

3.3 WORKING AROUND HIGH VOLTAGE OVERHEAD LINES

The approach distance and working around high voltage overhead lines the requirements to the activities of utility or non-utility construction personnel are governed by the Occupational Safety and Health Administration (OSHA), National Electrical Safety Code (NESC), federal, state, or local statutes or regulations.

Call the CLP Installation Manager or Representative if work needs to be performed that meets the above qualification.

If work must be performed on an overhead utility line, with prior notice and approval, CLP will initiate proper safety measures, which may include the following:

- Relocating the lines.
- Installing physical barriers to prevent any contact with the lines.
- De-energizing and grounding the lines.
- Other proactive safety steps as necessary.
- Compliance with safety requirements governed by OSHA

Minimum OSHA requirements are as follows:

- For lines rated 50 kV or below, minimum clearance between the lines and any part of the crane or load shall be 10 feet; In transit with no load and boom lowered, the equipment clearance shall be a minimum of 4 feet for voltages less than 50 kV,
- For lines rated over 50kV; Minimum clearance between the lines and any part of the crane or load shall be 10 feet plus 0.4 inch for each 1 kV over 50 kV or twice the length of the line insulator but never less than 10 feet; In transit with no load and boom lowered, the equipment clearance shall be a minimum 10 feet for voltages over 50 kV up to and including 345 kV and 16 feet for voltages over 345 kV up to and including 750 kV in accordance with the CLP Safety Manual.

It is your responsibility to know and abide by all OSHA and local regulations when working in the vicinity of electrical lines.

Section 4.0 COMMON STANDARDS FOR ELECTRICAL DISTRIBUTION WORK ON JOINT BASE LEWIS-MCCHORD

4.1 DISTRIBUTION SYSTEM SUMMARY

4.1.1 PRIMARY DISTRIBUTION VOLTAGE – 13,800(WYE)/7,970V

The primary distribution voltage at Joint Base Lewis-McChord is 13,800/7,970 volts. This is most commonly found in feeders existing at the various substations.

4.1.2 LOW VOLTAGES

Low voltage distribution at Joint Base Lewis-McChord is any voltage less-than-or-equal to 1,000 volts. The low voltage distribution system is fed from step-down transformers, whose primary voltage is 13,800/7,970V.

4.1.3 METERING

Secondary metering is required for all new service connections, whether temporary or permanent. All requests and coordination for metering will go through JBLM DPW Utilities branch. Information about meter guidance, specifications, and regulations are provided for your convenience in Utilities Metering Manual, in person at the DPW Utilities Branch office located in Building 2012, Room 001, or online at the JBLM Design Standards Website, http://www.lewis-mcchord.army.mil/designstandards/

4.2 PAD-MOUNT SERVICE TRANSFORMERS

All new pad-mount service transformers shall be 3-phase, unless a single-phase transformer is necessary. Primary voltage is 13,800 volts wye. Primary case shall be grounded. Transformers shall have loop feed capability with elbow-mounted arresters (if not loop-fed), dead front, bushing wells with inserts installed, 4 hole spades minimum for secondary terminals, three (3) 2-position ON/OFF switches for primary feed-through isolation, bay-o-net fusing for transformers smaller than 1000kVA and vacuum fault interruption (VFI) protection for transformers 1000kVA and larger, top level oil temperature gages, liquid level & pressure vacuum gages, drain valve with sampler, copper or aluminum windings meeting current DOE efficiency standards and two each 2-1/2% taps above and below normal. This will assure that the user voltage can be regulated within proper limits. Lightning arresters will be installed on all unused high voltage well bushings. No Parking stands or Y splitters will be installed unless deemed necessary by CLP. In accordance with the utility privatization contract, all high voltage transformers and switches will be inspected by CLP before being connected to Joint Base Lewis-McChord's electrical distribution system. Color of transformers shall be Munsell Green.

Please request an Excel version of the Transformer Specifications Data Sheet for all new transformers.

4.3 POLE-MOUNT TRANSFORMERS

All new pole-mount service transformers shall be single-phase. Primary voltage is 13,800 volts wye. Primary case shall be grounded. For 3-phase configurations, the transformers will be connected in a delta-wye configuration. For single-phase configurations, 75KVA and below, the transformer will be connected line-to-ground. For single phase configurations above 75KVA, and 2-phase configurations, the transformers will be connected line-to-line. Lightning arresters, and fuse cutouts will be installed on the high side of every transformer. In accordance with the utility privatization contract, all high voltage transformers and switches will be inspected by City Light & Power before being connected to Joint Base Lewis-McChord's electrical distribution system. Color of transformers shall be ANSI Grey.

Please request an Excel version of the Transformer Specifications Data Sheet for all new transformers.

4.4 UNDERGROUND HIGH-VOLTAGE CONDUCTOR

All underground high-voltage cable (i.e. over 1,000 volts) shall be placed in conduit encased with a minimum of 3-inches of concrete. Depth of burial shall be 36 inches below grade measured from the top of the concrete encasement. A 6-inch wide, red plastic marker tape with the words "HIGH VOLTAGE" shall be placed directly over the high voltage line at a depth of 18 inches below finished grade or 6 inches below the top of sub grade whichever is deeper. Any change of direction that is more than 5 degrees will require the installation of a manhole unless coordinated and approved by City Light & Power. Maximum spacing between manholes or equipment shall not exceed 500 feet.

4.4.1 PRIMARY DISTRIBUTION CONDUCTOR

All new medium voltage cable shall be copper 15 kV, 100 percent insulation level for multi-grounded 4-wire system and 133 percent for ungrounded 3-wire system, EPR, with concentric neutral sized per NEC, ICEA, and CLP standards.

4.5 UNDERGROUND CONDUCTORS BELOW TRAFFIC

Underground construction below roads must pre-approved by CLP. All conduit containing conductors of any voltage including communication circuits that run under streets or parking lots shall be in conduit and concrete encased or steel encased. Under-road installation methods will be open-cut or horizontal boring. Risers shall have Rigid Galvanized Steel (RGS) conduit or fiberglass sweeps when making the transition from underground to overhead high voltage power lines. Only one high voltage riser in rigid galvanized steel or Intermediate Metal Conduit per utility pole will be installed. Conduit bend calculations shall be made to provide proper bend radii to reduce conductor pulling tensions.

4.6 OVERHEAD CONSTRUCTION

All power poles, steel support structures and their foundations shall be rated for a 100-mph wind load.
Refer to CLP Construction Detail Drawings for overhead design and building. Standard overhead conductor sizes are #2, #1/0,#4/0 AWG, and 336 KCMIL ACSR.

Section 5.0 SERVICES NOT RELATED TO PERMANENT SERVICE CONNECTIONS

CLP will perform requested services that are not part of the Permanent Service Connections section. These services are covered here but are not limited to the below.

5.1 TEMPORARY ELECTRIC SERVICE

A temporary service connection can be provided that is either overhead or underground where facilities are available for a non-permanent period. That period will be defined by the DPW Utilities Branch, Contractors, and CLP. All electrical services will require secondary metering, to be coordinated with the DPW Utilities Branch. Costs will be the responsibility of the requestor to install and remove the services.

Please contact the CLP Installation Manager or Representative for any further questions.

5.2 RELOCATION OF CLP LINES AND EQUIPMENT

Projects requiring underground or overhead electrical infrastructure to be relocated should follow Section 1 of this manual.

Please contact the CLP Installation Manager or Representative for any further questions.

Section 6.0 Electrical Safety and Code Clearances

6.1 General

It is the policy of CLP to operate the electric distribution system with the highest degree of care for the safety to the public and CLP employees. To ensure the care and safety needed for an electric distribution system, the National Electric Safety Code (NESC) is used for design, construction, maintenance, and operation of the electric system by CLP as well as any applicable practices by the public and private industry. The applicable NESC in effect at the time will apply to new installations and extensions. Existing installations may be altered, replaced for maintenance, or additions made to comply with either the current edition or original requirements of the applicable NESC in effect at the time of original installation as allowed in NESC Rule 013B.

- CLP reserves the right to temporarily disconnect service when a hazardous condition is discovered, until such time as the hazardous condition is addressed.

6.2 Minimum Clearance from Overhead Lines

- For the purpose of this section, the term “clearance” means the shortest distance between any two surfaces.
- Minimum clearance between any building or other structure and any overhead transmission line, overhead distribution facility, or electric utility pole will be maintained in accordance with the provisions of the NESC.
- Minimum clearance between signs, chimneys, radio and television antennas, storage tanks and other structures, and any overhead transmission line, overhead distribution facility, or electric utility pole will be maintained in accordance with the provisions of the NESC.
- Minimum clearance over streets, alleys, parking lots, rights-of-way, easements, etc., of overhead transmission & distribution facilities, will be maintained in accordance with provisions of the NESC.
- Minimum clearance between over-height vehicles, including house moving, and any overhead transmission line, overhead distribution facility, or electric utility pole of CLP will be maintained in accordance with the provisions of the NESC.

6.3 Equipment Operation around Energized Facilities

6.3.1 Requests for System Outages

CLP on a case-by-case basis may allow individual system elements to be removed from service to accommodate construction or maintenance activities. CLP complies with the Joint Base Lewis-McChord outage planning policy, which include various forms and scheduling requirements. Under these circumstances, outages must be planned well in advance, and every effort must be made to minimize the duration of outages. If at all possible, the construction or maintenance activity shall be conducted in such a manner that the facility can be returned to service immediately in the event of a loss of another system element.

Outages lasting longer than one-week may require the construction of a temporary facility to minimize the required outage time. Outages on system elements that will leave a load serving facility vulnerable under a single additional contingency will require plans to mitigate the next contingency. These plans should restore the load serving capability of the system as soon as possible. All time and material necessary to develop the contingency plan will be paid for by the requesting party. In the event the contingency plan is executed, the requesting party will pay all time and materials associated with service restoration.

Electric transmission systems present a unique challenge in that outage and restoration times will typically require several weeks. On a case-by-case basis, planned outages for the modification of transmission systems may be granted. However, due to the extended nature of these outages, contingency plans for the restoration of load must be in place prior to the planned outage. In some cases, an outage may not be granted, and new facilities may need to be constructed before existing facilities may be abandoned.

6.3.2 OVERHEAD

When working near or operating equipment around overhead electrical lines, Federal OSHA standards require that unqualified persons maintain the electrical distances listed in Column B of Table 4.1 between energized lines/parts and themselves, their tools, their equipment, and all conductive materials. Contacting the line can result in severe injury or death. If work must be accomplished near an overhead electrical line, call the CLP Base Installation Manager (Page i) for assistance as needed to identify line-operating voltage, do not rely on proximity warning devices such as hook insulators or boom guards, because each has its limitations or otherwise avoid contact with these energized facilities. If distribution lines must be de-energized, the customer shall provide a written request to CLP and allow 10 business days for CLP to respond to the request. It is the responsibility of the contractor to apply safety grounds to safely perform work on the de-energized line. CLP does not ground for others to work on the system or assume responsibility for their workers. CLP will de-energize, test, tag, and issue a clearance to the contractor. Requests to de-energize overhead lines should be submitted early in the requester’s planning process and will be reviewed on a case by case basis by CLP and the respective Base Leadership. Transmission outages require a significant level of preplanning and could take weeks to coordinate.

6.3.3 TABLE 4.1: MINIMUM APPROACH DISTANCE TO ANY ENERGIZED OVERHEAD LINE OR PART BY UNQUALIFIED PERSONS (GENERAL PUBLIC, GENERAL INDUSTRY, CONSTRUCTION EQUIPMENT) ADAPTED TO CLP SYSTEM FROM OSHA 1910.333 AND 1926.1408

A: Voltage Phase to Phase (kV)	B: Minimum Clearance Distance (feet-inches)	C: Electrical Distance with Temporary Warning Devices Installed Phase to Ground (feet-inches)
up to 50	10’ - 0”	10’ - 0”
Over 50 to 200	15’ - 0”	15’ - 0”
Over 200 to 350	20’ - 0”	20’ - 0”
Over 350 to 500	25’ - 0”	25’ - 0”

6.3.4 UNDERGROUND

Grading, excavation, ground rod, stake or post installation work will not be started until an underground facilities location has been completed. Digging into or damaging underground power lines can result in severe injury or death to the operator and others, and can cause interruption of service to wide areas. Complete a Base Dig Permit before digging or excavating. Trained personnel from CLP will locate electrical facilities at no cost.

The National Electric Safety Code requires the protection and separation of underground electric supply lines from other structures, including other utilities. Below are typical clearances for parallel utilities, and crossings of utilities.

TABLE 4.3: TYPICAL PARALLEL UNDERGROUND UTILITIES

(All dimensions are in feet) Clearance to other utilities (telecommunication, fiber optics, etc.) or high voltage underground transmission cables shall be determined on a case by case basis by CLP Engineering.
** Note: Reduced clearances to these lines must be approved by CLP Engineering.*

CLP Utilities (Underground)	Potable Water	Non-Potable Water	Waste-water	Storm Sewer	Gas Main	Gas Mains 150 psi or higher	Electric Primary Up to 34.5kV	Electric Secondary (0-480V)
Electric Primary Up to 34.5kV	10*	10*	10*	10*	6	10*	X	3
Electric Secondary (0-480V)	3	3	3	3	3	10*	3	X

TABLE 4.4: TYPICAL CROSSINGS OF UNDERGROUND UTILITIES

(All dimensions are in feet) Clearance to other utilities (telecommunication, fiber optics, etc.) or high voltage underground transmission cables shall be determined on a case by case basis by CLP Engineering.
** Note: Reduced clearances to these lines must be approved by CLP Engineering.*
*** Note: 1' separation from electric primary to plastic pipe gas main and 5' separation from electric primary to metal gas main.*

CLP Utilities (Underground)	Potable Water	Non-Potable Water	Waste-water	Storm Sewer	Gas Main	Gas Mains 150 psi or higher	Electric Primary Up to 34.5kV	Electric Secondary (0-480V)
Electric Primary Up to 34.5kV	1	1	1	1	1/5**	5*	X	0
Electric Secondary (0-480V)	1	1	1	1	1	5*	0	X

Section 7.0 SERVICE-RELATED ELECTRICAL UTILITY SYSTEM DESIGN GUIDELINES

7.1 GENERAL

The intent of this section is to acquaint government system planners and designers with some key design guidelines that CLP uses to identify requirements, scopes of work, and costs for new or modified service connections. Most new construction and renovation projects at the installation require additions and/or modifications to the primary electrical supply system. Projects requiring service connections pay for changes or additions to the CLP-owned electrical system that are required to service the new or renovated facilities. As it is important to capture all potential costs associated with changes or additions in the initial stages of project planning, this section provides a summary of key technical guidelines and a checklist to help project planners and designers recognize the considerations they must make to adequately evaluate the scope of work and costs associated with obtaining utility power for their projects. Project planners and designers must engage with CLP when developing the project and its power requirements. **All design activities outlined in this section must be conducted by CLP unless noted otherwise.**

7.2 SERVICE-RELATED MEDIUM VOLTAGE SYSTEM DESIGN GUIDELINES

- **Capacity** – all existing distribution system feeders, substations, and utility supplies have limits to how much power they can supply. If nearby distribution feeders or substations are approaching/exceeding their maximum supply capacity, even a small service connection may require significant upgrades to the distribution system before the connection can be made. The following guidelines are key to assess capacity for customer service connections:
    - Estimate new load as accurately as possible (this is completed by customer’s planner or designer). Overestimation of building loads may result in unnecessary upgrades to CLP’s system and add significant cost to the project.
    - Identify nearby circuits that could be used for the new service connection.
    - Evaluate the circuit capacity and demand to select closest circuit(s) that have the capacity to supply the new service. If the nearby circuits are already loaded to their design capacity, a new circuit may need to be constructed to a nearby switching point or substation. Alternatively, existing feeders may be upgraded to increase capacity.
    - Properly size all new cables/conductors, switches, transformers, and terminations for maximum design load at worst case scenario.

- **Safety and Environment** – For every change made to the electrical system, it is necessary to address design- and operations-specific safety requirements and environmental compliance. The following guidelines are key for ensuring safety and environmental compliance in a service connection design:
    - Understand and specify proper grounding and bonding requirements for poles, switching equipment, cables, vaults, duct banks, and transformers. IEEE standard C2 - National Electrical Safety Code (NESC) provides specific requirements for grounding and bonding medium voltage electrical system components. Considerations must be made to develop a grounding and bonding system that complies with safety codes and is compatible with the existing grounding system.
    - Specify proper transformer configurations – Delta-Wye or Wye-Wye.
    - Consider concentric neutral versus tape shield cables with separate ground cables. CLP’s preference is to match existing systems.

- Make sure that the new system will have adequate overvoltage and overcurrent protection.
- Consider grounding positions and viewing windows for pad-mounted switches. These features allow operators to ground the switch and visually verify they are open prior to performing any maintenance or troubleshooting activities.
- Make sure all medium voltage construction such as duct banks, manholes, handholes, pads, poles, insulators, switches, surge arresters, terminations, cable/conductor placement, guying, and grounding systems meet NESC requirements for proper electrical clearance, proper working clearance, adequate access, mechanical/structural integrity, and safe operations.
- Ensure all low voltage civil and electrical work meets National Electrical Code (NEC) requirements.
- Use at a minimum all applicable IEEE, ANSI, UFC, and NEC standards when specifying medium voltage apparatuses such as cables, switches, fused cutouts, reclosers, and transformers.
- Always specify dead-front terminations for pad/vault-mounted switches and transformers.
- Carefully choose and specify proper insulation material for pad-mounted switches. Air, Oil, SF6, and solid-dielectric are the most common insulation material used for medium voltage apparatuses. Each has pros and cons that may impact safety, operability, environment, and cost.
- For pad-mounted transformers, consider a less-flammable fluid (i.e. FR3) for the insulation medium as opposed to mineral oil when installing close to buildings. Refer to CLP transformer standards.
- Ensure all apparatuses have adequate voltage ratings, continuous current carrying capacity, and ANSI short-circuit withstand ratings.
- For overhead systems, identify proper pole size, physical configuration, hardware components, cross arms type and size, guying requirements, avian protection, insulators, and lightning protection that comply with CLP's construction standards.

- **Operability** – All service connection systems must provide optimal switching, isolation, and restoration functionalities that are easy to operate and maintain in all conditions. The following guidelines are key to consider regarding operability of service connection systems:
  - Do not design underground service tap lines with T-body elbows or Y splices to the main feeder. This makes switching and isolation of the tap line and restoration of main feeder extremely difficult, unsafe, and time consuming to operate. Instead, break off the main feeder and install a tap line using multi-way pad-mounted or vault-mounted switch that can easily isolate the tap line and restore the main feeder.
  - For overhead service tap lines that serve overhead transformer banks and are short (single pole span) the use of cutout fuses at the service transformer primary may be adequate.
  - For overhead service tap lines that serve overhead transformer banks and run more than one pole span, consider tap line fused cutouts at the location where the tap line connects to the main feeder.
  - For an overhead tap line that routes underground via a riser and feeds to a pad-mounted transformer, make sure to design proper fused cutout for service that is 200A or less and load break switch for service that is greater than 200A at the riser. If the underground run is only a few hundred feet and the service transformer primary has a means of load breaking, the riser may be equipped with air break switches.
  - Specify pad-mounted transformers with three (3) 2-position on/off load-break switches for proper isolation and restoration for loop-feed configurations.
  - Make sure to allocate proper space and access around all medium voltage apparatus.

- **Resiliency** – Each service connection system should have capabilities for sensing fault conditions and/or loss of utility, quickly isolating the faulted/dead system, and rerouting power from an unaffected/alternative system. This requires smart technology that can sense, monitor, and perform predefined control logic functions. The following guidelines are key resiliency-specific design guidelines for service connection system:
    - Assess and identify if the new service is critical and requires redundancy. If redundancy is required and there is only a single radial feeder available, consider adding an alternative feeder in the project scope of work. This may require building a new overhead or underground system to the next available supply point.
    - Consider specifying fault indicators at the radial service connection's tap lines, risers, and multi-way switching points. The fault indicators will help operators quickly identify fault locations and restore the unaffected portion of the system.
    - If the service connection point has one or more alternative supplies, consider multi-way pad-/vault-mount switchgear with voltage sensors, motorized switches, and digital relays that can sense loss of utility and automatically switch to an alternative feed.
    - If the service connection is tapped off a looped main feeder using multi-way pad/vault-mounted switchgear, consider specifying the switchgear with SCADA-ready motorized load-break ways for the main feeder and vacuum fault interrupter (VFI) way(s) for the tap line(s) to feed the new service. Such switchgears can be easily incorporated to existing or future distribution automation and SCADA systems to significantly improve resiliency of the new service and the surrounding system.

- **Protection** – Electrical systems are prone to abnormal conditions such as short circuit, voltage surges, and arc-flash events that are dangerous to personnel and equipment. Lack of proper protection against such events can result in injuries, loss of life, and/or damage to critical electrical assets. Protection systems such as fuses, VFIs, circuit breakers, and/or protective relays must be properly designed and specified for all service connection systems. The following guidelines are key for designing service connection protection systems:
    - All electrical components must have protection for short circuit and voltage surges.
    - For small (500kVA or less) radial overhead service tap lines feeding to overhead transformer banks, consider fused cutouts at the main feeder connection point (if the tap line is longer than one pole span) and at the transformer primary.
    - For large (greater than 500kVA) radial overhead service tap lines and long pole lines feeding overhead transformers and extending more than single pole span, consider an automatic recloser at the main feeder connection point.
    - For underground service connections using multi-way pad/vault-mounted switchgear, specify a VFI with protective relay and controls for the tap line that feeds to the service transformer.
    - Specify fuse protection for any single phase and 3-phase transformers that are smaller than 1000kVA.
    - Specify VFI protection for all service transformers that are 1000kVA or greater. The VFI protection allows better coordinated protection than a fuse and trips all three phases for short circuit faults, eliminating voltage imbalances and negative sequence currents typically present during single phase faults. Voltage and current imbalances negatively impact the functionality and operating life of electronics and equipment, e.g. 3-phase motors.
    - Specify proper sizing and placement of surge arresters to protect critical electrical assets from voltage surges.

- o Specify advanced metering and monitoring devices for service connections greater than 500kVA so CLP can collect metering and power quality data. The data will be utilized for future capacity sizing and power quality improvements.
- o Make sure to specify and plan for system modeling, short-circuit analysis, coordination study, and proper setting/sizing of protective devices as part of the project scope. It is extremely important to ensure proper coordination of the protective devices so overcurrent faults are isolated with minimal impact to the entire system.

7.3 Service Connection Planning and Design Checklist

7.3.1 Capacity

- ☐ Estimate electrical load and service transformer size (#of phases, kVA and voltage)
- ☐ Identify nearest feeder or service connection point that has adequate capacity to support estimated electrical load
- ☐ Scope all electrical and civil modifications, adds, and retrofits to connect new service transformer to the existing system service connection point
- ☐ Size all new electrical components to meet ampacity and voltage drop requirements

7.3.2 Safety and Environment

- ☐ Design grounding, neutral, and bonding system
- ☐ Choose dead-front design for pad/vault mount apparatus
- ☐ Define transformer configuration
- ☐ Identify protective device type and locations
- ☐ Develop major apparatus safety specifications in accordance with applicable standards
- ☐ Verify all electrical components meet safety standards for clearance, electrical ratings, mechanical, structural, access, and operations requirements
- ☐ Specify proper insulation material for pad/vault-mounted switches and transformers

7.3.3 Operability

- ☐ Identify switching and isolation requirements
- ☐ Specify pad-/vault-mounted switches, fused cutouts, load-break switches, or air break switches
- ☐ Ensure pad-mounted transformers are loop-feed configuration and have (3) 2-position switches
- ☐ Allocate proper clearance and access around all medium voltage apparatus

7.3.4 Resiliency

- ☐ Identify criticality of the new service facility
- ☐ Assess and ensure supply-side redundancy requirements
- ☐ Specify fault indicators
- ☐ Design automation and SCADA-ready switching systems

7.3.5 Protection

- ☐ Identify short circuit protective device type and placement requirements
- ☐ Identify overvoltage (surge) protection device and placement requirements
- ☐ Specify fuse (for less than 1000kVA) or VFI (for 1000kVA and greater) protection for service transformers
- ☐ Plan advanced metering and monitoring device for new service connection
- ☐ Account for system modeling, load-flow, short circuit, and coordination studies within the project scope