



ESR Supplement

Commercial Construction Guide, 400A and Greater Services

September 2024



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PGE Contact Information

PGE Contact Information

PGE's team of dedicated experts will help review, design, inspect, and construct a customer's request for new, relocated, or upgraded service.

PGE Teams Assisting with the Request for Service Phase

The following teams need to receive a customer's application materials at the start of a project.

Team	Key Words	Role
Design Project Manager (DPM) Provided after submission of a Request for Service.	Project Manager	<ul style="list-style-type: none">▪ Coordinates the PGE review of a request for service.▪ Sends final gear approval.▪ Designs the service including selecting the type of transformation, size of the transformer, and conduit pathway.▪ Reviews and approves/rejects customer proposed location for transformers.▪ Provides the customer with an approved Job sketch (aka Design)
Lighting Design Project Manager To contact a Streetlights DPM, contact the Service Coordination team 503-323-6700.	Lighting DPM	<ul style="list-style-type: none">▪ Designs new/upgraded streetlights in parallel with the customer's service design, if required by the municipality.▪ Provides area lighting services to customers.
Interconnection Coordinators (Solar, Wind, Battery, etc.) To contact the Interconnection team, call 503-464-8100.	Renewable Lead	<ul style="list-style-type: none">▪ Receives interconnection applications.▪ Coordinates the technical review of solar, wind, and other qualifying renewables.▪ For approved interconnections, requests final PGE inspection and meter installation.▪ Coordinates review of batteries and requests for parallel generation.
Fleet Partner Product Specialist To contact the Fleet Partner team, email fleetpartner@portlandgeneral.com .	EV Charging	<ul style="list-style-type: none">▪ Receives fleet electrification applications.▪ Coordinates the technical review of fleet electrification.

New large load customers over 1MW may obtain additional guidance from the PGE Business Development team. Feel free to reach out PGE's business development team by emailing Ecodev@pgn.com.

PGE Teams Assisting with the Application, Review, and Construction Phases

The following teams may assist the DPM in reviewing the customer’s application materials and site.

Team	Project Phase(s)	Role
Engineering Teams	Design Phase	<ul style="list-style-type: none"> ▪ The type of engineers reviewing the request for new/upgraded service is determined by the location of the service, service size, and other factors.
Meter Gear Engineers	Design Phase	<ul style="list-style-type: none"> ▪ Reviews all gears 400A and greater. ▪ Discusses gear requirements with electricians. <p>Note: The DPM sends the final gear review matrix.</p>
Field Construction Coordinator	Pre-Design, Design, Pre-Construction, and Inspection Phases	<ul style="list-style-type: none"> ▪ Facilitates the pre-construction meeting with the customer’s civil contractor(s) installing the vault and conduit infrastructure for underground services. ▪ Conducts necessary trench and conduit inspections for services 400A and greater. ▪ Supports streetlight improvement plans.
Construction Project Manager (CPM)	Permits and Construction & Inspection Phases	<ul style="list-style-type: none"> ▪ Facilitates project coordination after PGE approved job sketch is issued.
Service Inspector To schedule an inspection, contact the Service Coordination team 503-323-6700.	Inspection Phase - Final Inspector	<ul style="list-style-type: none"> ▪ Conducts final inspections for all services: residential, commercial, mixed-use, and medium voltage. ▪ Installs riser brackets on PGE poles and drops off the bottom portion of PGE lockboxes.
Metermen	Inspection and Construction Phase	<ul style="list-style-type: none"> ▪ Installs Current Transformer and meters greater than 320A. ▪ When customers rewire or upgrade existing services, reviews the service to ensure it meets current PGE requirements. ▪ Installs meters for solar, wind, and other renewables.
Crews	Construction Phase	<ul style="list-style-type: none"> ▪ Builds and energizes the service!

PGE Contact Information

Phone Numbers

Contact	Phone Number		
	Toll-Free	Local	Fax
Service Coordination To open a new request for service or schedule a final inspection	800-822-1077	503-323-6700	503-612-3501
Business Services Team Customer Service To request billing and payment information for existing accounts	800-822-1077	503-228-6322	503-612-0151
Tree Trimming	800-544-1794	503-736-5460	—
Oregon Utility Notification Center To locate underground utility cables	8-1-1 or 800-332-2344	503-246-6699	—
Outages and Emergencies, 24 hours To report a power outage	800-544-1795	503-464-7777	—
Light Out (streetlights) To report a streetlight problem	800-544-1795	503-464-7777	—
Energy Theft Hotline To report an energy theft	800-962-8184	—	—
Interconnection Team To obtain information on customer-owned solar and wind systems, and on batteries	—	503-464-8100	—

Email Addresses

Contact	Email Address
Service Coordination	service.coordinators@pgn.com
Tree Trimming	forestry@pgn.com
Light Out (streetlights)	LightOut@pgn.com
Net Metering	netmetering@pgn.com
PowerPartner	https://portlandgeneral.force.com/powerpartner

1 Preliminary Information

TOPICS IN THIS SECTION

- Scope
- Request for Service Checklist
- Design and Construction Timeline Considerations
- Formatting Electronic Files
- Updates to a Drawing Package
- Renewable (Solar, Wind, etc.) and Storage (Battery) Plans
- Fleet Partner
- Dispatchable Standby Generation Program (Large Commercial Backup Generators and Batteries)
- Accuracy of Information and Conflicting Requirements

1.1 SCOPE

This *Design and Construction Guide* is intended to support a partnership between commercial customers 400 A and greater, their project team, and Portland General Electric (PGE). Creating a partnership at the beginning of a project aids in successful and timely delivery of electric service.

This Guide supplements information available in PGE’s [Electric Service Requirements](#) (ESR) book for *new, rewired, relocated, or temporary commercial services*. This Guide provides process specific information for each project phase: the pre-design phase, the design phase, construction of the trench and conduit system, and inspections.

The pre-design and design sections are intended to assist:

- Architectural firms,
- Professional engineers,
- Consultants, and
- Construction contractors.

The pre-construction and construction sections are intended to assist:

- Construction contractors,
- Excavators, and
- Civil engineers.

This Guide is not intended to provide support for civil infrastructure projects (i.e., bridge crossings, road widening, traffic signals, railroad crossings, water crossings, etc.). These types of projects are dependent on site specific circumstances and may involve additional PGE standards and evaluations. We strongly recommend that the customer consult PGE to resolve any questions concerning the requirements in this book.

Do not use figures or text in this guide as construction plans by themselves. An approved job sketch is required for site specific design and construction details.

1.2 DESIGN AND CONSTRUCTION TIMELINE CONSIDERATIONS

To develop an economical and effective option for the site, contact PGE during initial design by submitting a request for service on [PowerPartner](#). Customers already engaged with other PGE teams will also need to complete a Request for Service on PowerPartner to create their specific project work orders. New and existing services require extensive planning for utility facilities, utility conflicts, safety clearances, and adherence to jurisdictional requirements and/or Right of Way (ROW) provisions.

Early and reliable communication may help avoid costly redesign and post-bid contractor change order requests.

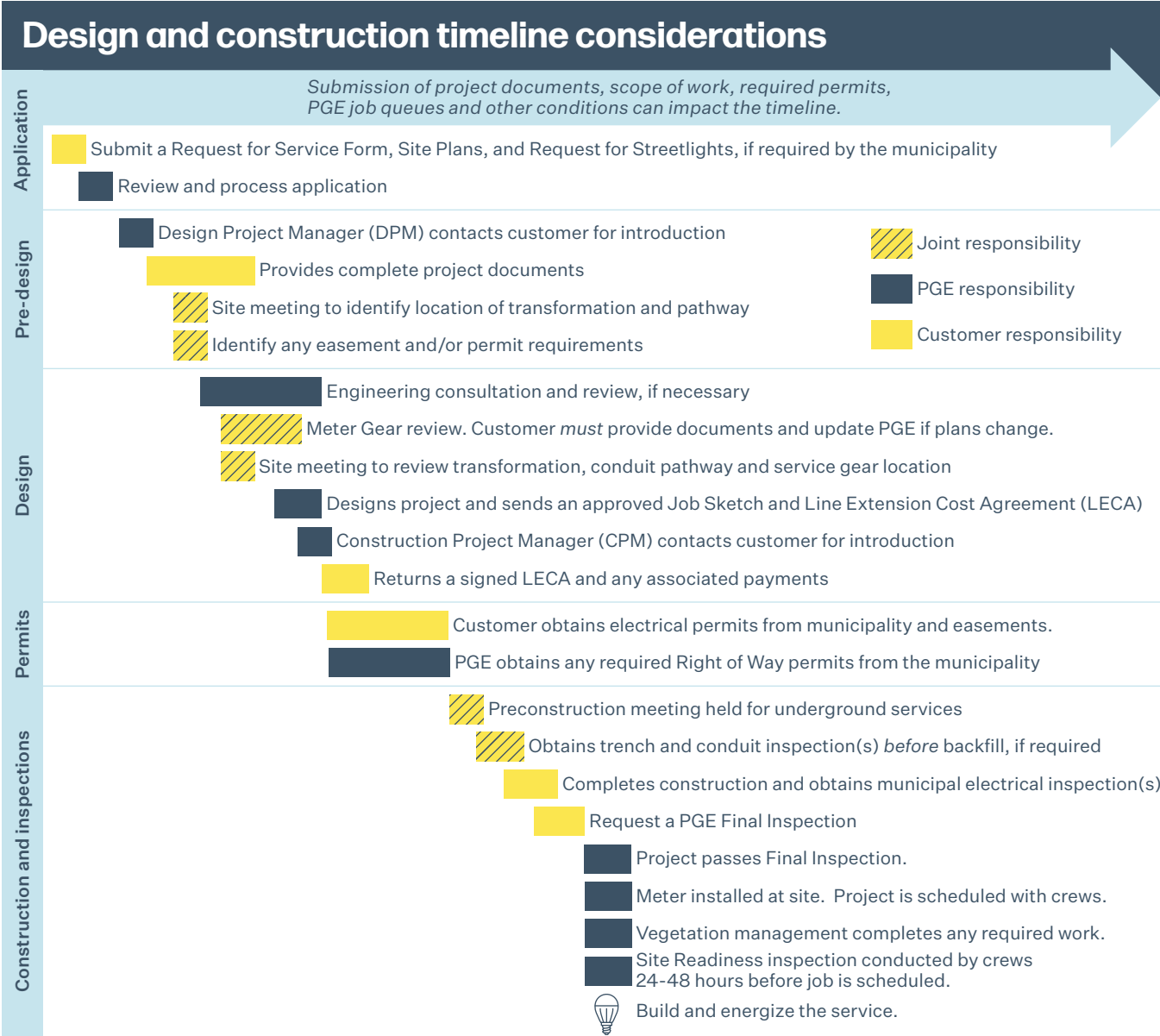


Figure 1. Design and Construction Timeline Considerations

1.2.1 KEY PRE-DESIGN AND DESIGN PROJECT MILESTONES INCLUDE:

1. A PGE DPM will respond to the Request for Service within 5 business days (see section [1.3 Request for Service Checklist](#)). Next steps include reviewing the project, adding any additional required PGE reviewers, and requesting any missing customer documents or information needed to initiate a design.



The following often missed essentials will hold up a project:

- If area lighting is desired, or streetlights are a jurisdictional requirement, customers must make note of this in the Request for Service Form on the [PowerPartner](#) portal. If this is not noted in the original request or the requirement is identified later, customers must contact the Service Coordination desk to create a separate and distinct work order for a Lighting DPM to be assigned to the project.
- If the project includes renewable resources, storage or batteries, a **separate and distinct application**, review, and approval is required (see section [1.6 Renewable \(solar, wind, etc.\) and Storage \(battery\) Plans](#)).

NOTE: Projects that involve feeder extensions, substation upgrades, and/or transmission upgrades are complex and may involve longer lead times and additional costs.

2. For many projects, a pre-design site visit will be scheduled with the DPM and other relevant PGE employees, including the Field Construction Coordinator (FCC) (see section [2.2 Important Underground Design Decisions](#)). This site meeting is not the same as the pre-construction meeting in [step 6](#).



SCHEDULE: Any new or upgraded service projects located in the “Portland Core” or “Waterfront District”, will have additional requirements, engineering review, and may involve greater lead times for design and construction. See [Appendix E Underground Network Map](#) for a map of PGE’s Portland Core.

3. Upon receipt of all necessary customer information, PGE will provide the customer with a Design Complete Commitment Date (DCCD). This date depends on receipt of all necessary customer information and the amount of work in the design queue. See section [2.7 Required Design Documents](#) for a list of required design documents and common missed items.

If additional documents are requested by PGE, the amount of time it takes customers to obtain those documents is added to the timeline. Delays in receiving information are added to the design time, but not necessarily in a “day for day” ratio.

4. For some projects, a PGE DPM may send the customer a preliminary job sketch (aka design) and later arrange a meeting with the customer’s design team and internal PGE stakeholders to review the site.

5. Once PGE provides a job sketch (design), to avoid scheduling delays the customer should promptly return their signed Line Extension Cost Agreement (LECA), pay any costs, schedule a pre-con, and start construction.



The job is “on hold” for obtaining permits and any special-order equipment or materials until the document and payment are received. The LECA expires after six months. After this period, the LECA, job sketch, and construction costs must be reviewed by PGE (and revised if necessary) before moving to the pre-construction stage. A redesign fee may be applied at the time of review, as well as updated construction costs.

IMPORTANT: After the design has gone through PGE’s approval process, if customers change their plans, even plans involving landscaping and vehicle access, a redesign may be required.

6. Pre-construction meeting – Once the PGE final design has been issued and construction will begin soon, the customer must schedule a pre-construction meeting with all required parties (see section [4.2 Pre-Construction Meeting \(Underground Services 400A and Greater\)](#)).

1.2.2 CONSTRUCTION TIMELINES


Construction timelines depend upon the following items:

1. Customer’s return of the signed LECA and payment of any costs due.
2. PGE can experience long lead times for many materials especially in the current global supply chain challenges. Some items can have lead times of twelve-months or longer.
3. PGE will assign or purchase materials upon receipt of the customer’s LECA and any required permits from governing agencies, if required, for new/upgraded PGE equipment located in a the right of way.
4. Customer’s passing all required PGE trench and conduit inspections **before backfill occurs**. Some overhead services have one inspection by a Service Inspector. More complex, underground services may have a pre-construction conference with multiple trench and conduit inspections by a Field Construction Coordinator.
5. Customer’s passing local inspections to comply with ordinances and/or state laws required before PGE can establish service, including streetlights if that is a jurisdictional requirement. This usually includes approval of the electrical installation by the applicable electrical inspection authority.
6. Customers completing any required landscaping and/or tree trimming requested by PGE.
7. Customer’s passing PGE’s final inspection by a Service Inspector, then
 - PGE will complete required landscaping and/or tree trimming, if required.
 - PGE will obtain permits from the governing agencies, if required, for street closures, flaggers, etc.
 - PGE will schedule a meterman to install the meter(s).
 - After the installation of meter(s), PGE will schedule a crew to install the wire and energize the service. This likely will not occur on the same day as meter installation.

1.3 REQUEST FOR SERVICE CHECKLIST

Creating a partnership at the beginning of a project aids successful and timely delivery of electric service. To initiate conversations about a project's location and size of transformers, location of termination equipment, and clearance requirements, PGE will need the following:

1. **Submit a Request for Service Form** on [PGE's PowerPartner](#): During initial design, customers may not have all the required information needed for a PGE DPM to develop a design. PGE will eventually require all this information: voltage, service size, connected load, square footage of new construction, the size of the largest motor and any electric vehicle charging stations. Having the customer's electrician submit accurate details will assist in the design process.
 - a. **Temporary power:** In the request for service, indicate the need for temporary power. The project's DPM will provide available options. A separate request for service with the affiliated load sheet will be required for services 400A and greater.

 **NOTE:** If the load increases on a temporary service, a new request for service and load sheet must be submitted to avoid blowing the transformer.

- b. **Other special considerations:** Provide any special considerations associated with the project. These may include:
 - Monument lighting
 - Pumps
 - Irrigation control
 - Street/area lighting
 - Road widening
 - Overhead-to-underground conversions
 - **Streetlight design**
 - **Frontage Improvement Plan**
 - Removal of existing electrical equipment
 - On-site generation
 - Renewable and/or storage plans
 - EV charging plans
 - Clearance concerns

2. **Site Plan** – Provide computer-aided drafting (CAD) files with civil engineering drawings of the site plan and profile with the footprint of the building as well as the preferred locations of electric equipment. See section [1.4 Formatting Electronic Files](#) for formatting requirements.

Additional information will likely be required by the DPM. See section [2.7 Required Design Documents](#) for a list of commonly requested items and a list of common missed items on drawings.

1.4 FORMATTING ELECTRONIC FILES

Follow these requirements when preparing and submitting the drawing package:

- Provide computer-aided drafting (CAD) files with civil engineering drawings of the site plan and profile. PGE accepts AutoCAD 2013 or newer (.DWG files). PGE will use the customer's files in the original survey coordinate system or datum; please specify this on the drawing. Updates to drawing files are requested at milestones in the project.
- Include the same layers in the CAD files as are shown on the site plan and profile hard copy. The minimum layers needed are:
 - Survey control points
 - Existing and future street right of way
 - Lot lines
 - Lot numbers
 - Street names
 - Building footprints
 - Curbs
 - Sidewalks
 - Centerlines of streets and roadways
 - Easements
 - Stationing
 - Existing electrical facility locations
- Make sure the data meets the following requirements:
 - If survey control points are not available in CAD format, PGE software will accept control points in text or Excel file format.
 - If nonstandard file and layer naming conventions are used, provide guidelines for reference.
 - Provide all custom fonts, line types, and hatch patterns to PGE.
 - If the data contains attachments (such as aerial imagery) or raster files, either provide the attachments or delete the files from the reference before submittal.
 - If multiple files are sent, provide a description of what is included in each file.
 - Manufacturer specifications should not be included in the drawing package. If requested, they must be submitted separately.
- Submit the files via email. Zipped files are acceptable, but executable (*.exe) files are not. Contact the PGE DPM for approved file transfer methods if the files are too large to transfer using e-mail.

1.5 UPDATES TO A DRAWING PACKAGE

Project scope often changes. Changes, we understand! Customers must clearly communicate the changes via email to the project DPM. As a customer's design is revised, customers must communicate what changed in the second file by:

1. Itemizing all data changes in the email to PGE.
2. In the drawing, indicate where the revision has changed using the cloud method, or by placing revision numbers next to affected portions of the drawing.

IMPORTANT: Non-itemized changes may result in inaccurate reviews or approval of gear, which upon discovery may require re-review and different gear at the customer's expense.

1.6 RENEWABLE (SOLAR, WIND, ETC.) AND STORAGE (BATTERY) PLANS

Customers planning to install a renewable, storage, and/or battery must submit a separate application to PGE's Interconnection team for review and approval. More information on generation requirements and applications is available on portlandgeneral.com/renewable-installers/interconnection-requirements.

1.7 DISPATCHABLE STANDBY GENERATION PROGRAM (LARGE COMMERCIAL BACKUP GENERATORS AND BATTERIES)

Commercial customers planning to install a backup generator or battery may be eligible to participate in PGE's Dispatchable Standby Generation (DSG) program. For program participants, PGE assumes responsibility for the generator and/or batteries fuel costs, routine testing, and most of the annual maintenance and operating costs including upgrades to select components. In exchange for these services, during a critical grid need PGE can temporarily call on the customer's on-site backup to produce electricity that is fed into the electric system. More information on the DSG program is available online [here](#).

1.8 FLEET PARTNER

PGE's Fleet Partner program supports companies in electrifying their fleets, so they can realize their sustainability and economic goals. For program participants, PGE builds the make-ready infrastructure required for the site. Customer cost incentives and rebates exist that make the program financially feasible. More information on the Fleet Partner program and applications are available on [Fleet Charging | PGE \(portlandgeneral.com\)](https://portlandgeneral.com/fleet-charging).

Note, customers must submit a separate application from their request for service. To minimize cost and maximize timely delivery, PGE recommends initiating the application at the start of the project.

1.9 ACCURACY OF INFORMATION AND CONFLICTING REQUIREMENTS

The construction of new or upgraded services must conform to PGE requirements and to the applicable provisions of the following: National Electric Code (NEC), National Electrical Safety Code (NEESC), Oregon Electrical Specialty Code (OESC), state rules and regulations, city and county ordinances and codes, and Occupational Safety and Health Administration (OSHA) rules.

The requirements in this Guide are issued with the intent of complying with all governing codes, ordinances, and tariffs. In case of conflict, the appropriate tariff, code, or ordinance supersedes the interpretation offered here. Always refer to the most recent publication of any code, ordinance, or tariff.

The most up-to-date Commercial and Design Guide can be found in the digital version at [PortlandGeneral.com/esr](https://portlandgeneral.com/esr).

IMPORTANT: PGE does not assume responsibility for keeping this book current. Consult PGE when there are questions as to the applicability of any of the Guide's content to a specific project.

2 Pre-Design Phase

TOPICS IN THIS SECTION

- Service Type and Size
- Important Underground Design Decisions
- Clearance Requirements
- Working Clearances for Sub-Grade Equipment
- Landscaping and Trees
- Temporary Power Requirements
- Required Design Documents
- Streetlights
- Area Lighting Permitting and Right of Way Considerations

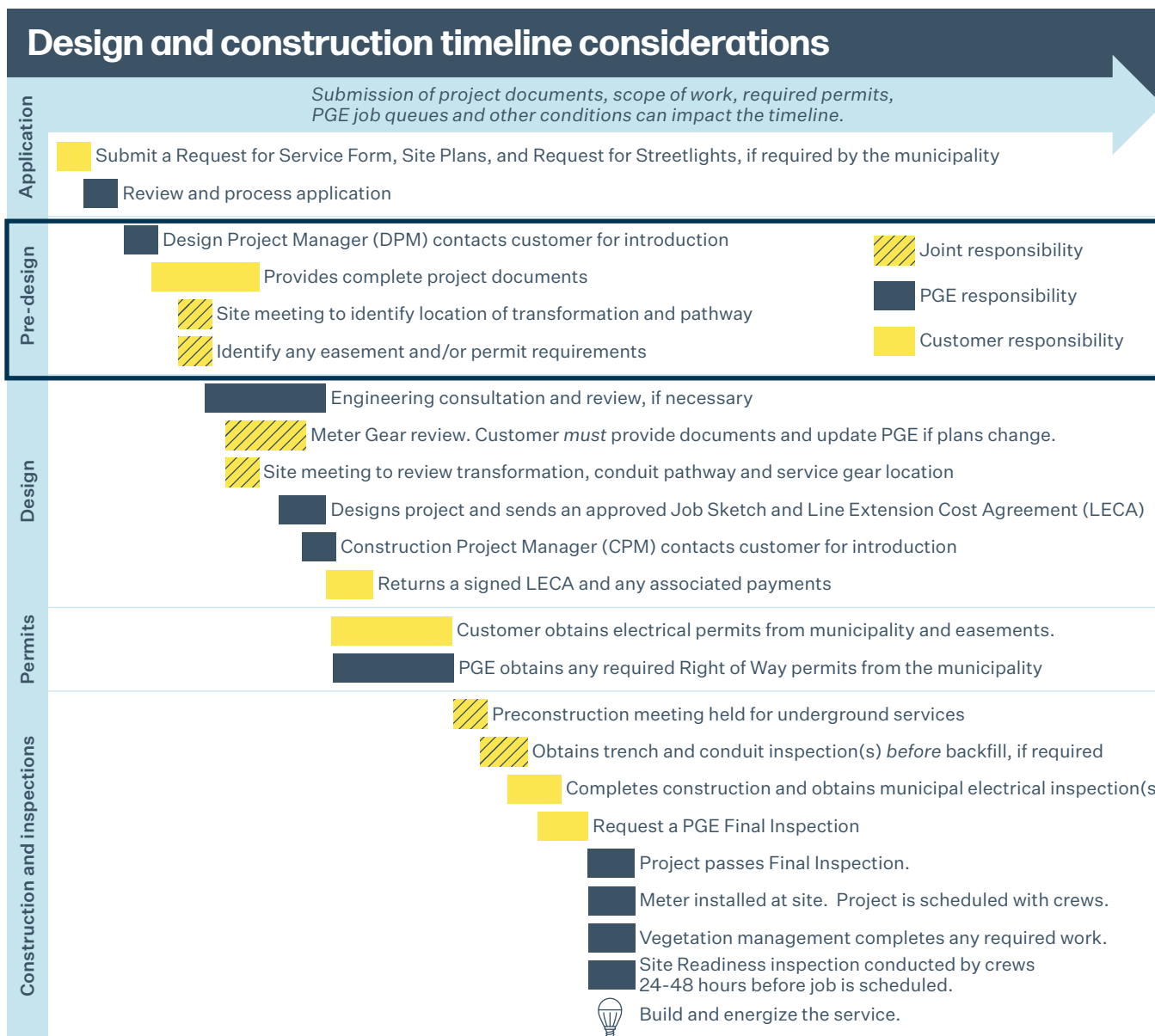


Figure 2. Pre-Design Timeline

2.1 SERVICE TYPE AND SIZE

Initially, PGE's DPM and the customer need to exchange information, project plans, and conduct a site evaluation meeting to discuss and evaluate the following critical design elements:


- Service type and size.
- Type of transformer and its location to achieve clearances.

In determining the location of transformers, the conduit pathway, and location of meter gear, PGE and the customer must adhere to multiple PGE working and safety clearances in addition to jurisdictional clearance requirements. Early and frequent communication between the project's design team and PGE will assist all parties in the development of a safe, efficient, and economical electrical supply system.

The DPM will solicit information about the project, arrange a site evaluation meeting, solicit input from PGE internal resources, and coordinate the exchange of information. After **all PGE required information is received**, a design will be initiated. Once an approved PGE job sketch (aka design) is provided to the customer, PGE will provide checklists detailing each party's responsibilities and the impact of not meeting them on the construction timeline.

2.1.1 400A TO 1200A

Commercial services between 400A to 1200A may be served by overhead or underground design.

 A PGE DPM will assess if overhead service is an option. Overhead is usually more cost effective. Overhead services require either:

- An existing available pole with space to mount transformers, or
- Space to install a new pole on the development's frontage and a clear overhead pathway to the customer's electrical equipment.

Some municipalities may require underground service. See section [2.2 Important Underground Design Decisions](#) for more information. See the [ESR, Chapter 3 Services](#), for PGE's underground and overhead service sizes.

2.1.2 1201A TO 3000A

Commercial services between 1201A to 3000A will require on-site transformers with an underground conduit system connecting them to the service point. PGE requires transformers to be located within the lot lines of the property serviced. The termination of the service must be located on the exterior of the customer owned/leased building (see the [ESR, Chapter 3 Services](#)).

2.2 IMPORTANT UNDERGROUND DESIGN DECISIONS

Before designing a service, the DPM and Field Construction Coordinator (FCC) will arrange a site evaluation meeting with the customer’s design team to discuss and evaluate the following critical design elements, in this order:

- Service type and size
- Type of transformer(s) and its location to achieve clearances
- Conduit pathway with no more than 270 degrees of bends
- Meter gear type and location to achieve required clearances
- Clearances required by PGE and others
- Other requirements that might relate to the project site, structure, and/or service.

PGE has sole discretion over the location and type of transformers, the location of meter gear, and the conduit pathway. For preliminary design considerations, review PGE standards as outlined in this section.

Customers are responsible for the installation of vaults, conduit pathways, and termination equipment. PGE will not install a conductor and energize the service if the conduit system is improperly constructed, termination equipment does not match the equipment reviewed by PGE, or other changes to the approved job sketch are made. The customer is responsible for repairing—or for the costs associated with repairing—any problems before installation of a PGE conductor.

Once the service is energized, PGE owns and maintains transformers, conduits, and meters supporting a service.

2.2.1 TYPE OF TRANSFORMER

During the design phase, the PGE DPM will designate the type of transformer required and provide job specific vault and conduit details on the job sketch.

The customer’s service size and other factors will dictate whether PGE selects a concrete pad, a pre-cast concrete vault, or Class A vault located within the building. For the approximate footprint of PGE’s approved pre-cast pads, vaults, and their associated clearances, see [Appendix B Generic Transformer and Vault Dimensions](#).

2.2.2 LOCATION OF TRANSFORMER

The customer must provide space for PGE's transformer(s) and/or vault(s) on the customer's property with space for safe working clearances. This will require the customer to grant a permanent easement to PGE. The preferred location is "front-of-lot" next to a public street as PGE line crews and vehicles need equipment within 15-feet of a drivable surface and unrestricted 24-hour access. Clearances from surface and subsurface structures, as well as existing and future utilities are critically important in determining the specific location of the transformer(s), conduit (and vaults, if required). For generic transformer and pad vault working clearances, see [Appendix B Generic Transformer and Vault Dimensions](#).

PGE prefers to locate transformers in:

- Protected asphalt areas (24/7 access must be available, which renders parking prohibited in front of the transformer).
- Grass landscaped areas adjacent to a sidewalk and drivable surfaces.

PGE will not locate transformer vaults/pads in:

- Traffic areas,
- Parking areas, such as parking spaces,
- Lanes in a parking area,
- Driveway areas associated with truck loading docks, or
- Sidewalks.

When a pad-mount transformer on private property is not deemed possible by PGE, a Class A vault will be required within the building. Class A vaults should be located at grade, with direct access to the exterior of the building, and within 15 feet of a drivable surface. When a Class A vault is required, PGE will inform the customer of additional construction requirements and information needs (see the *Class A Vault Guide* found on portlandgeneral.com/esr).

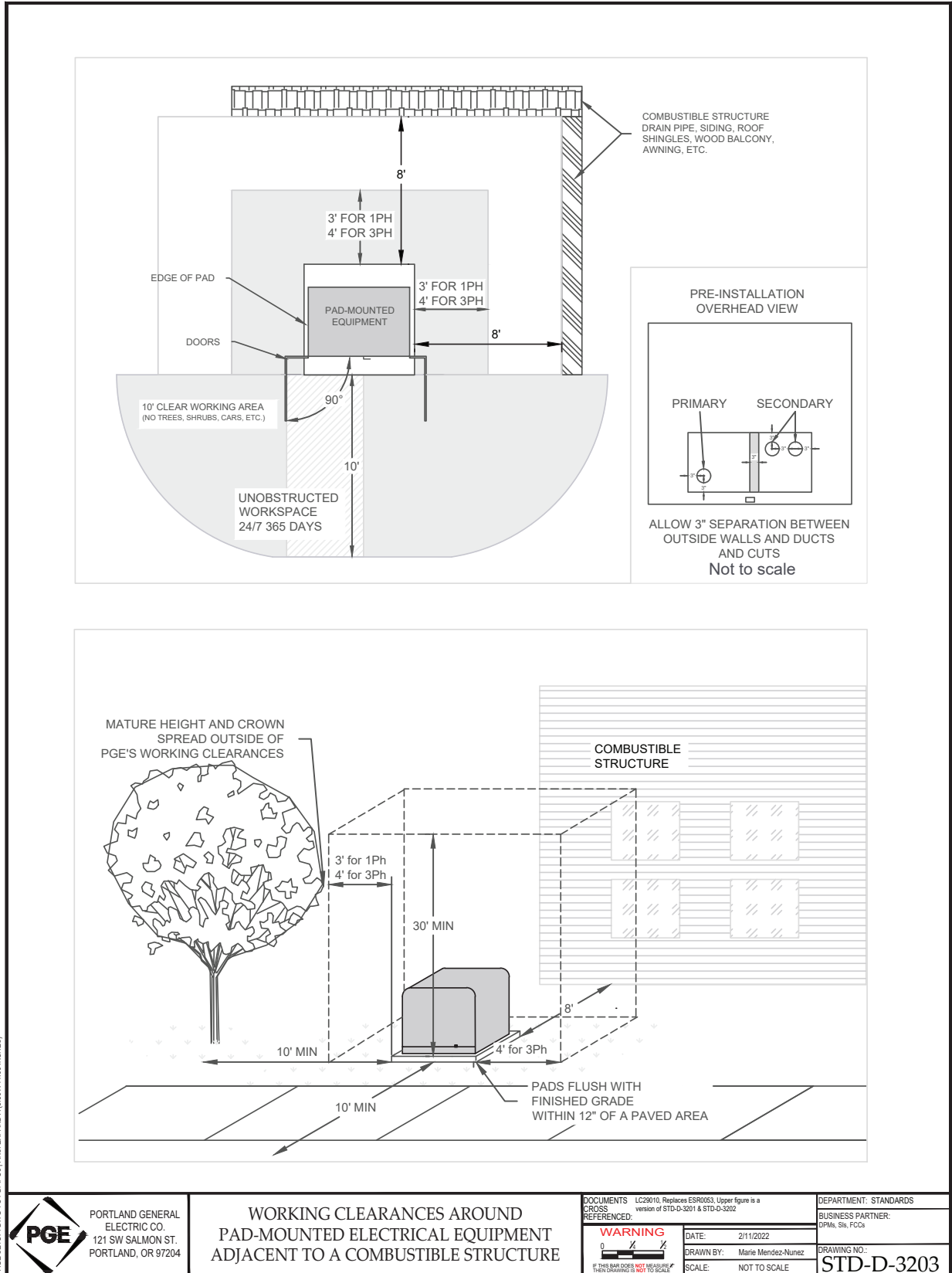


Figure 3. Working Clearances Around Pad-Mounted Electrical Equipment Adjacent to a Combustible Structure (STD-D-3203)

2.2.3 PGE DECISION: WHERE IS THE CONDUIT ROUTING?

The conduit pathway is the infrastructure in which PGE conductors will be installed to bring primary voltage to a transformer and secondary voltage from a transformer to the meter gear and service. Conduit requirements are detailed in section [6.5 Conduit Requirements](#) and the [ESR, Chapter 6 Underground Requirements](#).

NOTE: The pathway must not exceed 270-degrees of bends.

Typical PGE underground design utilizes open trench methods. The typical method for trenchless installation of conduit is horizontal directional drilling (HDD).

PGE will not locate conduit:

- Under or near bodies of water
- Under stormwater structures (e.g., bioswales, etc.)
- Under buildings with the exception of electrical rooms located on the exterior **building wall**
- Decks
- Fences
- Other structures

A PGE DPM may evaluate requests for trenchless technology methods when projects include a crossing, like a road, watercourse, or railway.

2.2.4 PGE-CUSTOMER DISCUSSION: WHAT TYPE OF GEAR IS REQUIRED AND WHERE WILL IT BE LOCATED?

Customers are required to provide externally mounted, accessible, at grade metering equipment. See the [ESR, Chapter 3 Services](#), for mounting requirements and the [ESR, Chapter 5 Clearances and Location Requirements](#) for clearance dimensions.

PGE only permits an electrical equipment room containing PGE meter(s), instrument transformer(s), and/or cable termination when PGE determines that no acceptable outdoor alternative exists. See the [ESR, Chapter 13 Electrical Equipment Rooms and Interior](#), for complete requirements. When permitted, electrical rooms must be on the exterior wall of a building and if a building is upgraded, the electrical room should remain on the exterior wall.

Meter gear locations must be reviewed and approved by PGE's Meter Gear Department and Metering Foreman.

Once the secondary conduit pathway and gear location is approved, the DPM will provide the customer or customer's electrician with the project's fault current. The electrician has the responsibility for identifying appropriate gear that can withstand the available fault current. The electrician must provide PGE with the cut-sheets, one-line, and if required, the building profile view with gear placement. PGE will conduct a Meter Gear review of the customer's proposal.



SCHEDULE: Do not purchase gear for services 400A and greater until PGE reviews the cut-sheets, one-line, and other documentation, and provides complete meter gear in full (see section [3.1 Customer Gear Review \(Services 400 A and Greater\)](#)). The Meter Gear Review is dependent upon customers providing **all required information/documents** necessary for the review at which point Meter Gear Review (in lieu of schedule) may take up to 4 weeks following the last response before sending a full review matrix.

2.2.5 PGE DECISION: DESIGN ELEMENTS FOR CONDUIT PENETRATION INTO BUILDINGS

When PGE decides that no acceptable outdoor location exists and the only acceptable location is within an electrical room, customers are responsible for providing adequate and safe conduit penetration. PGE requires that all conduits that penetrate customer owned and/or occupied buildings, which will become PGE's upon energization of the service, are protected straight runs of conduit (e.g., no bends, fittings, etc.). Conduits that penetrate exterior walls or floors must be protected and approved by PGE prior to construction. Methods of protection can include, but are not limited to, the following:

- Rigid steel carrier pipe with adequate spacers and/or seals
- Penetration sleeves and support systems (e.g., UNIBrace™, Link-Seal®, etc.)
- Rigid steel carrier pipe and housekeeping pad (i.e., floor/slab penetration)
- Penetrations may require additional sealing (e.g., fire, water, weather, etc.), depending on the location and/or circumstances.
- Conduit alignment should maintain 5-feet of clearance from the building foundation unless approved by the building's Engineer of Record (EOR).
- PGE requires a statement from the project's structural engineer, indicating the penetrations do not interfere with the structural loading capacity of the building.

2.3 PGE CLEARANCE REQUIREMENTS

Clearances are **very** important in determining the location of electrical equipment to ensure safety, reliability, and effective operation and maintenance; the electrical equipment may be owned by PGE or the customer, but regardless of ownership, the clearance requirements still apply. The following list outlines the main clearance categories for electrical equipment. Each category has both vertical and horizontal clearance requirements.

- **Meter clearances** which include NEC and EUSERC clearances. See the [ESR, Chapter 3 Services](#), and the [ESR, Chapter 5 Clearances and Location Requirements](#).
- **Fire safety clearances** from electrical equipment to combustible surfaces and hazards, like gas equipment and LP equipment. See the [ESR, Chapter 5 Clearances and Location Requirements](#)
- **NESC Clearances** from PGE conductors, pad-mount transformers and electrical equipment to structures including, balconies, awnings, windows, doors, decks, patios, steps, fences, walkable surfaces, and buildings. See the [ESR, Chapter 5 Clearances and Location Requirements](#). PGE clearances may be greater than the NESC clearance.

NOTE: Consider NEC and OR-OSHA Safe Work Clearances for their employees to energized facilities.

- **Safe work clearances** in front of and around electrical equipment for PGE personnel and contractors. See section [2.4 Working Clearances for Sub-Grade Equipment](#) and the [ESR, Chapter 5 Clearances and Location Requirements](#).
- **Clearances from drivable surfaces.** See the [ESR, Chapter 5 Clearances and Location Requirements](#).
- **Installation/removal clearances** needed for boom trucks and other vehicles.
- **Landscaping Clearances.** See section [2.5 Landscaping and Trees](#).

Site and/or equipment specific clearances may be addressed by PGE during the site-visit, pre-design meeting, or at the pre-construction meeting.



SCHEDULE: A customer’s failure to consider all clearances, especially safe work clearances, will often create significant construction delays, and additional customer costs, while required clearances are designed and implemented.

2.4 WORKING CLEARANCES FOR SUB-GRADE EQUIPMENT

Submersible equipment requires at least 5 feet of horizontal separation in front of and on the sides of the enclosure lid **frame**. At least 10 feet of horizontal separation is required in front of the enclosure lid **frame** of a lateral or switching vault. A vertical separation of 30 feet is required above the lid **frame**. **Awnings, landscaping, and balconies must not impede the 30-foot vertical clearance.** (The front of an enclosure lid **frame** is the side opposite the lid hinges.)

2.4.1 VAULT GRADE, LOCATION AND CLEARANCES

All vaults must be located on private property within an existing public utility easement or private easement. The vault must be a minimum of 8 feet from flammable structures. Typically for projects located on private property, PGE places vaults 5 feet off the sides or back of the property line.

IMPORTANT: The type and size of vault selected by PGE determines the PGE level of contractor required for installation (see section [4.1 Classification of Excavation Contractors](#)).

2.4.1.1 Elevation Information

Vault location must be lower than or at the same elevation as the customer’s termination cabinet. If the vault fills with water, this design minimizes the flow of water through the conduits into the customer equipment. If a suitable location cannot be found, then PGE will require a junction box and additional sealing or drainage mitigation measures.

2.4.1.2 Unsuitable Locations for Vaults:

- Locations higher than the customer's termination cabinet

NOTE: The customer is responsible for water mitigation strategies (see the [ESR, Chapter 6 Underground Requirements](#)).

- In traffic areas
- Parking areas, such as parking spaces, the lanes in a parking area, and driveway areas associated with truck loading docks do not provide 24/7 access
- Sidewalks should only be used as a last resort. If the vault must be placed in a sidewalk or plaza-type area where the public can be expected to walk, then metal doors in the concrete vault cover must have slip-resistant design and may require a Design Exception (DE) or Utility Vault Lease (UVE) issued by the governing jurisdiction.
- Landscaped areas near irrigation, bioswales, fountains, areas with high-water tables, etc.

2.4.1.3 Clearances for Vaults (Excluding Class A Vaults)

Consider the following clearances when evaluating vault location:

- From building footings
- From swales or other storm water infrastructure
- From other utility's vault walls, tops, or above grade terminations
- From vault access doors (building walls, overhangs, building entries/exits)
- From vault vents (water features, sprinklers, drive aisles, building entries/exits)
- Working clearances from vault to overhead wires (OR-OSHA zone)
- Conduits under building floors or foundations

NOTE: Construction clearances will be greater than installed clearances to accommodate shoring.

2.4.2 POWER LINE CLEARANCES

Projects located anywhere near power lines must meet the clearances outlined in the National Electric Safety Code (NESC), PGE Standards, and OR-OSHA, with the most "stringent" of the clearances prevailing. Clearances between overhead power lines and structures vary depending on voltage, the type of power line, access below the lines to pedestrians and vehicles, and the purpose of the structure. Different clearances are calculated by PGE for rest conditions and for conductor displacement from wind. PGE encourages customers and their contractors to call and discuss required clearances before beginning the site's design.

While clearances allocated may be sufficient for NESC and PGE standards, these may be insufficient for required working clearances during the construction phase. Contractors are required by state law to maintain safe working clearance to power lines overhead or directly adjacent to a worksite. Distances are determined by voltage, type of work, and employee qualifications. See OR-OSHA rules for additional information.

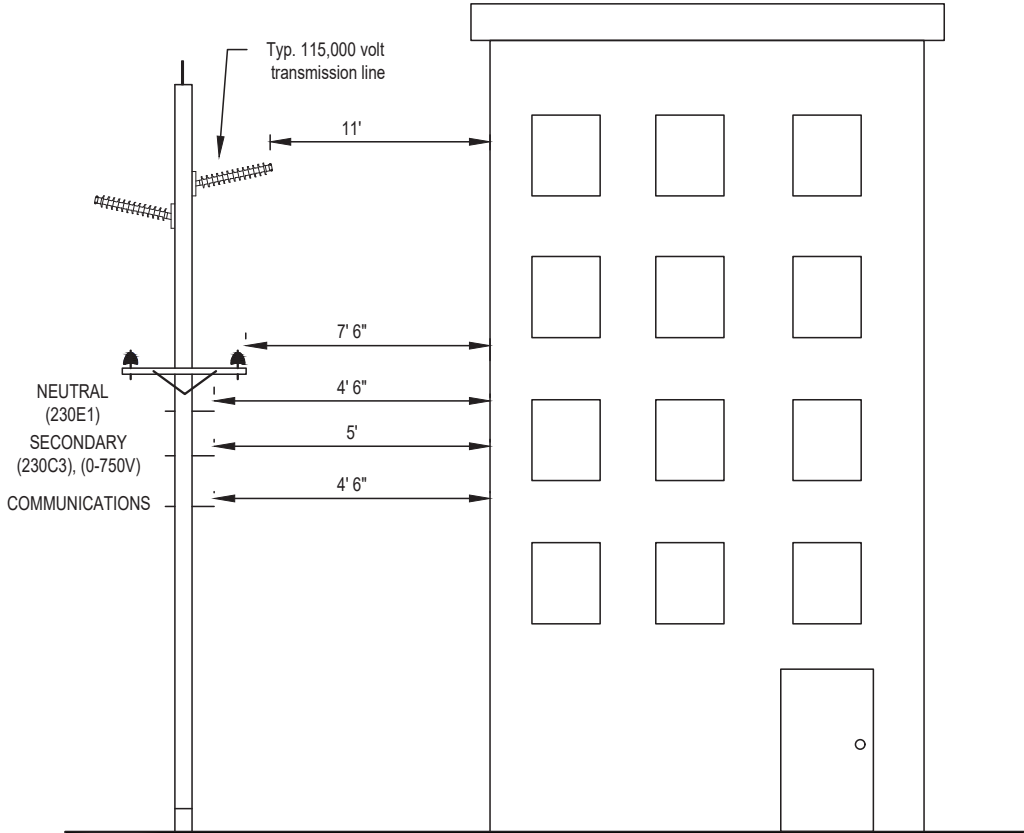
2.4.2.1 Temporary Relocation of Overhead Wires

Relocation of overhead wires for NESC, PGE, and/or OR-OSHA safe working clearances will involve an additional Work Order Request, additional time for evaluation, design, and construction, additional costs to the customer/project for said relocation, and in many instances, may not be feasible due to reliability issues for other customers in the area, municipality restrictions on relocations of poles and wires, or available infrastructure to support the request.

NOTE: Consideration of building activities that will be in conflict with overhead lines should be discussed early in your project to avoid costly delays at a later date. Scheduling and completing relocations is generally a 75-120 day cycle.

2.4.2.2 Minimum Final Building Clearance

Examples of typical clearances from wires, conductors, and cables are shown here. This is not a comprehensive list. Actual clearances may be greater.



PER NESC TABLE 234-1, THE HORIZONTAL CLEARANCE BETWEEN THE PHASE CONDUCTOR OF A 12,470 / 7,200V 3-PHASE, 4-WIRE DISTRIBUTION LINE AND A BUILDING (WITHOUT WIND) MUST BE NOT LESS THAN 7' 6".

THE NEUTRAL (230E1) AND COMMUNICATION CABLE HORIZONTAL CLEARANCE (WITH WIND) MUST NOT BE LESS THAN 4' 6".

THE SECONDARY (230C3) HORIZONTAL CLEARANCE (WITHOUT WIND) MUST NOT BE LESS THAN 5' 0".

CUSTOMERS MUST MEET OR-OSHA CLEARANCE REQUIREMENTS DURING CONSTRUCTION AND MAINTENANCE.

STD-D-3200

Figure 4. Minimum Final Building Clearance (STD-D-3200)

2.5 LANDSCAPING AND TREES

Trees growing too close to power lines can trigger power outages, pose safety concerns, or fire risks to customers or PGE employees. Customers must select trees and landscaping that will not interfere with the access, proper operation, or maintenance of PGE facilities.

Bark dust or other landscaping materials must not cover a vault lid or other below-ground PGE facilities and covers. Fake rocks, irrigation systems, and other items must not be placed over electrical equipment.

2.5.1 COMMON LANDSCAPING AND TREE PROBLEMS



1. This tree was located too close to a transformer. Remember to plan for a plant's growth when landscaping.



2. This transformer will be covered by vegetation that prevents line workers from accessing it for repairs and maintenance. PGE needs 10 feet in front of the opening doors of transformers.



3. This fence and ADA ramp were built so close to the transformer that the doors cannot be opened. PGE needs a flat, clear, unobstructed space in front of transformers doors.



4. This combustible fence is built too close to the transformer. Workers need 3 feet on all sides of single-phase equipment and 4 feet on all non-opening sides of three-phase equipment.

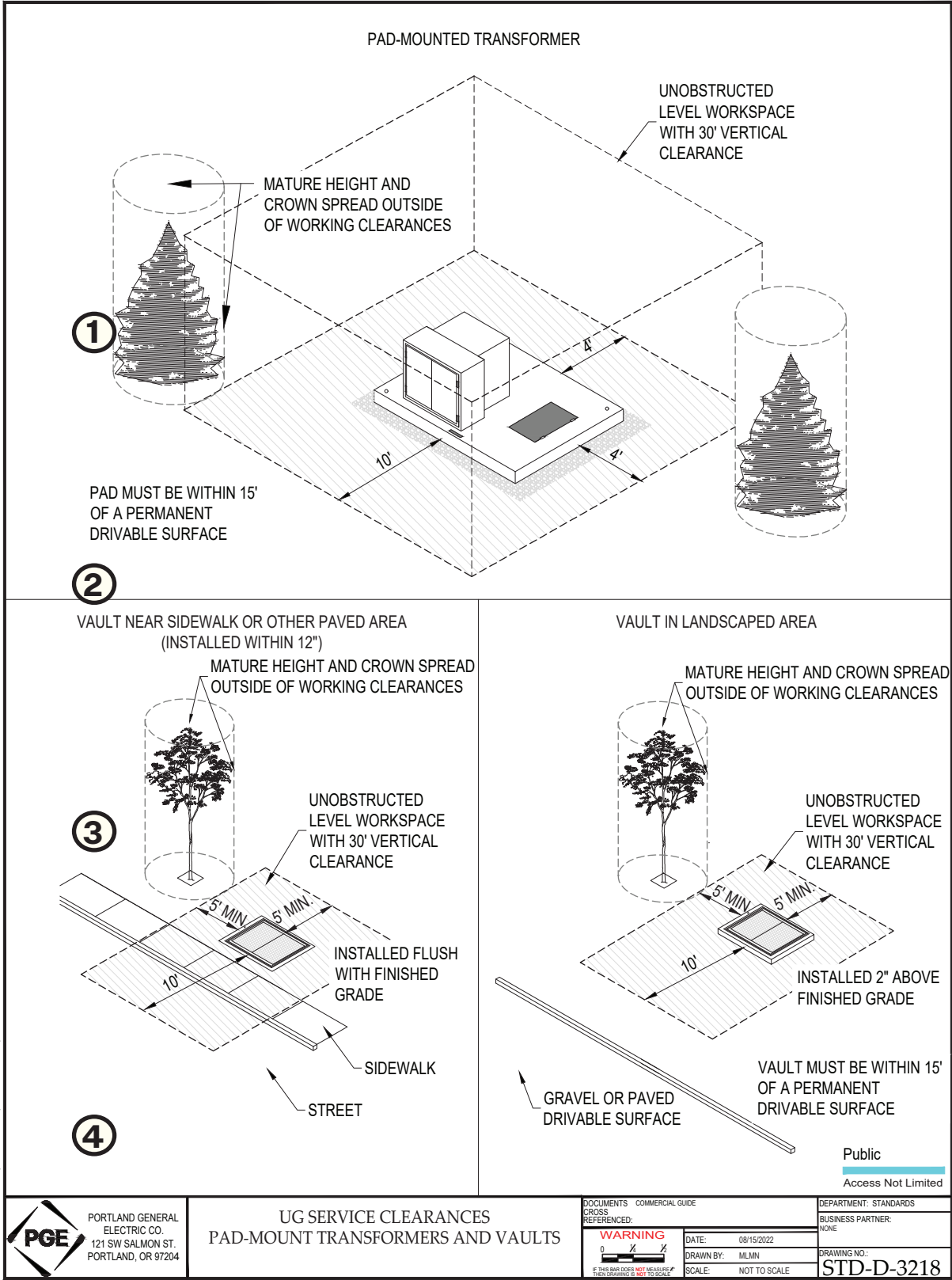


Figure 5. Pad-mounted Transformer (STD-D-3218)

2.6 TEMPORARY POWER REQUIREMENTS

If the project requires temporary power during construction, customers must request temporary power in their original request for service on PowerPartner. Those that do not request temporary power must later call Service Coordination to initiate a separate work order for temporary power. Overhead temporary service information is available in the [ESR, Chapter 4 Temporary Service](#). Underground temporary service requires a PGE design. The average design timeline is 60 days from the receipt of all required customer documentation for the temporary service.

2.7 REQUIRED DESIGN DOCUMENTS

Required design documents provide PGE with the information necessary to develop a design, assess the suitability of proposed utility locations, and verify safety clearances. PGE's design timeline is ultimately dependent on submission of all requested customer design documents selected by the DPM. Most projects require, but are not limited to, the following information/ documents:

- Civil plans (e.g., street plans, grade, sidewalk, parking, and curbing details)
 - Utility plans (e.g., existing and proposed utilities)
- Site plan with proposed meter locations
 - Lot lines, easements
 - Transformer vault location and requirements
- Grading/Elevation plans and profile
- Structural details with foundation, surface structures, utility vaults and any other sub-grade structures (existing and/or proposed)
- Architectural plans showing the elevation of the building (awnings, balconies, etc.)
- Landscape plan (streets, trees, and irrigation)
- Electrical plans
- Switchgear location and review - see section [3.1 Customer Gear Review \(Services 400 A and Greater\)](#)
- PGE Area Light or Street Light with a Street Improvement/Frontage Plan, if applicable
- Other documents requested by the DPM

2.7.1 COMMON MISSED ITEMS ON DRAWINGS

- Equipment clearances
- Switchgear locations
- Proposed transformer locations, clearances & access
- Vault clearances & access
- Vehicle access/approach distances
- ROW's
- Private property
- Future system improvements
- Live vault conduit connections



SCHEDULE: If changes arise in the Municipal approved Frontage Improvement Plan (if required), notify PGE as soon as possible. Email the updated document(s) and note, on the drawing and/or in an email, the updates made to the original. While some changes may not require a re-design, other changes may require a complete re-design, on-site space considerations, and/or new equipment.

2.8 STREETLIGHTS

PGE offers 3 options for streetlight facilities per Tariff; however, the jurisdiction determines what option is to be installed. Customers must contact the local jurisdiction to determine if lighting is a requirement for their project. If streetlights are a requirement, customers must provide the PGE Lighting DPM with a streetlight design layout stamped “Approved” by the appropriate jurisdiction. The layout must include complete streetlight design details (pole and luminaire specifications). Once PGE receives an approved streetlight design layout, it can start its design.

If streetlights are a jurisdictional requirement for the project, make note of this in the request for service. If this is not noted on the original request or the requirement is identified later, customers must contact the Service Coordination desk (503) 323-6700 to create a new work order. Then, a PGE Lighting DPM to be assigned to the project.



SCHEDULE: Streetlight materials are ordered for each project and have long lead times (minimum of 8 weeks with some materials taking up to 6 months). For Option A projects, PGE recommends contacting the PGE Lighting Design Project Manager as soon as possible to coordinate materials ordering.

2.9 AREA LIGHTING

PGE offers a convenient area lighting plan under which PGE owns, installs, and maintains area lighting for perimeters, parking lots, or other locations. Contact the Service Coordination team (503) 323-6700 to arrange for a discussion with a PGE Lighting Design Project Manager regarding the costs and design requirements, if any.

2.10 PERMITTING AND RIGHT OF WAY CONSIDERATIONS

The customer is responsible for the cost of all permits and easements required for the installation and maintenance of the electrical facilities that serve the customer. An easement is required for the placement of electrical facilities (such as poles, guy wires, anchors, underground lines, transformers, vaults, junction boxes, and pedestals) on private property. Any electrical infrastructure that cannot be completely contained on private property will require review and permitting by the appropriate local governing jurisdiction. Permits may also be required if the electrical facilities cross property, railroad tracks, ODOT-managed highways, waterways, parks, or state/federal lands. The PGE DPM will assist in coordinating required permits but has no control over jurisdictional responses and timelines or conditions.

In the public Right of Way permit, only PGE-approved excavation contractors can work under a PGE street-operating permit. If operating under a PGE street-operating permit, PGE will acquire the permit and provide a copy to the contractor. See section [4.1 Classification of Excavation Contractors](#) for more information.

3 Design Phase

TOPICS IN THIS SECTION

- Customer Gear Review (Services 400 A and Greater)
- PGE's Job Sketch (Design)
- Customer's Steps Upon Receipt of a PGE Job Sketch

To keep the project on schedule, the customer must ensure all data needed has been submitted to the DPM. PGE will provide the customer with a Design Commitment Date, which depends on the receipt of all necessary customer information. The Design Commitment Date is also influenced by the amount of work in PGE's Design queue (see section [2.7 Required Design Documents](#) and [Appendix A Pre-Design Requirements Checklist](#)). Generally, allow 60 or more days for PGE to complete the design. If additional documents are identified as needed by reviewing departments, the amount of time it takes to obtain those documents is added to the timeline. Delays in receiving customer information are added to the design time, but not necessarily in a "day for day" ratio.

IMPORTANT: Notify PGE if any revisions occur to any of the project documents. Redesign fees and revised construction costs may apply if revisions occur after PGE provides an approved job sketch. Changes may also require re-review of customer gear and new gear at the customers expense.

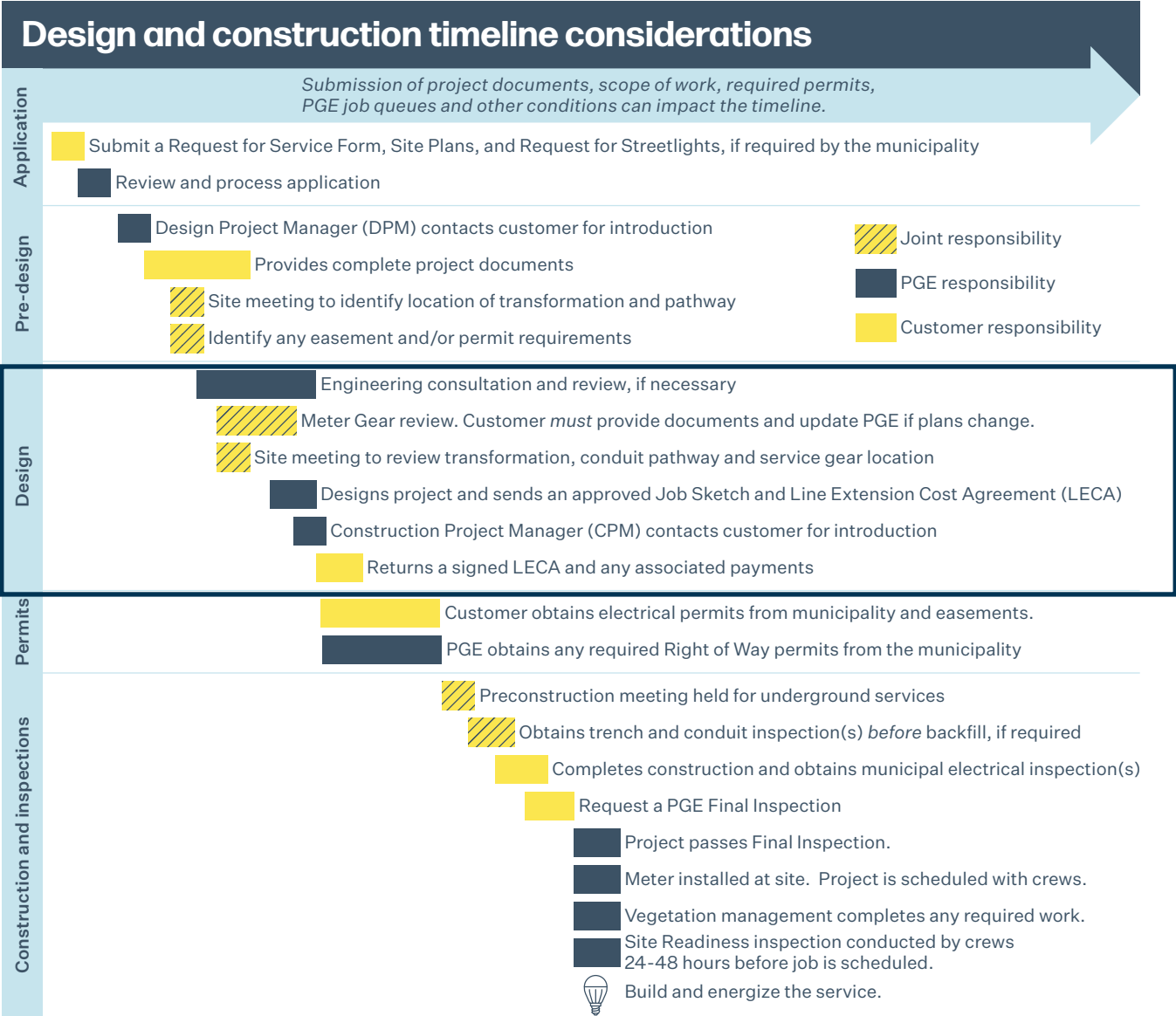


Figure 6. Design Timeline

3.1 CUSTOMER GEAR REVIEW (SERVICES 400 A AND GREATER)

A PGE gear review is required for all services 400A and greater. The customer is responsible for providing their PGE DPM with the following information:

- Verify number of jaws in meter socket(s)
- Cut-sheets from manufacturer with EUSERC designations for switchboards, CT cabinets, CT mounting brackets, and/or remote meter enclosures
- Dimensioned working clearances around all metering equipment
- Elevation drawings of metering equipment to verify arrangement and spacing
- Electrical one-line
- Confirm location of metering equipment on site plan
- Confirm service size and voltage
- Floor plans showing room and floor elevations
- Mock-ups of required phenolic labels
- For interior equipment, identified egress path(s) from the electrical room to the exterior of the building
- For interior equipment, provide dimensioned electrical room layout

PGE teams will review the following:

- Conduit pathway
- Number of conduit
- Conduit spacing
- Egress/ingress routes to the gear
- Gear orientation
- Ensure clear, level working clearances, and
- Other considerations before approving the service.



SCHEDULE: The PGE Gear Review timeline is dependent upon a customer's response time in replying to questions and requests for additional information. Once all required information/documents are received, PGE's Gear Review may take up to 4 weeks following the last response to send the full review matrix. While electricians will likely be in direct contact with PGE's Meter Gear Engineers, the project's DPM will email the complete gear review matrix to the customer.



IMPORTANT: Do not purchase gear before receiving the complete meter gear review matrix from a PGE DPM. Doing so could result in customers needing to re-purchase gear and delays.

3.1.1 GEAR REVIEW OF EXISTING SERVICES

Any service that has had customer electrical equipment modified in any way that changes the rated capacity of the gear or affects the terminations of PGE’s service conductors, must be evaluated by the gear review process and brought up to current requirements.

In addition to the customer’s required information above, existing services require a PGE meterman to conduct an on-site review of the existing equipment and clearances to provide direction. If PGE believes there is rust, damage, or other safety concerns with the metering equipment or conductors, and the gear must be replaced, the service must be meet current requirements.

3.2 PGE’S JOB SKETCH (DESIGN)

PGE’s job sketch will provide customers the following information:

- PGE project number
- Source pole details
- New pole location(s)
- Anchor location(s)
- Switchboard location on the property
- Vault/pad details and approximate locations
- Conduit running lines
- Number and size of required conduits
- Orientation of conduits entering/exiting vaults
- General construction notes/requirements
- Places on the site where landscaping or tree trimming are required
- Areas where Right of Way permits are required
- Contact information for their assigned Field Construction Coordinator
- Service sizes and fault current calculations
- Contractor level required to complete the work

NOTE: PGE’s job sketches are not drawn to scale.


IMPORTANT: Do not bid and/or build before receiving an approved PGE job sketch. Doing so could lead to increased costs and delays.

3.3 CUSTOMER'S STEPS UPON RECEIPT OF A PGE APPROVED JOB SKETCH

3.3.2 CUSTOMER RESPONSIBILITIES

Approved job sketches do not contain site surveyed information. Customers are responsible for taking PGE's job sketch and integrating it into their civil engineering plan to ensure vertical and horizontal alignment of PGE facilities. Customers must meet the minimum PGE working clearances, NESC code requirements, and other required clearances.

Once PGE provides an approved job sketch, the customer has six months to:

- Return the signed LECA
-  ▪ Pay any costs due. Until the customer pays, PGE cannot install standoff brackets, drop off CTs, provide upper portion of the PGE lockbox, install meter equipment, or request permits.
- Schedule a pre-construction conference **with the PGE inspector listed on the Job Sketch.**
- Provide the name and key contact of the excavation contractor before starting any work on the PGE infrastructure to ensure that the contractor meets PGE's requirements for the level of PGE infrastructure being installed
- Obtain PGE provided supplies, conduit markers, ground rods, and secondary pedestals (PF-300s) available at PGE yards.
 - Standoff brackets are installed by PGE Service Inspectors. To request installation of a standoff bracket on a pole, contact the PGE Service Coordination team.
 - PGE Service Inspectors will hand out the mountable bottom of the PGE lockbox to the electrician or customer **at the time of the final inspection.** The customer is then responsible for installation.
 - Build the service infrastructure to PGE Standards and requirements
- Obtain easements granted to PGE for transformation located on the customer's property.
- Schedule required PGE inspections for trench(es), conduit(s), and/or vault(s). Commercial services often require multiple inspections with the project's Field Construction Coordinator.
- Conduct landscaping and/or tree trimming as required.

After six months, the LECA, and design, must be reviewed by PGE (and revised if necessary) before moving to the pre-construction stage. If revisions occur after PGE provides an approved Design, a redesign fee and current construction costs may apply at the time of review.

4 Pre-Construction Phase

TOPICS IN THIS SECTION

- Classification of Excavation Contractors
- Pre-Construction Meeting (Underground Services 400A and Greater)
- Work in the Right of Way

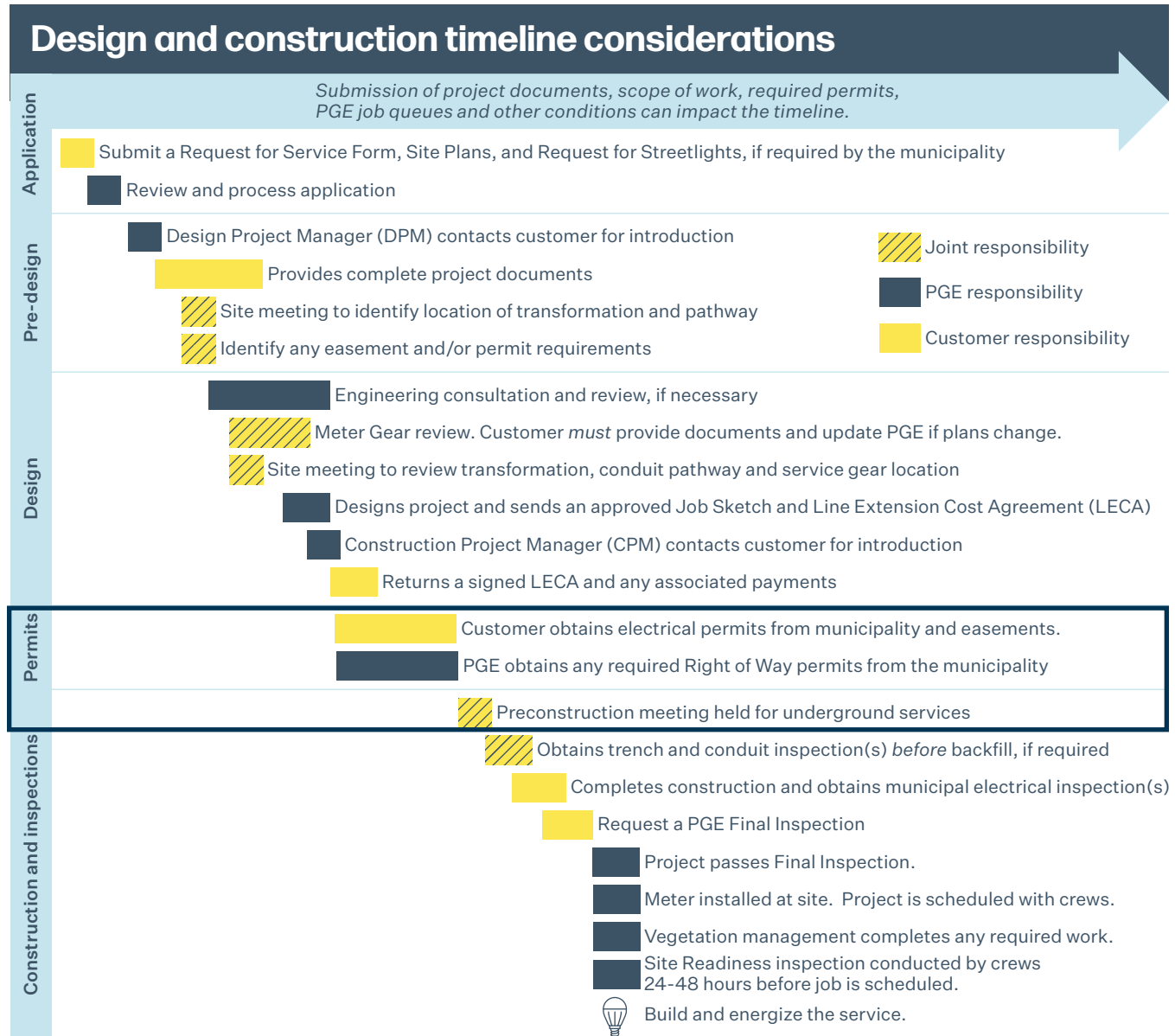


Figure 7. Permits Timeline

4.1 CLASSIFICATION OF EXCAVATION CONTRACTORS

PGE classifies excavation contractors into three levels with restrictions based on the size of vault and complexity of the installation. The PGE job sketch will indicate the contractor level required by PGE for the project.

The General Contractor/Project Owner must provide their PGE DPM the name and key contact of their excavation contractor as soon as possible in the pre-design process and specifically, before starting any work on the PGE infrastructure to ensure the contractor meets PGE's requirements for the level of PGE infrastructure being installed. The DPM will verify that the designated excavator meets the PGE level for installation if there is work to be done in a public right-of-way. The DPM will also **verify** all insurance and bonding requirements are current.

NOTE: Some municipalities have additional contractor requirements prior to the approval of a ROW permit.

4.1.1 CALL BEFORE YOU DIG

IMPORTANT: Before you dig, call 8-1-1 or 800-332-2344 for the location of underground utilities; or visit callbeforeyoudig.org. In the Portland metro area, call 503-246-6699.

Oregon law requires a customer or excavator to call to determine the location of underground utilities two full working days (48 hours) before beginning excavation. The excavation must not be started until utility locations have been marked or the utilities have informed the excavator that they have no facilities in the area.

4.2 PRE-CONSTRUCTION MEETING (UNDERGROUND SERVICES 400A AND GREATER)

Once PGE's job sketch has been issued and construction is set to commence for underground services 400A and greater, the customer must schedule a pre-construction meeting with a Field Construction Coordinator (FCC) and DPM. Customers can find their point of contact on their job sketch. The following participants should attend the pre-construction meeting:


- The customer's Civil Contractor(s) used to install the vault and conduit infrastructure — required attendee(s)
- General Contractor's Project Manager(s)
- Site Superintendent
- Project Manager(s), and
- Foreman from the excavation and electrical contractors.

PGE's inspection process starts with initial infrastructure inspections and continues through to the final service and metering inspections. Frequent communication between the customer and PGE ensures a successful project. To avoid delays or unforeseen complications, all changes in the design must be addressed with the DPM or FCC before proceeding with construction.

4.3 WORK IN THE RIGHT OF WAY

If work in the public right of way is required, then a permit from the local jurisdiction must be obtained before any work may be performed. PGE will not apply for the permit until any required fees noted on the Line Extension Customer Allowance (LECA) have been submitted by the customer.

Only PGE approved excavation contractors will be allowed to work under a PGE street-operating permit. Before work begins, the contractor must notify the local jurisdiction according to the terms of the permit issued for that work. The amount of advance notification varies from jurisdiction to jurisdiction. PGE will inspect the site prior to backfilling and before installing the electrical facilities. Upon completion, the contractor will submit a post-construction notification to the jurisdiction. A copy of the permit must be on site at all times during construction.

 **Pre-Construction Meeting Guide**

Checklist for Common Discussion Points:

- PERMITS:**

Local jurisdiction's permitting requirements are different depending on the location.

Some points of emphasis:

 - Approved right-of-way (ROW) permit and traffic control plan (if applicable) must be on site during construction.
 - Permit holder must provide required notification to jurisdiction prior to construction.
- PREAPPROVED CONTRACTORS:**

Any contractors they hire who will be working under PGE's permit in the ROW must be preapproved by PGE to do so. Preapproval entails having insurances and bonding confirmed by PGE CS&I department prior to commencing work as well as being authorized to perform the scope of work.
- SKETCH:**


Sketch review with PGE, customers, and contractors is vital to clearly understand everyone's responsibilities for the project. In addition to PGE installation instructions, the sketch also outlines specific requirements for how to install items that are customer responsibility.
- INSPECTIONS & SCHEDULING:**

PGE's inspection process starts from initial infrastructure inspections through final service and metering inspections. Timelines need to be considered for both the inspections and line crew for construction.
- COMMUNICATIONS:**

Keeping lines of communication open ensures a smoother project. Contact PGE with any and all questions. Significant changes in the design must be addressed with the project manager before proceeding to avoid delays or unforeseen complications.
- ACCESS:**

Access to the work site is critical when the line crew arrives. If the site is not accessible, the job will likely be delayed.
- CONTACT INFORMATION:**

Service Coordination
503-323-6700 Email: service coordinators@pgn.com



NOTES:

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Figure 8. Pre-Construction Meeting Guide Form

5 Inspection Phase

TOPICS IN THIS SECTION

- Trench and Conduit Inspections
- Final PGE Inspection

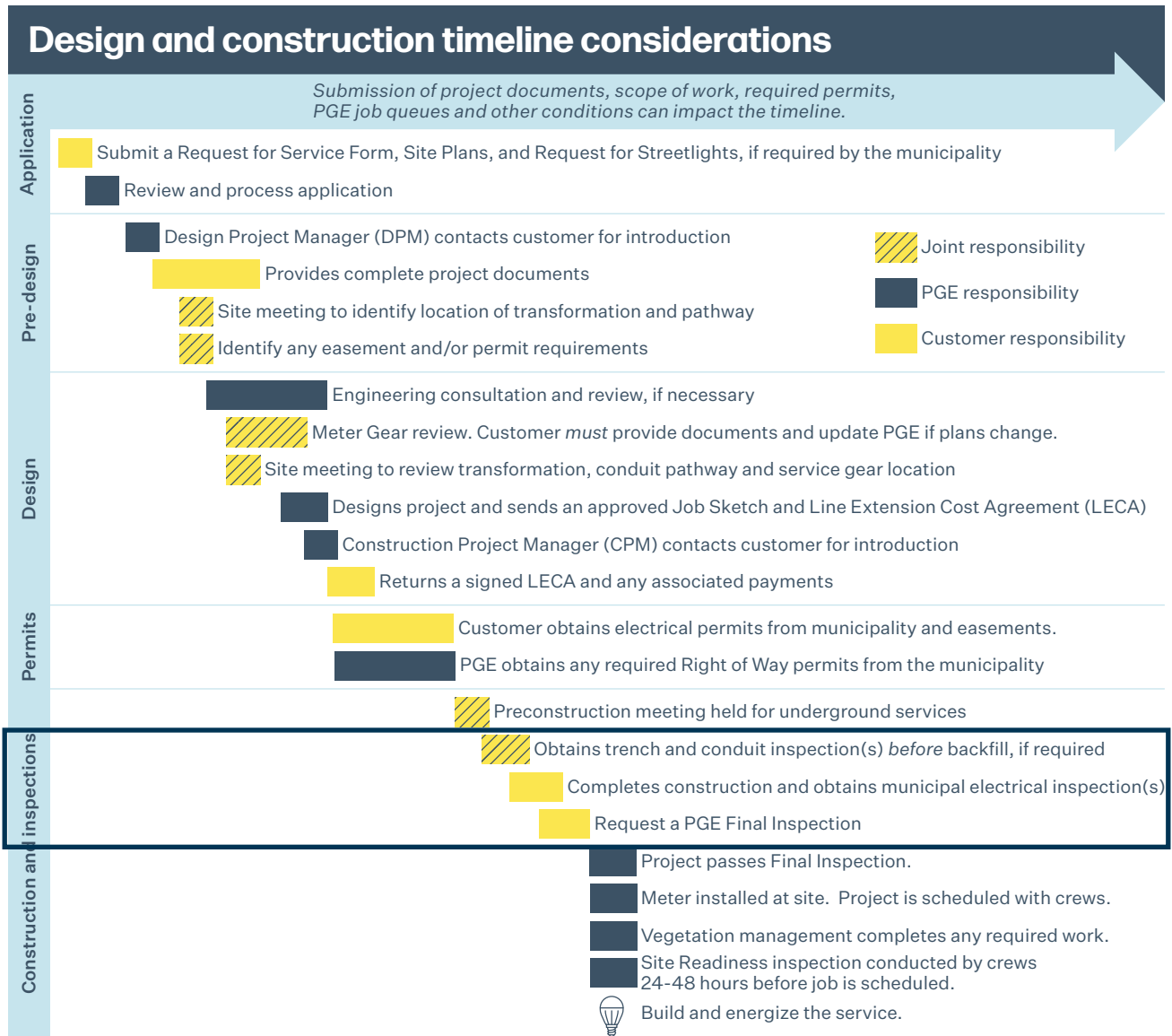


Figure 9. Inspection Timeline

This section describes PGE’s inspections for new and upgraded commercial electric service 400 A and greater. During the construction phase, commercial services often require multiple inspections for trench(es), conduit(s), and/or vault(s). Once the trench and conduit inspection(s) are complete, and the site has passed a final electrical inspection by the jurisdiction, the customer must schedule a final PGE inspection of the gear and site clearances by a Service Inspector.

5.1 TRENCH AND CONDUIT INSPECTIONS

During the construction phase, commercial services often require multiple inspections for trench(es), conduit(s), and/or vault(s). Once the customer builds their trench and before backfilling is done, a PGE Field Construction Coordinator (FCC) must inspect the trench. Customers are responsible for calling and scheduling this initial trench inspection. Before calling for an initial trench inspection customers should review [Appendix C Initial Trench Inspection Checklist](#). During the inspection, the FCC will verify the site meets PGE requirements and when corrections are required, the FCC will work with the customer to address any corrections.

FCC's will conduct a final inspection of the trench and conduit system. During the FCC's final inspection of the trench and conduit system, they will verify that all trenches, vaults, pedestals, junction boxes, and other equipment are installed to PGE standards. To build to PGE's requirements, review [Appendix C Initial Trench Inspection Checklist](#). The list includes verifying that:

- Each conduit on the vault wall is labeled with the PGE pad or vault number that the conduit is routed to.
- Pull strings are tied to the vault lids of switch vaults and transformer vaults.
- Vaults are free of mud, dirt, and debris. Any PGE vault opening and/or vault doors must be covered with at minimum a 3/4-inch marine grade plywood. Pallets and other covers are not acceptable.
- A list of PGE approved handholes and part manufacturers is available on: portlandgeneral.com/esr.

IMPORTANT: The FCC's final inspection of the trench and conduit system is not PGE's final inspection. A Service Inspector must conduct the final inspection of the gear and site clearances, and approve the site before the project is scheduled.

5.2 FINAL PGE INSPECTION

After the service receives a municipal electrical approval sticker, the customer is responsible for contacting the Service Coordination team (503) 323-6700 to schedule a PGE final inspection by a Service Inspector and set up the billing accounts. Before the inspection, customers must have completed:

- Installation of the meter socket(s) and conductor(s)
- Any required landscaping/tree trimming
- Installation of a lockbox (if required)
- Affixed any required labels, and
- Met PGE requirements.

If PGE determined an interior gear location was required, during the final inspection the Service Inspector will provide the bottom of the PGE lockbox. The customer is then responsible for installation. A PGE Meterman will install the top portion of the lockbox and obtain the customer's key when installing the metering equipment for the service.

When the site passes PGE's final inspection, PGE will return to the site a few times on different days.

- Commercial meters are typically installed by a PGE Meterman. At this point, the project is scheduled with crews.
- If any landscaping, concrete cuts, or tree trimming is required by PGE, vegetation management will come to the site to complete the work.
- One to two days before the job is scheduled for the crews, a Foreman may confirm the site is ready for the construction of the service and energization.
- Lastly, PGE crews will construct and energize the service.



SCHEDULE: Access to the work site is critical when the line crew arrives. If the site is not accessible, due to landscaping, tree trimming, parked vehicles, or fencing, the job will likely be delayed.

6 Construction Requirements

TOPICS IN THIS SECTION

- Working Overhead Clearances from Power Lines
- Customer Provided Trenches
- Vault Installation
- Concrete Pad Installation
- Conduit Requirements
- Conduit Installation for Pad-Mounted Transformers
- Conduit Installation of Secondary Underground Service to an Overhead Pole
- Conduit Installed at Vaults
- Conduit Routing/Alignment into Building
- Conduit Installed on Switchboards
- Backfill Requirements
- Horizontal Directional Drilling (HDD) Conduit Installation
- Barrier Posts

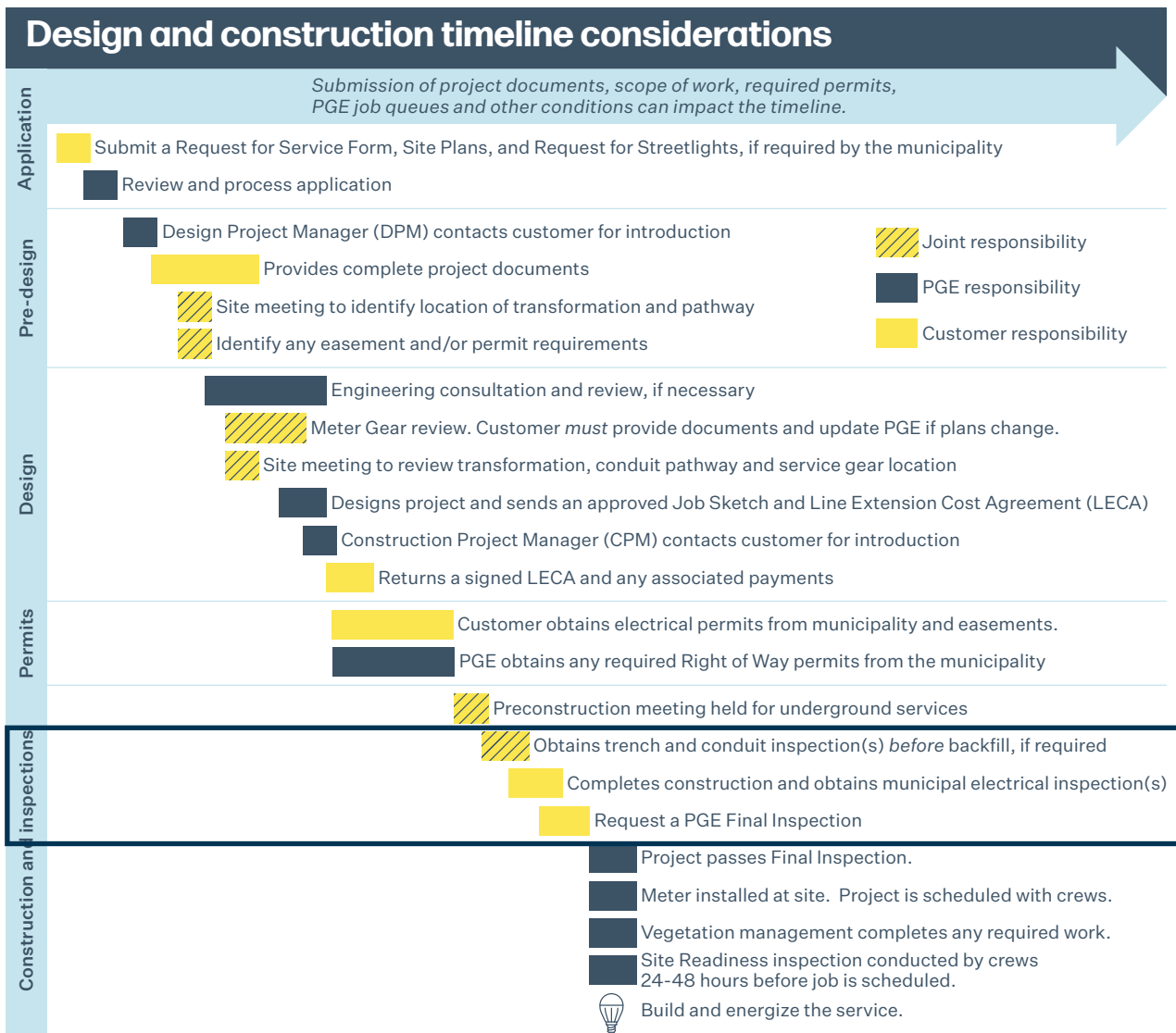


Figure 10. Construction Timeline

As requirements for trenches, conduits, and vault are met, and before trenches are backfilled, the customer must schedule required inspections with their FCC. For a guide on when to call for an initial and final trench inspection, see [Appendix C Initial Trench Inspection Checklist](#) and [Appendix D Trench Inspection Checklist](#). These lists contain the most common requirements and may not fully apply to the project. Contact the FCC if there are questions about vault or pad placement.

6.1 WORKING OVERHEAD CLEARANCES FROM POWER LINES

PGE will assist customers in ensuring overhead clearances from power lines to building wires are sufficient to meet NESC and PGE standards; however, they may be insufficient for required working clearances during the construction phase. Contractors are required by state law to maintain safe working clearance to overhead power lines. Distances are determined by voltage and type of work and employee qualifications. See OR-OSHA rules for additional information. See section [2.4.2.1 Temporary Relocation of Overhead Wires](#) for more information.

6.2 CUSTOMER PROVIDED TRENCHES

The required depth of the trench is dependent on multiple factors, including but not limited to the following:

- Size of PGE selected equipment, most notably the depth of conduit terminations in vaults
- Size of the required conduit and prefabricated conduit bends from the equipment to the gear
- Conduit runs and fittings (maximum sum of 270 degrees of bends in-between equipment and vaults). Conduit runs exceeding 180 degrees or are 150 feet or greater in length require fiberglass sweeps at each bend.
- Crossings with other underground utilities
- Required vertical and horizontal separation from other utilities
- Minimum cover required of the local jurisdiction

The assigned FCC can provide specific trench depth information.

IMPORTANT: Trench depth may exceed the minimum NESC clearance.

6.2.1 PREPARE BEFORE YOU DIG


- Call 8-1-1 for the location of underground utilities, or to have previous locates refreshed.
- Refer to Oregon Utility Notification's Center's Standards Manual for additional information about customer responsibilities including potholing. Potholing is required near existing trenches and when directional boring.

- When a PGE standby crew is needed, schedule it several weeks ahead of time. A PGE standby crew will observe when a customer is penetrating into an energized facility. The standby crew will open the facility to confirm conduit entry/exit and will serve as a safety watch for the customer or customer's contractor. The customer is responsible for supplying the equipment and manpower.
- Obtain appropriate materials to cover, mark, and protect the excavation.

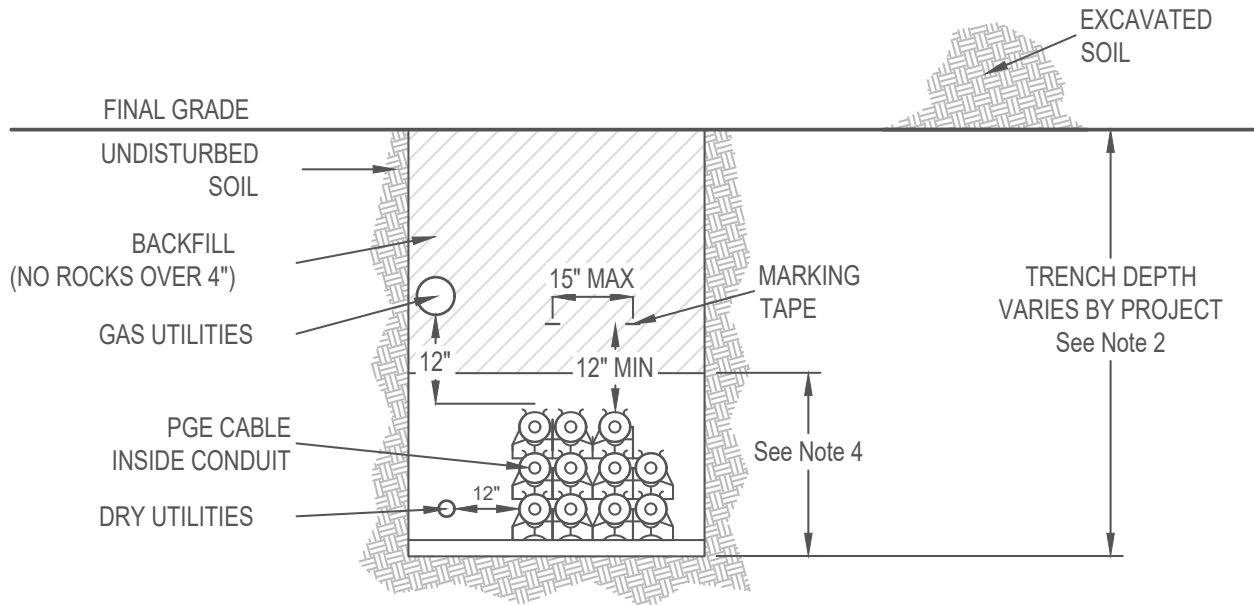
IMPORTANT: Do not undermine PGE equipment – including underground cable, transformers, vaults, or poles – unless approved by a PGE standby crew.

6.2.2 TRENCH EXCAVATING REQUIREMENTS

Follow the PGE job sketch unless directed otherwise by the FCC on the project. PGE requires trench excavation to meet these requirements:

- **Trench pathway** - Trenches must be straight, with consistent depth and width, and follow the run line depicted on the PGE job sketch or mapped out with the FCC during the pre-construction meeting. Consult local municipalities for conduit and trench install requirements at roads. Many prohibit diagonal conduit and/or trench installations near roads, and require perpendicular alignments.
 - **Clearances within Joint Utility Trenches** - Trenches must be wide enough to accommodate all joint utilities allowed while maintaining required horizontal and vertical clearances. See [Figure 11](#).
 - Installation Consideration: The vertical height of sweeps is typically greater than the sweep radius when installed at 90 degrees. Consult the manufacturer for vertical heights of sweeps. Typically:
 - 36" radius PVC 90° sweeps have a vertical clearance of 44 inches; 2 – 4-inch fiberglass sweeps have a vertical clearance of approximately 58 inches
 - 60" radius PVC 90° sweeps have a vertical clearance of 68 inches; 5 – 6-inch fiberglass sweeps have a vertical clearance of approximately 7-feet
 - **Contractor Level** - Trench work in a public right-of-way or PGE easement requires an excavator currently registered and in good standing with PGE Contract Services. PGE categorizes contractors as Level 1, 2, or 3. The PGE job sketch will indicate the contractor level required by PGE for the project. The DPM can assist in verifying that the contractor meets PGE's requirements for the level of infrastructure being installed.
-  **SCHEDULE:** PGE related work cannot occur in a public Right of Way without a Right of Way Permit. The permit will not be applied for until any customer required fees noted on the Line Extension Customer Allowance (LECA) have been submitted to PGE.
- **Protecting the Public** - The excavator is responsible for protecting the general public from all open trenches with fencing, plates, barricades, etc.

- **Excavated soil** or loose material must be placed a minimum of 24 inches from the field edge of the trench.
- **Trench bottoms** must be free from large rocks, roots, or materials that could puncture or damage conduits during the backfill process.
- **Water and runoff** must be removed from trench until conduit is inspected.
- **Trench and Conduit Inspections** - Once notified, PGE will respond to requests for trench inspections as soon as reasonably possible. It is the contractor's responsibility to provide protective measures if an inspection cannot be completed within the requested time frame.



1. Install conduit at depths necessary to enter all vaults, pads, and equipment as determined by PGE.
2. PGE requires 30" minimum cover. Local jurisdictional requirements may increase the minimum cover requirements. Cover is typically greater due to the vertical height of the factory sweeps selected.
3. Trench not to exceed 6 feet in depth without PGE approval.
4. When applicable, select backfill must be placed a minimum of 6 inches below and 6 inches above the centerline of the conduit or cable configuration.
5. Install underground marking tape over the top of the conduits.
6. Municipal water and sewer will have their own unique clearances, which PGE will verify during the design phase and include in the project's Job Sketch.
7. For a figure showing one run of conduit, see ESR Figure 38.

STD-D-3105

Figure 11. Trench with Maximum PGE Service, Eleven 6-Inch Conduits (STD-D-3105)

Refer to PGE's [ESR, Chapter 6 Underground Requirements](#), for more information about trench depth, cable separation, temporary cover requirements, and backfill material requirements. Contact the FCC with any unanswered concerns or questions.



Figure 12. Conduit Spacers Required for Multiple Conduit Installation



Figure 13. Horizontal and Vertical Configuration in Trench with Conduit Spacers



Figure 14. Minimum 12” Separation from PGE Conduit to Dry Utilities

6.3 VAULT INSTALLATION

IMPORTANT: A PGE DPM will determine whether a concrete pad or vault design is required for the project. A list of approved vault manufacturers is available on PortlandGeneral.com. An FCC inspection of the vault and conduit is required before the vault is backfilled.

Customers are responsible for excavating the vault or handhole location. The following requirements must be met for pre-cast concrete vaults:

- For commercial installs, excluding subdivision installs, PGE needs survey references for elevations, right of way, private property, and vault locations based on civil infrastructure documents. For subdivision projects, final grade around vaults, final elevation of vaults, and property pins must be on-site before PGE will construct and energize the service.
- Vault risers may be required. Refer to the approved job sketch.
- 8 & 10 Series Vaults Require “pick plans” prior to installation.
- Excavate the entire area beneath the vault to a depth of 12 to 18 inches below final grade of pad or vault. To prevent settling, all soil beneath the pad site must be compacted and level before setting pad or vault. Backfill base 6 inches with $\frac{3}{4}$ inch minus gravel. Compaction is required. A compaction test may be an additional requirement.
- Conduit must enter pre-cast vaults through conduit terminations or a cut and poured ‘window’.

NOTE: Do not core into a vault. Use conduit terminations and/or knockouts.

- At the FCC discretion and prior approval, customers may use a core drill and Link-Seal® for a single conduit penetration.
- Backfill in 18-inch lifts.
- When vaults are installed, the customer is responsible for providing survey references to their contractor, including but not limited to: offsets from other utilities, final vault corners, vault elevations, final curb and or sidewalk locations and elevations.

IMPORTANT: Incorrect placement or final grade of PGE vaults are the customer’s responsibility to correct.

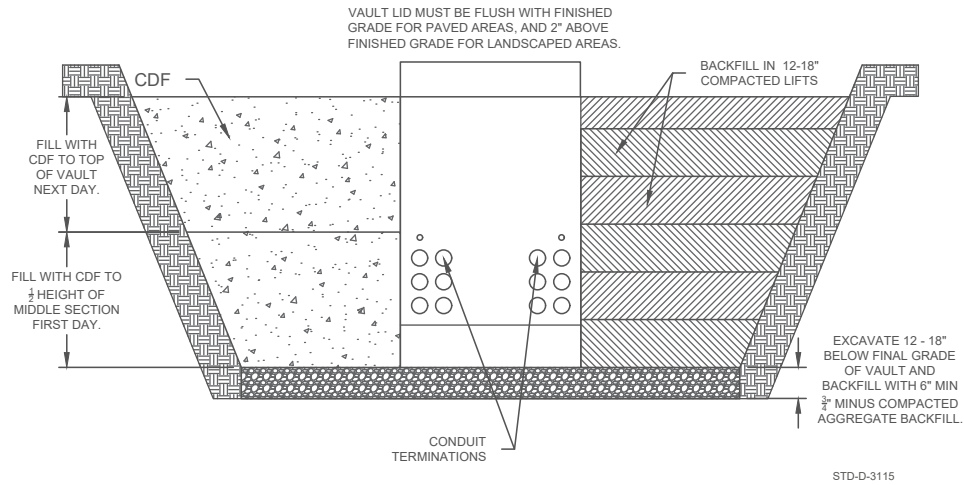


Figure 15. Vault Backfill Requirements (STD-D-3115)¹

Vaults must be flush with the finished grade within 12 inches of a sidewalk or other paved area. Final grades and elevations around pads are required before transformer installation.

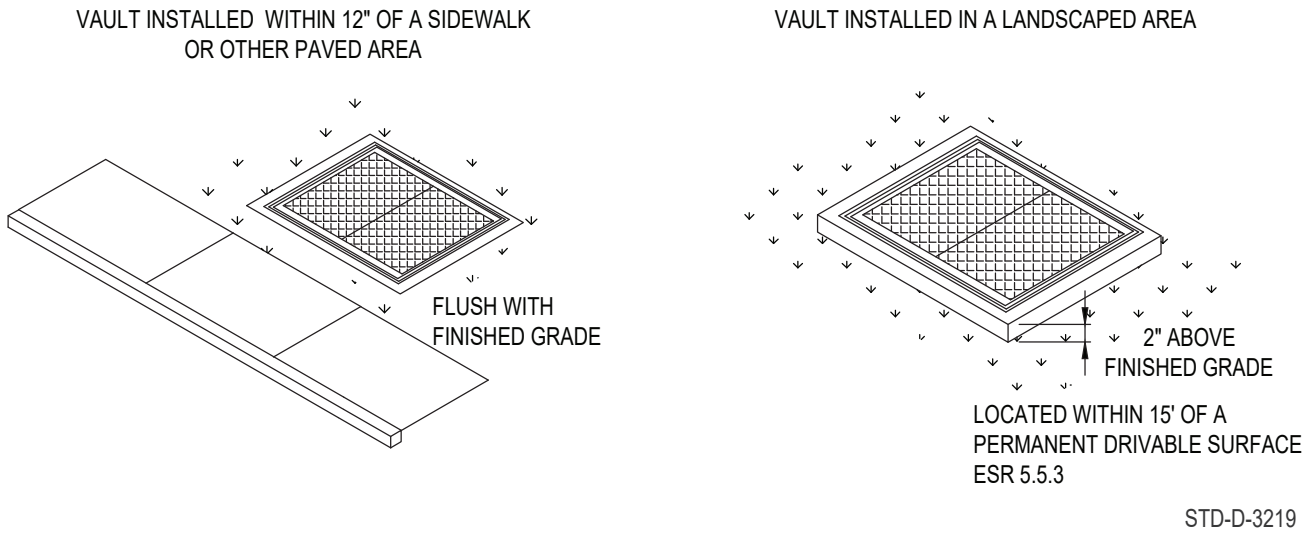


Figure 16. Vault Installation with Finished Grade (STD-D-3219)

1. Backfill is generally adequate, though at times CDF is needed.

6.4 CONCRETE PAD INSTALLATION

A PGE DPM will determine whether a concrete pad or vault design is required for the project. When a concrete pad is required by the PGE DPM, it will be listed on the approved job sketch. Concrete pads must be procured from an approved PGE manufacturer.

To prepare the soil for the pad, customers must:

- Excavate the entire area to a depth of 12 inches below final grade. The conduit install will likely require excavating well beyond the minimum. Install conduit sweeps deep enough to allow for a straight stub projecting a minimum 12 inches above final grade.
- Backfill with, and compact $\frac{3}{4}$ minus gravel so that the top of the pad sits 4 inches above final grade, unless directed otherwise by the FCC.
- Lay an area of $\frac{3}{4}$ -inch minus gravel at least 12 inches wide around all sides of pads that are located within blacktop surfaces.

Pads must be flush with the finished grade within 12 inches of a sidewalk or other paved area. Final grades and elevations around pads are required before transformer installation.

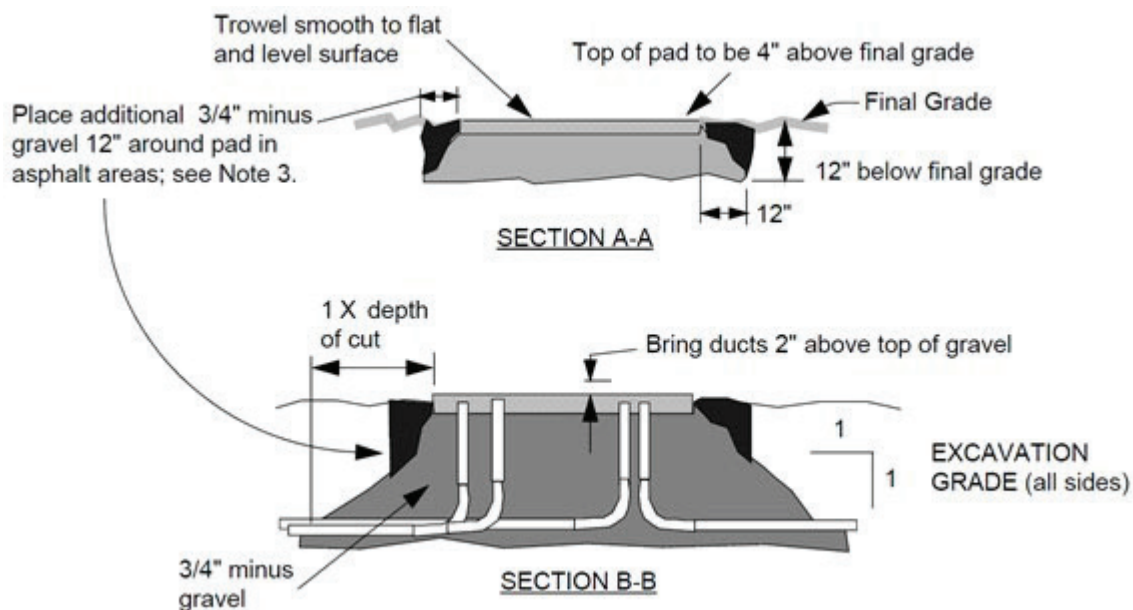


Figure 17. Concrete Pad Installation with Finished Grade

6.5 CONDUIT REQUIREMENTS

PGE specifies conduit made of Schedule 40 polyvinyl chloride (PVC) for trench designed systems and high-density polyethylene (HDPE) duct that is black with three equally spaced extruded red stripes for horizontal directional drilled (HDD) systems. PGE will specify the conduit size established by the size and type of conductor in the job sketch. This section summarizes key conduit requirements. See the [ESR, Chapter 6 Underground Requirements](#) for complete PGE requirements for all projects.

6.5.1 CONDUIT SWEEPS AND PULL LINES

- Sweep bends of electrical-grade Schedule 40 gray PVC, rigid steel, and fiberglass are acceptable. All bends must be factory made. Field bends or field heat bends are not acceptable. Do not cut factory-formed sweeps.
- All factory and field-cut conduits must be chamfered.
- In applications exceeding 180 degrees in a single conduit run, or runs exceeding 150 lineal feet, PGE requires fiberglass sweep bends to be installed in the entirety of the run. **When all the sweep bends in a conduit are added up, the sum must not exceed 270 degrees.**
- Conduit spacers are required for multiple-conduit installations where a horizontal configuration in the trench cannot be obtained.
- Conduit must decline in grade gradually to achieve appropriate height in vaults. Contact the FCC if there are any questions.
- Before PGE accepts the conduit and starts pulling conductors, all customer-installed conduit must be proofed and then a non-conducting 500-pound rated pulling line must be installed. The pulling line will be tied off at each end with a minimum six feet of pulling line slack. Conduit installed for PGE internal facilities by a PGE-approved contractor must have a 2500-pound rated pulling line installed before PGE accepts the conduit and pulling conductors

Table 1. Minimum Separations for Conduit

Material	Required Dimensions
Separation between Bends	3-foot straight sections are required out of vaults. For 5”-6” conduits, PGE may require a 5-foot straight section. A 5-foot minimum straight section is required between any conduit sweeps. See the ESR, Chapter 6 Underground Requirements for more information.
Conduits	3-inch minimum separation skin to skin in trenches. 3-inch minimum separation skin to skin within the pull/termination sections.
Bend Radius	Factory bends are typically 90°, 45°, 30°, 22.5° or 11.25° degrees. PGE requires factory bends with this radius: <ul style="list-style-type: none"> ▪ 36-inches for 2-4-inch conduit. ▪ 60-inches for 5-6-inch conduit.
Conduit stub ups	2-inches above gravel or in concrete pads
Vault Lid	Landscaped areas – greater than 12” from a sidewalk, 2-inch above finish grade. Sidewalk/Paved areas – within 12” from a sidewalk, flush with finish grade.

6.5.2 MITIGATING POTENTIAL WATER FLOWS

Waterproofing of building and/or vault penetrations related to electrical infrastructure are the customer’s responsibility. The customer must inform PGE of the methods used. PGE may require specific mitigation measures and may require additional infrastructure in the event of potential moisture issues, and/or disallow installation of irrigation, water features, etc., near PGE facilities.

6.5.3 CONDUIT INSTALLATION FOR PAD-MOUNTED TRANSFORMERS

In the job sketch, customers will receive pad details and the approximate location to be incorporated into their civil engineering plan. When installing conduit for pad-mounted transformers, the customer must locate the pad 4 inches minimum above the final grade, and stub conduits no more than 2 inches above the compacted gravel.

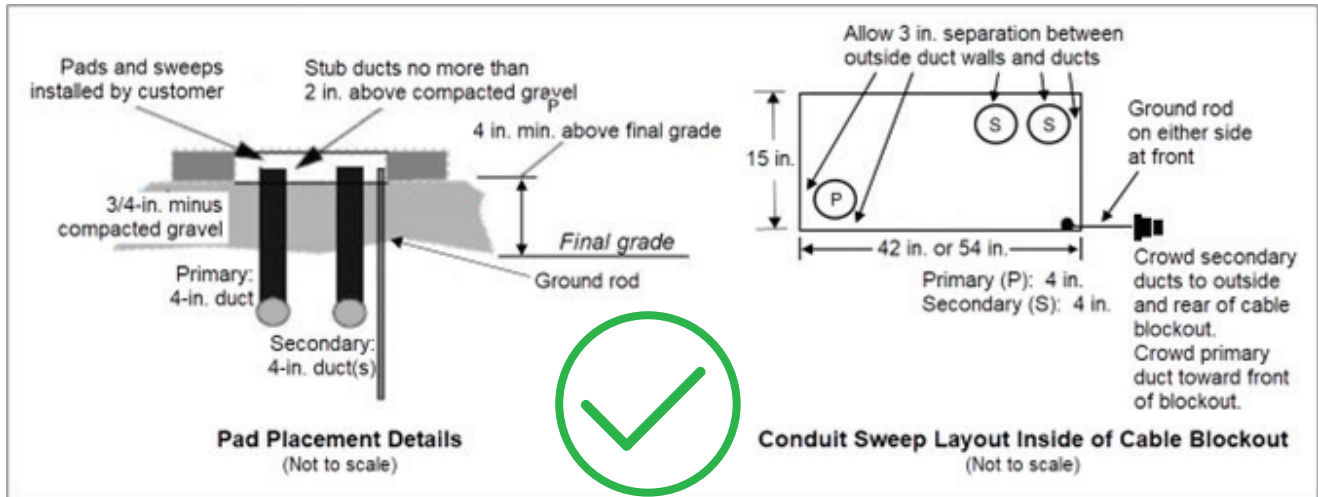


Figure 18. 3 Phase Pad Placement Detail (STD-D-3117)



Figure 19. Common Problems for Conduits at Concrete Pads

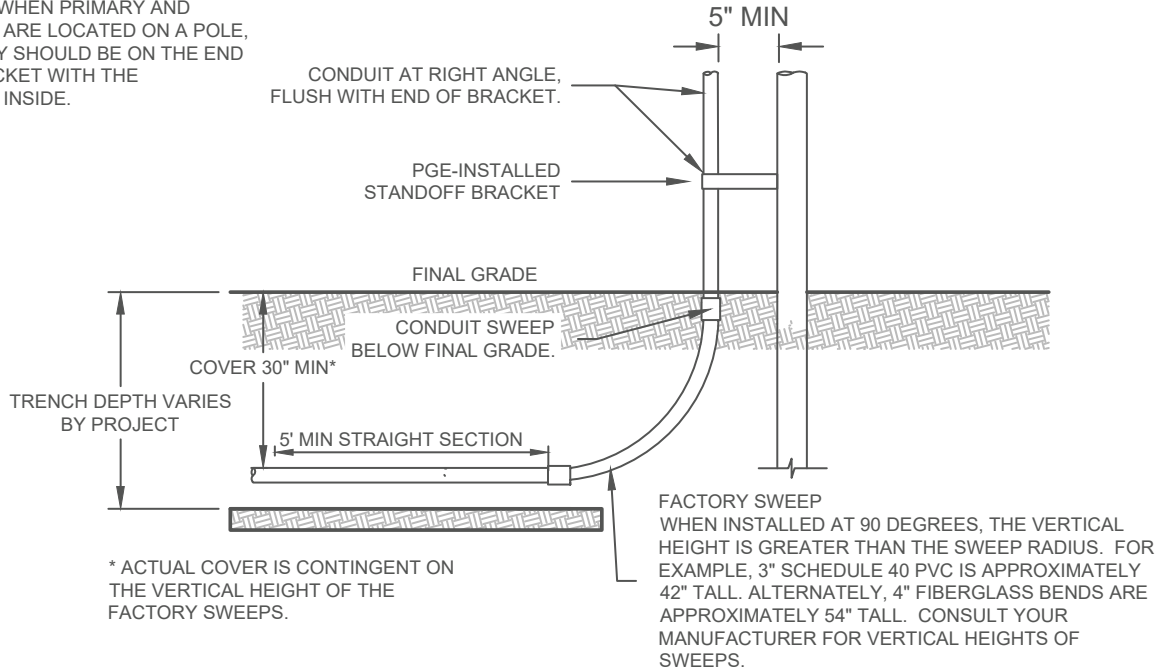
LEFT: Not enough space was left between the primary and secondary conduits. In three-phase pads, primary and secondary require 2 feet minimum separation measured from wall to wall.

RIGHT: The problems here include:

1. The pad is not located at grade.
2. The conduit protrudes more than 2 inches above pad. Conduit must be flush or below the pad
3. The ground rod must not be between the primary and secondary. The ground rod should be within 2" of the incoming primary conduit.

6.5.4 CONDUIT INSTALLATION OF SECONDARY UNDERGROUND SERVICE TO AN OVERHEAD POLE

TYPICALLY, PGE JOB SKETCHES WILL REQUIRE THE CONDUIT TO BE GROUPED IN 1 QUADRANT ON THE FIELD SIDE. WHEN PRIMARY AND SECONDARY ARE LOCATED ON A POLE, THE PRIMARY SHOULD BE ON THE END OF THE BRACKET WITH THE SECONDARY INSIDE.



STD-D-3131

Figure 20. Standoff Bracket (STD-D-3131)

1. When conduit will extend to a PGE pole, PGE will install a bracket on the pole or mark the location on the pole for the conduit. To get a standoff bracket installed on a PGE pole, call the Service Coordination team at 800-822-1077.
2. Once PGE has approved a customer's pathway and provided an approved job sketch, customers may trench up to the PGE distribution pole to place conduit and 90-degree sweep. Trench depths vary; review the job sketch for required depths.

Digging too closely to a power pole can weaken the soil holding the pole in place and compromise the pole's stability. Extra deep trenches are not allowed because this has the potential to create a shelf for the pole to rest on.



WARNING: When digging up to a pole or guy on uneven slope, sandy soil, or waterlogged soil, increased distance and precautions may be required to prevent undermining the pole. If concerned, please discuss with the PGE DPM and/or FCC.

3. Before backfilling, PGE must inspect the trench for adequate depth, and conduit and cable placement.
4. After backfilling, tamp the soil.
5. A final underground inspection is required when the installation is complete (pull strings, final grade, etc.).

6.5.5 CONDUIT INSTALLED AT VAULTS

PGE required vaults on private property are called padmount, or pad vaults. Pre-cast concrete vaults can house equipment for transformation, switching, and cable splicing. Vaults may also be used as intermediate pull points for conduit runs exceeding 270-degrees of bends or 500-feet of conductor. Consult [Appendix B Generic Transformer and Vault Dimensions](#) for generic transformer and pad-vault information. If PGE selects a pre-cast vault, additional engineering is required.

In the PGE job sketch and pre-construction meeting, customers will receive vault details and the approximate location.

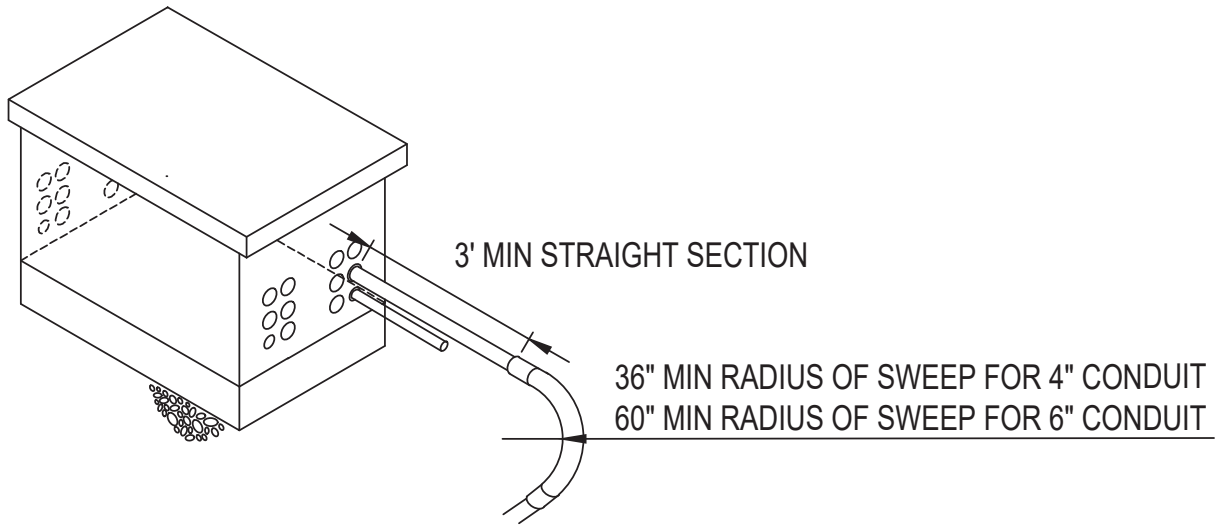
When conduit is installed at a vault:

- Conduits must exit vaults with 3 feet (2"-4" conduit) of straight distance before adding a bend. For 5"-6" conduit, PGE may require 5 feet of straight distance.
- All PGE vaults require trench depths greater than 30 inches to reach the bottom termaducts and/or to be flush with the top of transformer pads. **Vaults may require 6 feet of depth or more to reach the bottom termaducts.**
- For switching vaults, primary conduits usually enter at opposite corners.
- Within the right of way, PGE may require a vault riser based on jurisdictional and design requirements. Riser details are provided on the job sketch.
- For 1730 and 1324 vaults (handholes), the top of 90° conduit bends can only protrude 2-inch into the bottom of the vault. Refer to [Table 2](#) for minimum trench depths into a handhole.

Table 2. Minimum Trench Depth for Conduits Installed at Vaults

	Depth of Vault Top Minus 2"	+	Depth of 90° Bend*	=	Minimum Trench Depth
PVC	16"	+	44"	=	60"
Fiberglass	16"	+	54"	=	70"

*Consult manufacturer for specific dimensions of the 90 bends.



STD-D-3310

Figure 21. Conduit Installation into Vaults (STD-D-3310)

Consult the PGE job sketch for specific conduit routing related to the project's vaults.



Figure 22. Conduit Exiting Vault with 3 Feet Straight Distance



Figure 23. Conduit Termination Reducers



Figure 24. Backfill Required under Conduits

6.5.6 COMMON PROBLEMS FOR CONDUITS INSTALLED AT VAULTS



Figure 25. Conduit Exits Vault without Minimum Required Straight Section

6.6 CONDUIT ROUTING/ALIGNMENT INTO BUILDINGS

When PGE determines that no acceptable outdoor location exists and an electrical room is necessary on the exterior wall of the building, the orientation of the electrical room and electrical gear will determine requirements for conduit penetrating into a building. See the [ESR, Chapter 13 Electrical Rooms and Interior Installations](#), for additional requirements. The following lists the general customer requirements for installing conduit routing into buildings:

- Sealing of walls to prevent water and moisture intrusion at conduit penetrations.
- Sealing of conduits to prevent water and moisture intrusions.
- Conductors and pathway will be electrically outside the building.
- Conductor installation equipment (e.g., pulling eyes, anchors) will be required at specific locations in the room as identified by PGE.
- PGE may require a separate pull section. When required, the pull section is a space that must match the dimensions of the termination section. Generally, PGE does not require a separate pull section when the customer is entering the bottom of a termination section in an at grade electrical equipment room. PGE evaluates the need for a pulling/drip loop section on a case-by-case basis. Customer's MUST provide a separate pull section when the electrical room is below street grade. For information, see the [ESR, Chapter 11 Commercial, Industrial, and Large Residential Services, 801A or Higher](#).
- Other requirements may exist based on the customer's site and design.

For design requirements for conduit routing into buildings, see section [2.2.5 PGE Decision: Design Elements for Conduit Penetration into Buildings](#).



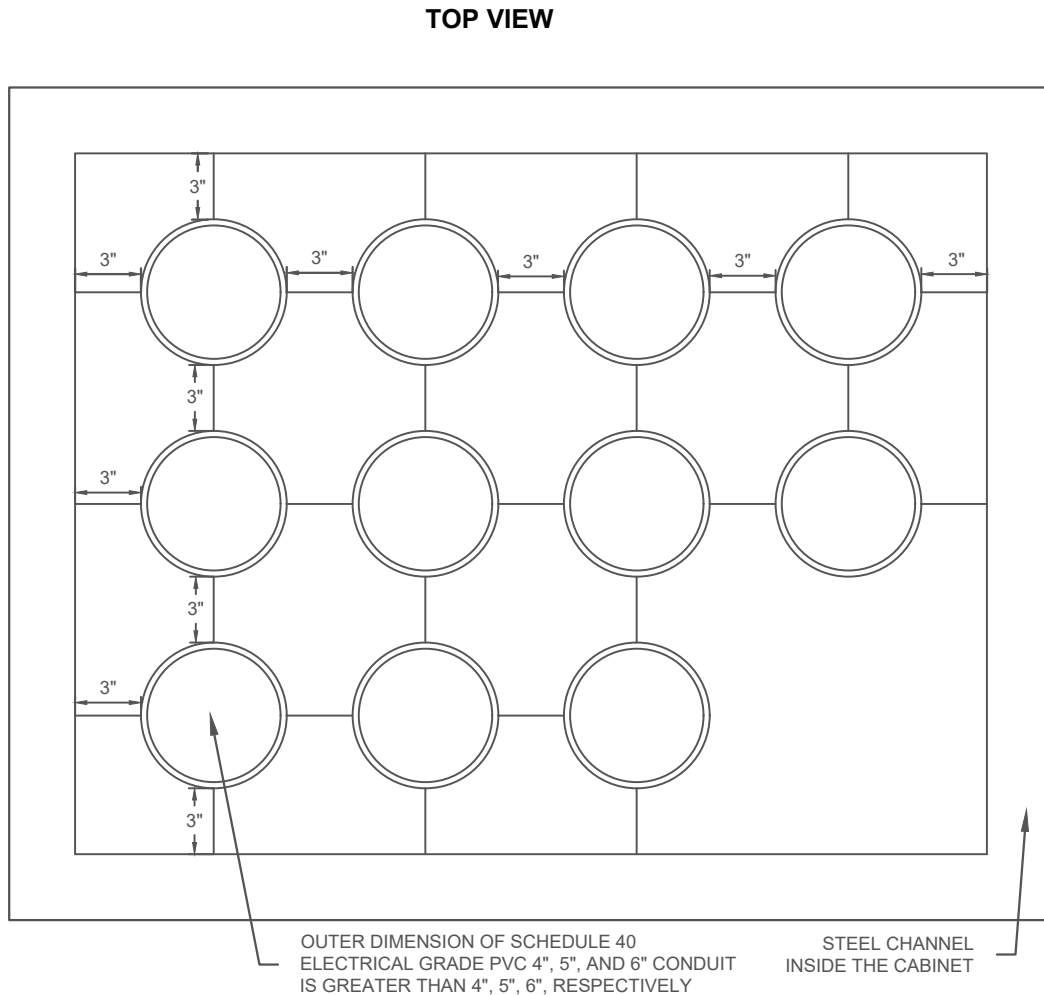
Figure 26. Conduit Routing/Alignment into Buildings

6.6.7 CONDUIT INSTALLED IN SWITCHBOARDS

In switchboards, the clear opening in the termination/pull section must allow for:

- 3 inches separation from the conduit to the steel channel inside the cabinet
- 3 inches separation between every conduit

To assist customers, the minimum opening of termination/pull sections with typical conduit configurations in switchboards is included in [Figure 27](#), [Figure 28](#), and [Figure 29](#).

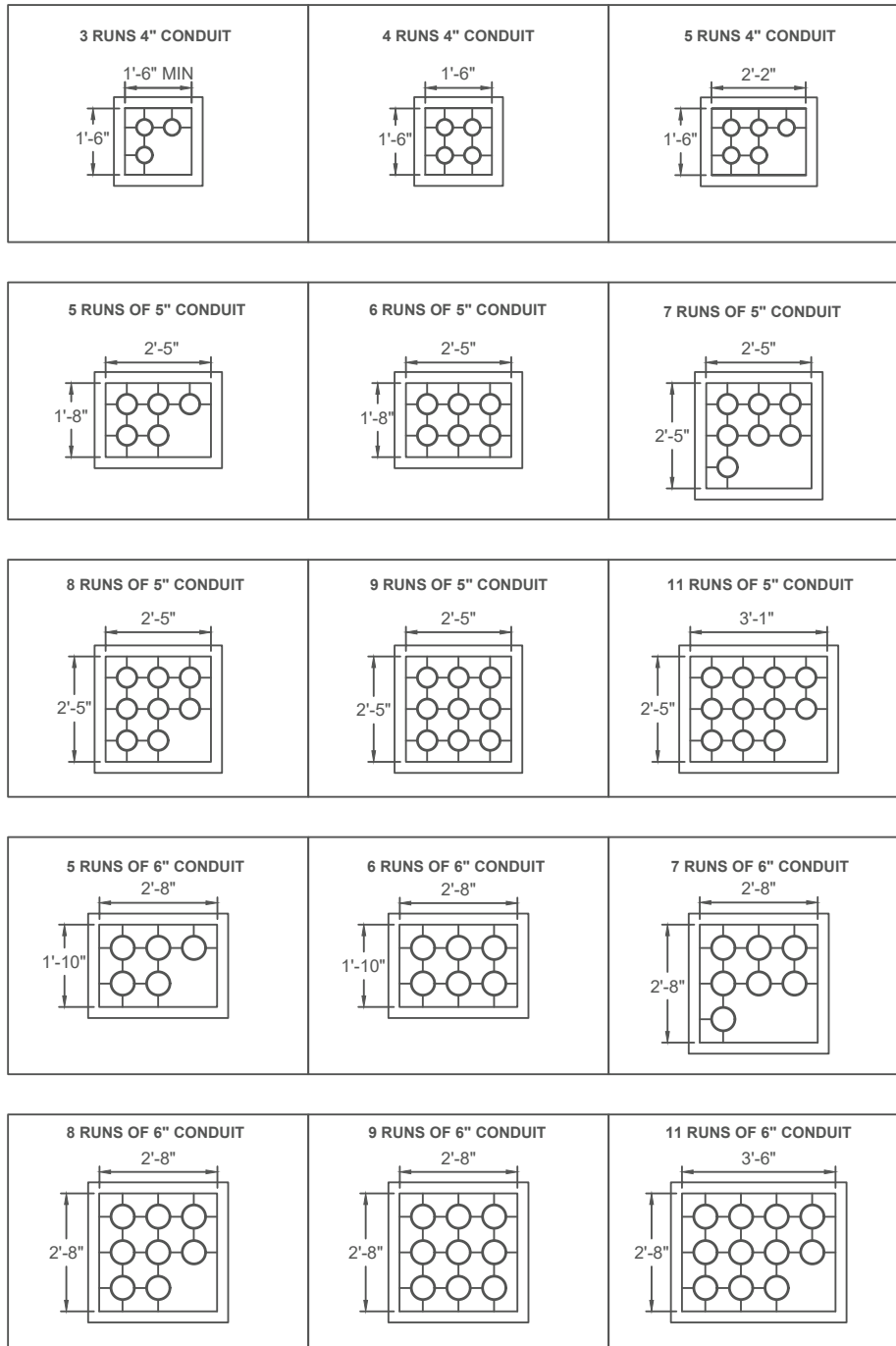


CONSULT MANUFACTURER FOR EXACT DIMENSION OF CONDUIT AND CHANNEL.

STD-D-3121

Figure 27. PGE's Required Separation of Conduit in the Customer Gear (STD-D-3121)

Chapter 6 – Construction Requirements



1. ALL DIMENSIONS SHOWN ARE THE *MINIMUM* WIDTH AND DEPTH REQUIREMENTS FOR THE OPENING IN THE TERMINATION/PULL SECTION OF THE CUSTOMER GEAR. PGE RECOMMENDS ADDING A MARGIN OF ERROR TO THESE MINIMUMS.
2. CONDUITS MUST HAVE 3" OF CLEARANCE BETWEEN THE OUTSIDE OF THE CONDUIT WALLS, AND 3" OF SEPARATION FROM THE FRAME WITHIN THE CABINET.
3. ALL 400 A AND ABOVE GEAR CONFIGURATIONS, AND ANY PROPOSED ALTERNATE CONFIGURATIONS, MUST BE REVIEWED DURING THE GEAR REVIEW PROCESS.
4. CONTACT YOUR DPM TO DISCUSS ALTERNATIVE CONDUIT PATTERNS.

STD-D-3210

Figure 28. Minimum Opening of Termination/Pull Sections with Typical Conduit Configurations in Switchboards (STD-D-3120)

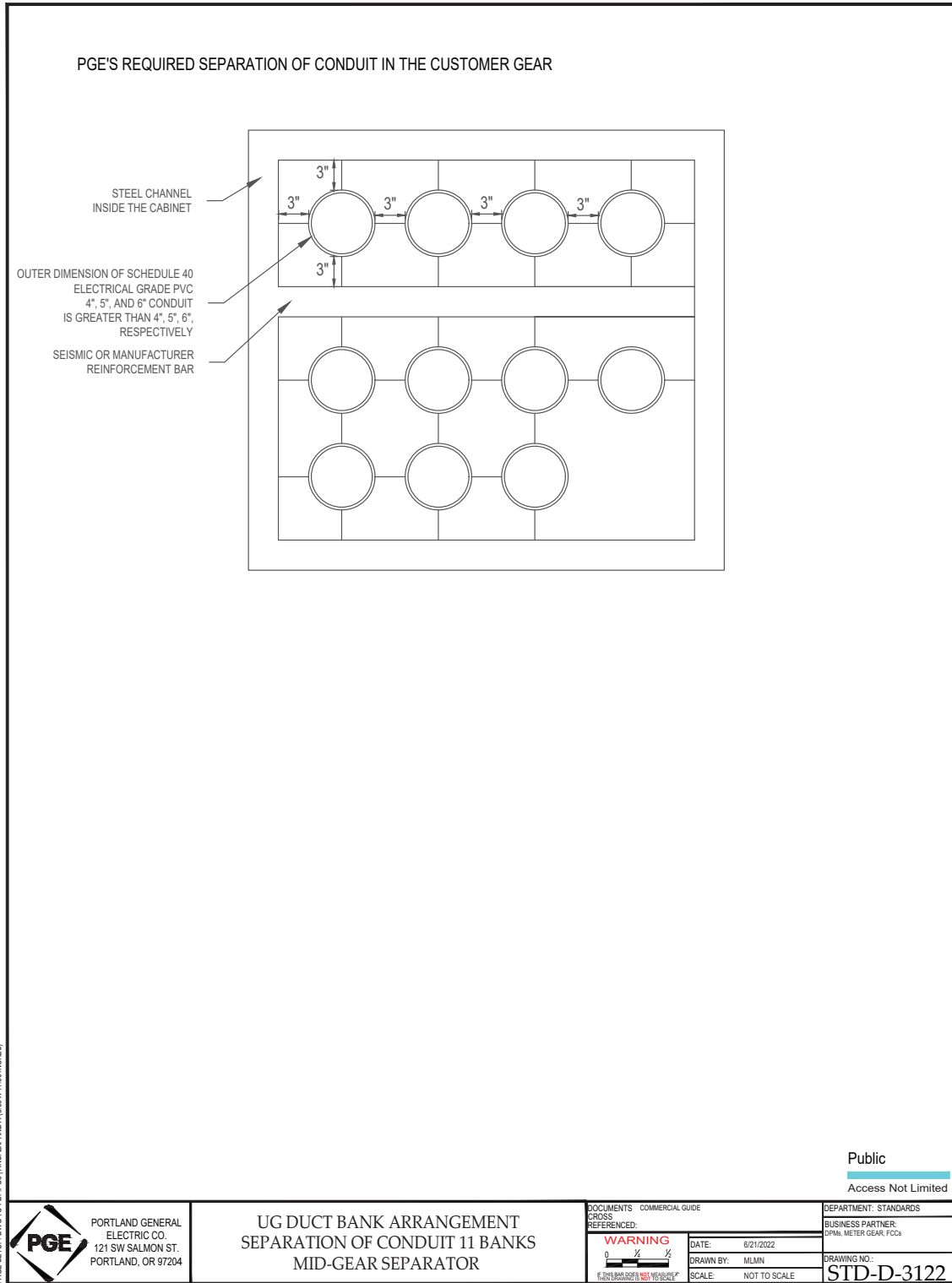


Figure 29. Switchboards with Seismic or Manufacturer Reinforced Bar (STD-D-3122)



Figure 30. Spacers for Conduit Installed in Switchboards

NOTE: Always check the conduits' orientation with the project's FCC.

6.6.8 DIRT AND DEBRIS

During construction, the contractor must keep the inside of the conduit free of dirt and other debris. PGE requires a temporary plug (an unglued conduit cap or plug) to prevent entry of water, dirt, or debris. The customer is responsible for removal of any debris before energization of the service.



Left: Duct Brushes and Test Mandrels



Right: Correctly installed ducts:

1. Conduits are protected with a plastic cap.
2. The line has 6 - 8 feet of slack at each end.
3. Terminations are written above the conduit runs.

6.6.9 DUCT PROOFING

After PVC and/or HDPE are installed, the contractor or installer is responsible for duct proofing all ducts installed before the job is complete and before the installation of PGE conductors. Duct “proofing”, also known as a mandrel test, involves pulling or pushing a mandrel through a conduit. This process ensures a duct is clear of obstructions and grit, and that no portion of the duct has collapsed or is out of round. If the mandrel will not pass through the conduit, it must be replaced or repaired at that point by the installer. Customers must obtain a wood/aluminum test mandrel (or equivalent plastic and/or hard rubber mandrel) configured to the size of the installed duct’s inner diameter (ID).

Any conduit sitting vacant, where PGE has not pulled in conductor, requires a mandrel test (aka a re-proof) before PGE will create a design using it.

6.6.10 PULL ROPE

After testing the ducts, the conduit installer must provide an approved fiber polyline pulling string in each conduit with a minimum tensile strength of 500lbs. The pulling string must be tied off with 6 feet of slack left on either end.

NOTE: For all HDPE applications, PGE internal work, or at a PGE Field Construction Coordinator’s discretion, polyester pull tape (such as Mule Tape® or Herculine®) with a minimum tensile strength of 2500 lbs. is required.

6.7 BACKFILL REQUIREMENTS

PGE conduit may be backfilled with native backfill material if it is free of:

- Rocks larger than 4 inches,
- Rocks with sharp corners, and
- Sharp foreign objects.

When native backfill cannot be used, select backfill must be used. PGE considers “select backfill” to be 3/4-inch gravel and requires at least 12 inches on top, then red “Danger” tape. Select backfill material passes through a 3/4-inch sieve, contains less than 30 percent rock solids by volume, and contains no sharp or foreign objects.

Select backfill must be placed a minimum of 4 inches below and 6 inches above the centerline of the conduit or cable configuration. When red CDF is used, conduit must be fully encased at a minimum of 6 inches on all sides. CDF must be red concrete dye, mixed prior to pour (i.e., plant or truck).

The backfill in the remainder of the trench must be free of rocks 4 inches or greater in diameter.

Trenches must be compacted to prevent severe settling. Compaction may require a compaction test by an authorized provider.

For PGE’s requirements, see the [ESR, Chapter 6 Underground Requirements](#).



Figure 31. Plant-mixed Red Dye is Required when CDF or Concrete is Used

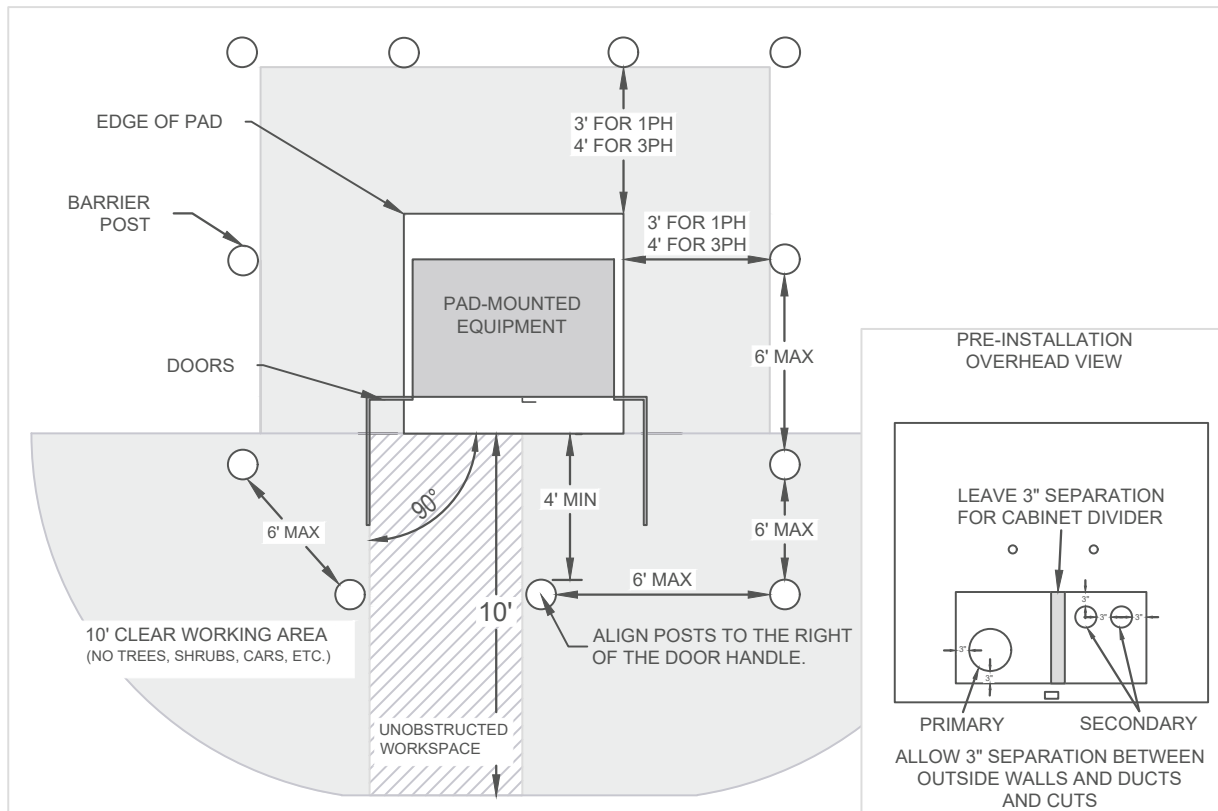
6.8 HORIZONTAL DIRECTIONAL DRILLING (HDD) CONDUIT INSTALLATION

Refer to the [ESR, Chapter 6 Underground Requirements](#).

6.9 BARRIER POSTS

Barrier posts, also known as bollards, may be required to protect equipment (meter gear, transformer, etc.) in areas with vehicle traffic. The final grade, direction, and location of traffic will affect the installation of barrier posts. Refer to the [ESR, Chapter 5 Clearances and Location Requirements](#), for installation details and clearance requirements.

IMPORTANT: Before installation of barrier posts, confirm placement with an FCC to ensure posts do not block equipment doors or inhibit operational clearance for PGE personnel.



STD-D-4002

Figure 32. Barrier Posts Around Pad-mounted Equipment (STD-D-4002)



Figure 33. Barrier Post: PGE Equipment is Accessible to Vehicular Traffic



Figure 34. Barrier Post: Distance from the 6" Curb to the Pad is 5' or Less



Figure 35. Barrier Post: PGE Equipment is Accessible to Vehicular Traffic

A Pre-Design Requirements Checklist



PRE-DESIGN REQUIREMENTS COMMUNICATION FORM

For residential projects equal or greater than 400A, all commercial services, and developer-driven relocation of PGE facilities.

Work Order Number	Design Project Manager
Customer Name	Email
Address	Phone Number
Date Sent	Date Completed

The PGE design timeline is dependent on your submission of the following required pre-design documents. Once PGE receives the following documents your project will be assigned a Design Complete Commitment Date (DCCD).

Important: Project scope often changes! We understand. It is the customer’s responsibility to clearly communicate changes via email to your assigned Design Project Manager. (Changes may extend design duration. Your Design Project Manager will communicate any extensions to the DCCD.)

Required Pre-Design Documents

Document	Date Requested	Date Received
PGE Request for Service Form (including load information)		
Site Plan Identifying Preferred Meter Locations		
Elevation Plan		
Civil/Utility Plan		
Street Improvement Plan		
Notes:		

Project Specific Requirements

Document / Information	Date Requested	Date Received

Appendix A – Pre-Design Requirements Checklist

Load Information	Date Requested	Date Received
Total # of meters		
# commercial meters		
# residential meters		
Units < 800 sq ft		
Units 801-1400 sq ft		
Units 1400+ sq ft		

Meter Gear Review

Important: The meter socket and location must be approved by PGE before meter installation, even if gear location meets ESR standards. If there are any changes to your project details at any point after meter socket and location approval, it needs to be reviewed again by PGE.

Document	Date Requested	Date Received
Electrical one-line		
Electrical room layout with dimensions and metering equipment placement. Provide proposed conduit entry alignment, if available. Note: Only required for interior installations.		
Egress routes from electrical rooms to building exterior. Note: Only required for interior installations.		
Working clearances around metering equipment		
Elevation layout, or front view, drawings of metering equipment to verify arrangement and spacing		
Manufacturer drawings for the following pieces of equipment Switchboard: <ul style="list-style-type: none"> a. Manufacturer drawings with EUSERC references identified. (Provide number of jaws in meter sockets within switchboard panels) b. CT cabinet, CT mounting base: Specify make and model for each. c. Remote meter enclosure: specify make and model. 		
Notes:		

B Generic Transformer and Vault Dimensions

Pre-cast concrete vaults are used to house PGE equipment. This can include equipment for transformation, switching, and cable splicing. Vaults may also be used as intermediate pull points for conduit runs exceeding 270-degrees of bends or 500-feet of conductor.

These generic transformer and vault drawings are intended to assist architects and designers in allocating space for transformers. Often insufficient space is allocated for the size of commercial transformers and the required clearances.

IMPORTANT: This information is generic and not job specific. Refer to approved PGE job sketches and/or manufacturers current cut sheets for details.

PGE will determine the minimum contractor level required to install the equipment.

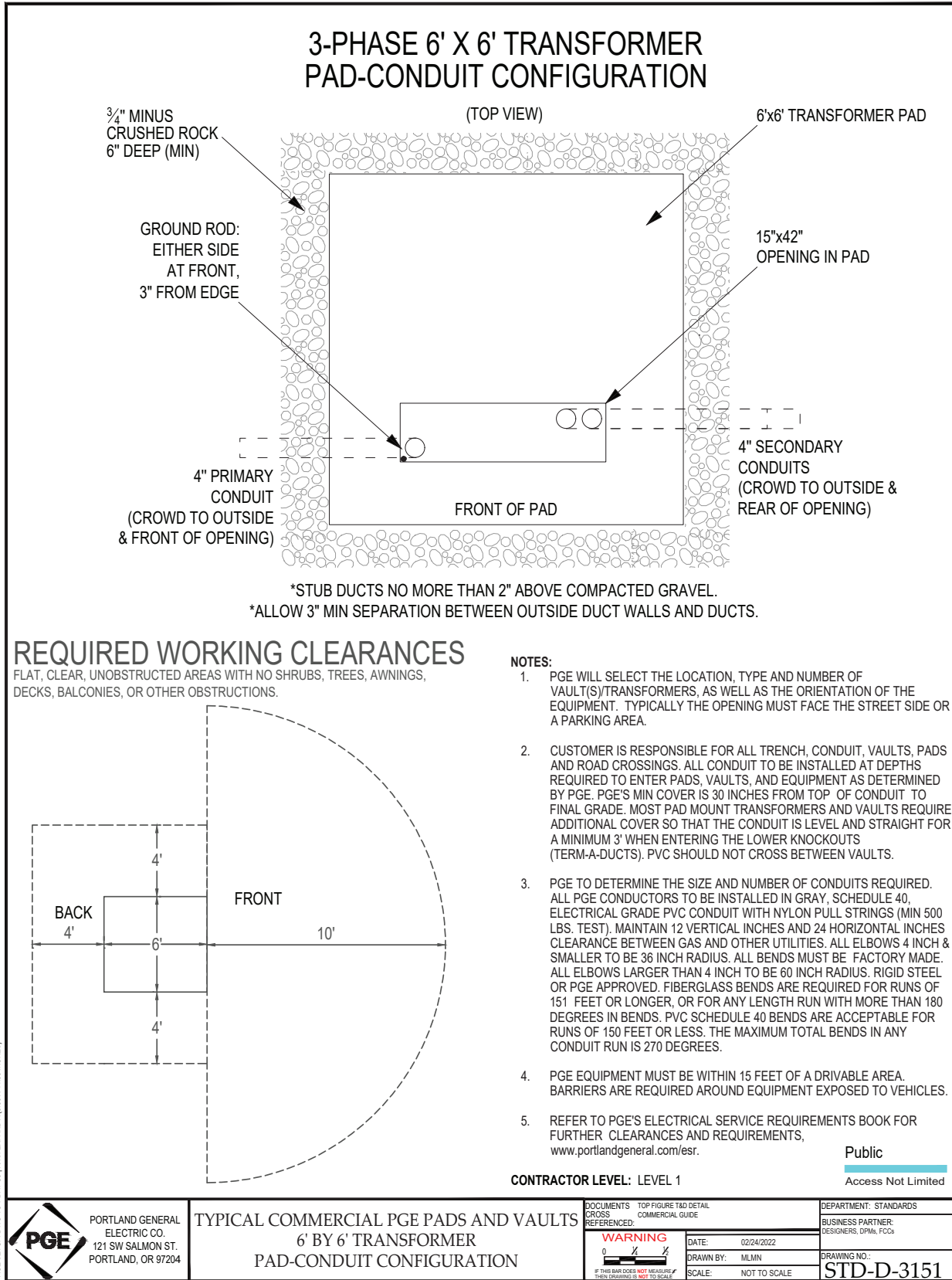


Figure 36. 3-Phase 6' by 6' Transformer Pad-Conduit Configuration (STD-D-3151)

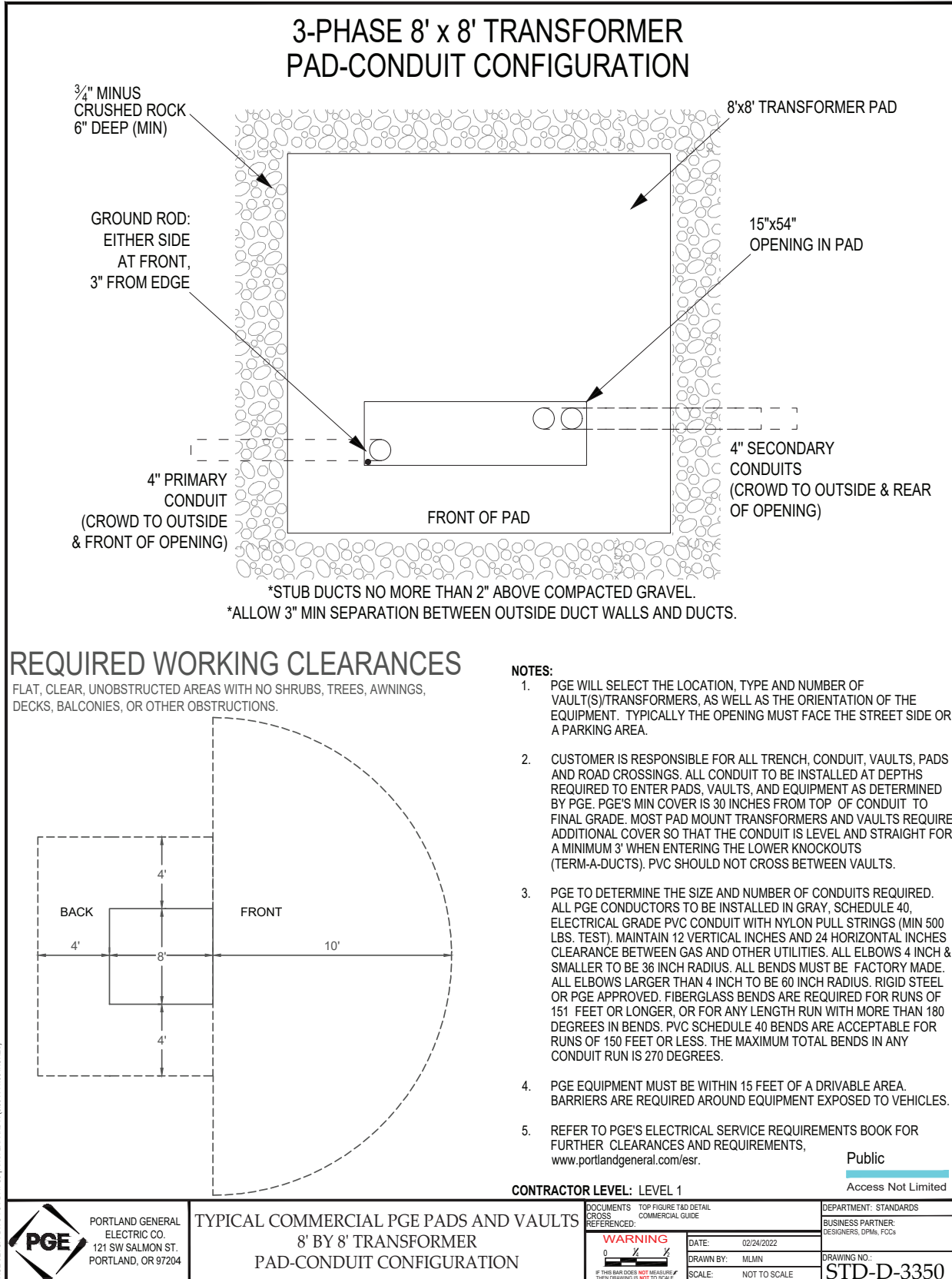
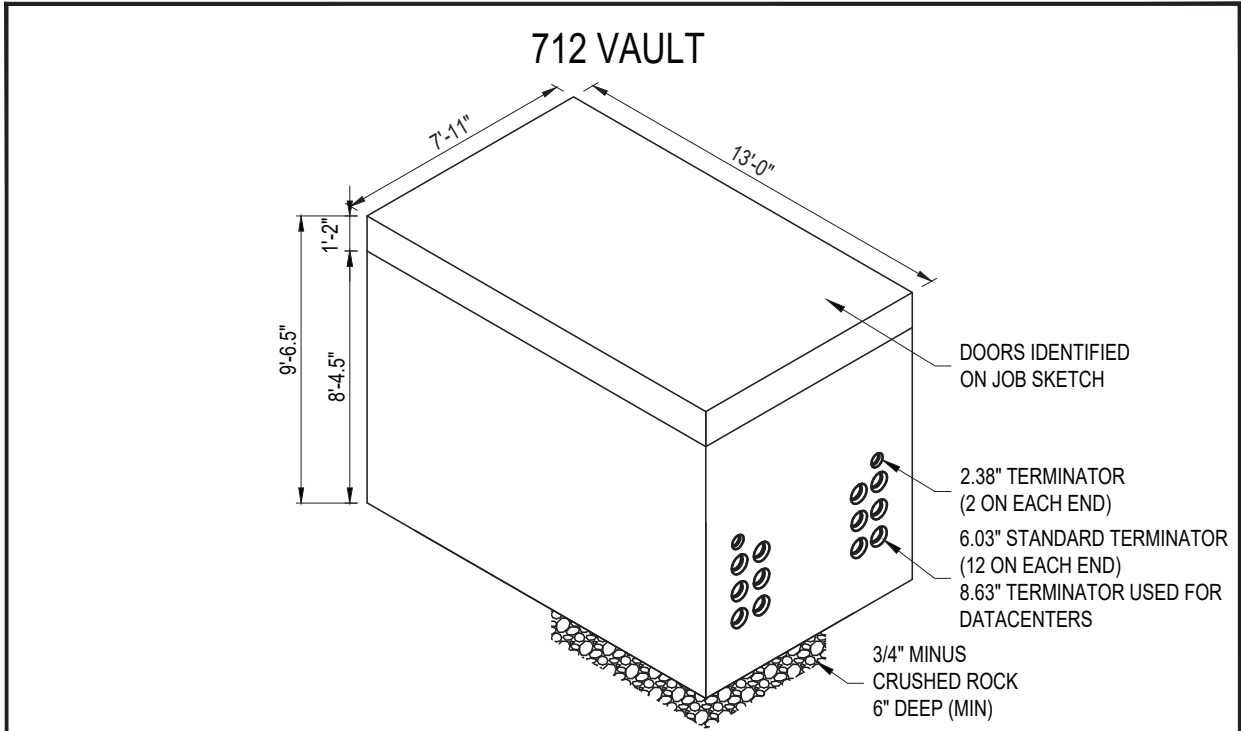
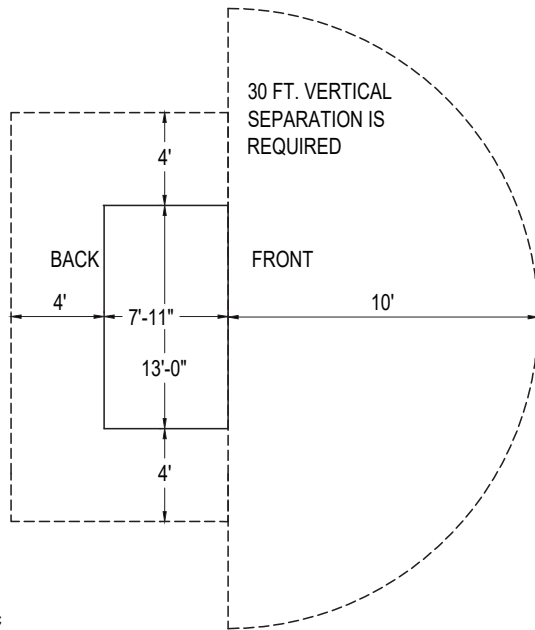


Figure 37. 3-Phase 8' by 8' Transformer Pad-Conduit Configuration (STD-D-3350)



REQUIRED WORKING CLEARANCES

FLAT, CLEAR, UNOBSTRUCTED AREAS WITH NO SHRUBS, TREES, AWNINGS, DECKS, BALCONIES, OR OTHER OBSTRUCTIONS.



NOTES:

1. PGE WILL SELECT THE LOCATION, TYPE AND NUMBER OF VAULT(S) AS WELL AS THE ORIENTATION OF THE EQUIPMENT. TYPICALLY THE OPENING MUST FACE THE STREET SIDE OR A PARKING AREA.
2. CUSTOMER IS RESPONSIBLE FOR ALL TRENCH, CONDUIT, VAULTS, PADS AND ROAD CROSSINGS. ALL CONDUIT TO BE INSTALLED AT DEPTHS REQUIRED TO ENTER PADS, VAULTS, AND EQUIPMENT AS DETERMINED BY PGE. PGE'S MIN COVER IS 30 INCHES FROM TOP OF CONDUIT TO FINAL GRADE. MOST CONDUIT PACKAGES REQUIRE ADDITIONAL COVER SO THAT THE CONDUIT IS LEVEL AND STRAIGHT FOR A MINIMUM 3' FOR CONDUITS 6" OR SMALLER, OR 10' FOR 8" CONDUIT, WHEN ENTERING THE KNOCKOUTS (TERM-A-DUCTS) OF THE VAULT. CONDUITS SHOULD NOT CROSS BETWEEN VAULTS.
3. PGE TO DETERMINE THE SIZE AND NUMBER OF CONDUITS REQUIRED. ALL PGE CONDUCTORS TO BE INSTALLED IN GRAY, SCHEDULE 40, ELECTRICAL GRADE PVC CONDUIT WITH 2,500 LB RATED WOVEN POLYESTER PULL TAPE (SUCH AS MULE TAPE OR HERCULINE) PULLED INTO THE CONDUIT. MAINTAIN 12" VERTICAL AND 24" HORIZONTAL CLEARANCE BETWEEN GAS AND OTHER UTILITIES. ALL CONDUIT SWEEPS MUST BE FACTORY MADE. ALL CONDUIT SWEEPS 4" & SMALLER TO BE 36" RADIUS. ALL CONDUIT SWEEPS 5-6" TO BE 60" RADIUS. ALL CONDUIT SWEEPS 8" TO BE A MINIMUM OF 84" RADIUS AND MUST BE MADE OF FIBERGLASS OR RIGID STEEL. FIBERGLASS OR RIGID STEEL SWEEPS ARE ALSO REQUIRED FOR RUNS OF 151' OR LONGER, OR FOR ANY LENGTH RUN WITH MORE THAN 180 DEGREES IN BENDS. THE MAXIMUM TOTAL BENDS IN ANY CONDUIT RUN IS 270 DEG.
4. PGE EQUIPMENT MUST BE WITHIN 15 FEET OF A DRIVABLE AREA. BARRIERS ARE REQUIRED AROUND EQUIPMENT EXPOSED TO VEHICLES.
5. REFER TO PGE'S MEDIUM VOLTAGE BOOK FOR FURTHER CLEARANCES AND REQUIREMENTS, www.portlandgeneral.com/esr.

CONTRACTOR LEVEL: LEVEL 2 TYPICALLY

Public
Access Not Limited

PORTLAND GENERAL ELECTRIC CO.
121 SW SALMON ST.
PORTLAND, OR 97204

TYPICAL COMMERCIAL PGE PADS AND VAULTS
712 - 8" SPLICE VAULT WITH LIFTOUTS

DOCUMENTS REFERENCED: MEDIUM VOLTAGE GUIDE, L26110-712

DEPARTMENT: STANDARDS

BUSINESS PARTNER: DESIGNERS, DPMS, FCCS

WARNING
IF THIS BAR DOES NOT MEASURE THEN DRAWING IS NOT TO SCALE

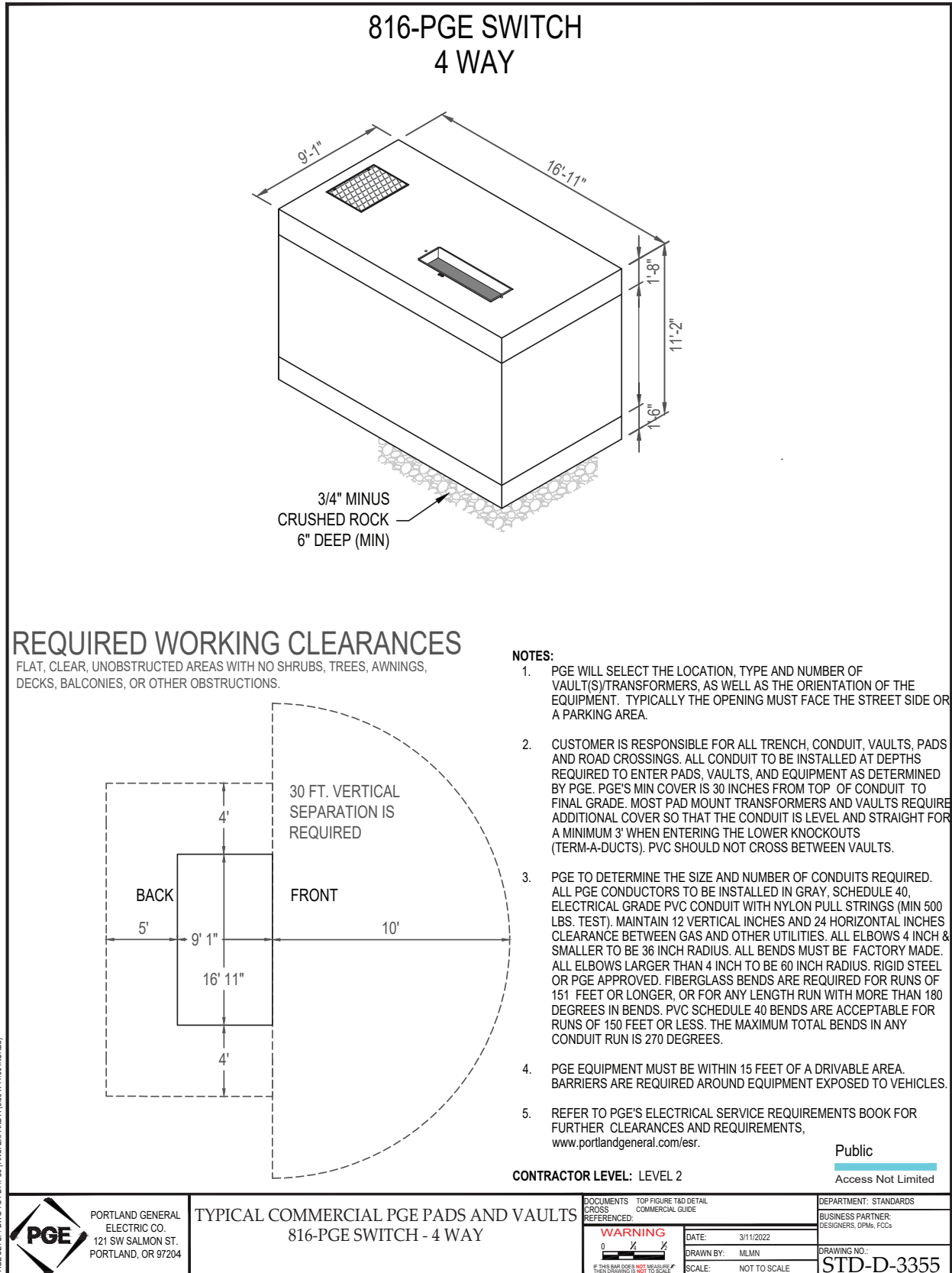
DATE: 5/20/2024

DRAWN BY: MLMN

SCALE: NOT TO SCALE

DRAWING NO.: **STD-D-3356**

Figure 38. 712-PGE Switch Vault - Vista (STD-D-3356)



PAGE SETUP: DWG TO PDF (PC) [ANSI EXPAND A (8.50 X 11.00 INCHES)]

816-PGE SWITCH.DWG | 8/31/2022 7:50:18 AM | MARIE MENDEZ-NUNEZ

Figure 39. 816-PGE Switch - 4 Way (STD-D-3355)

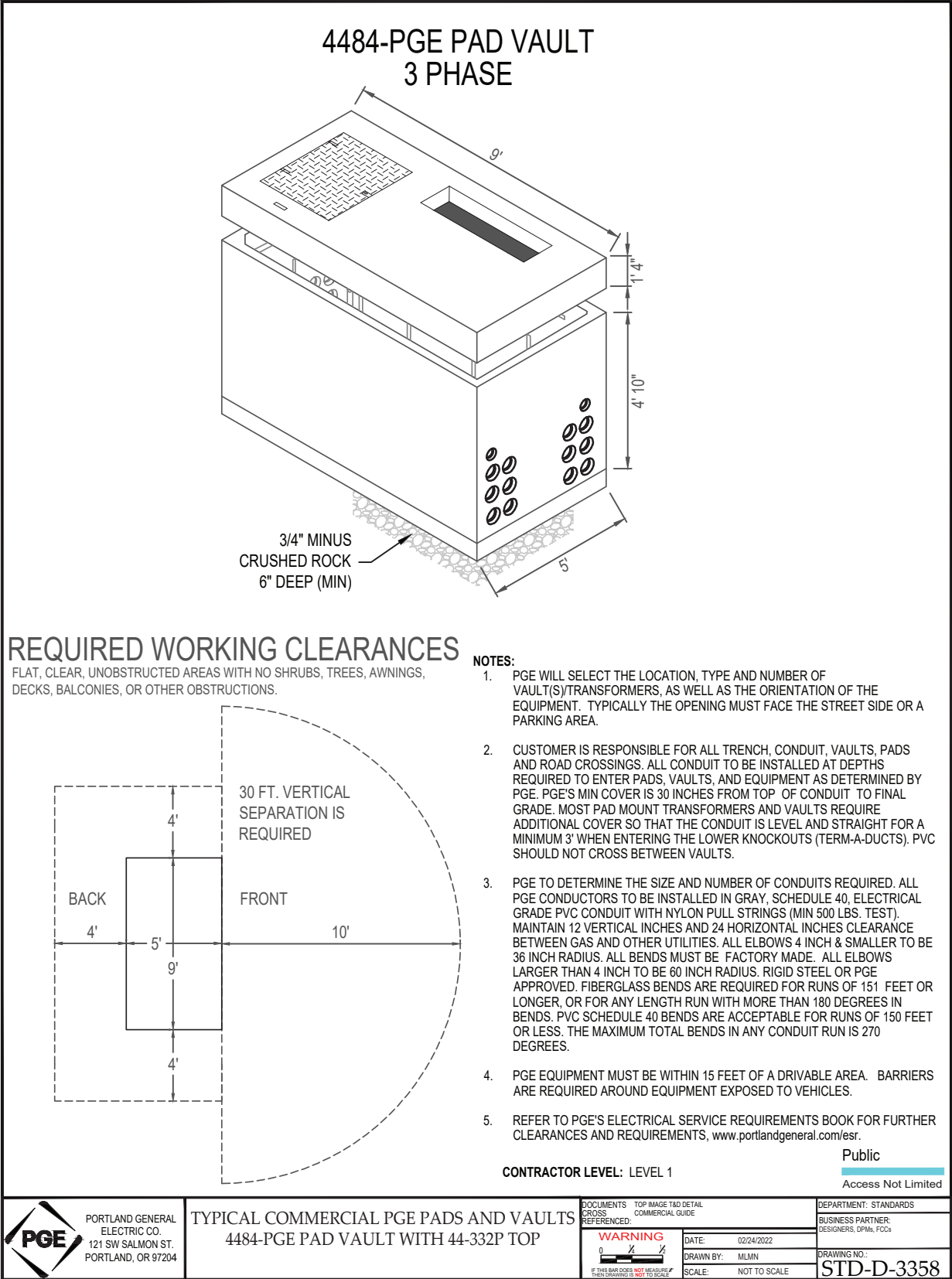


Figure 40. 4484-PGE Pad Vault 3 Phase (STD-D-3358)

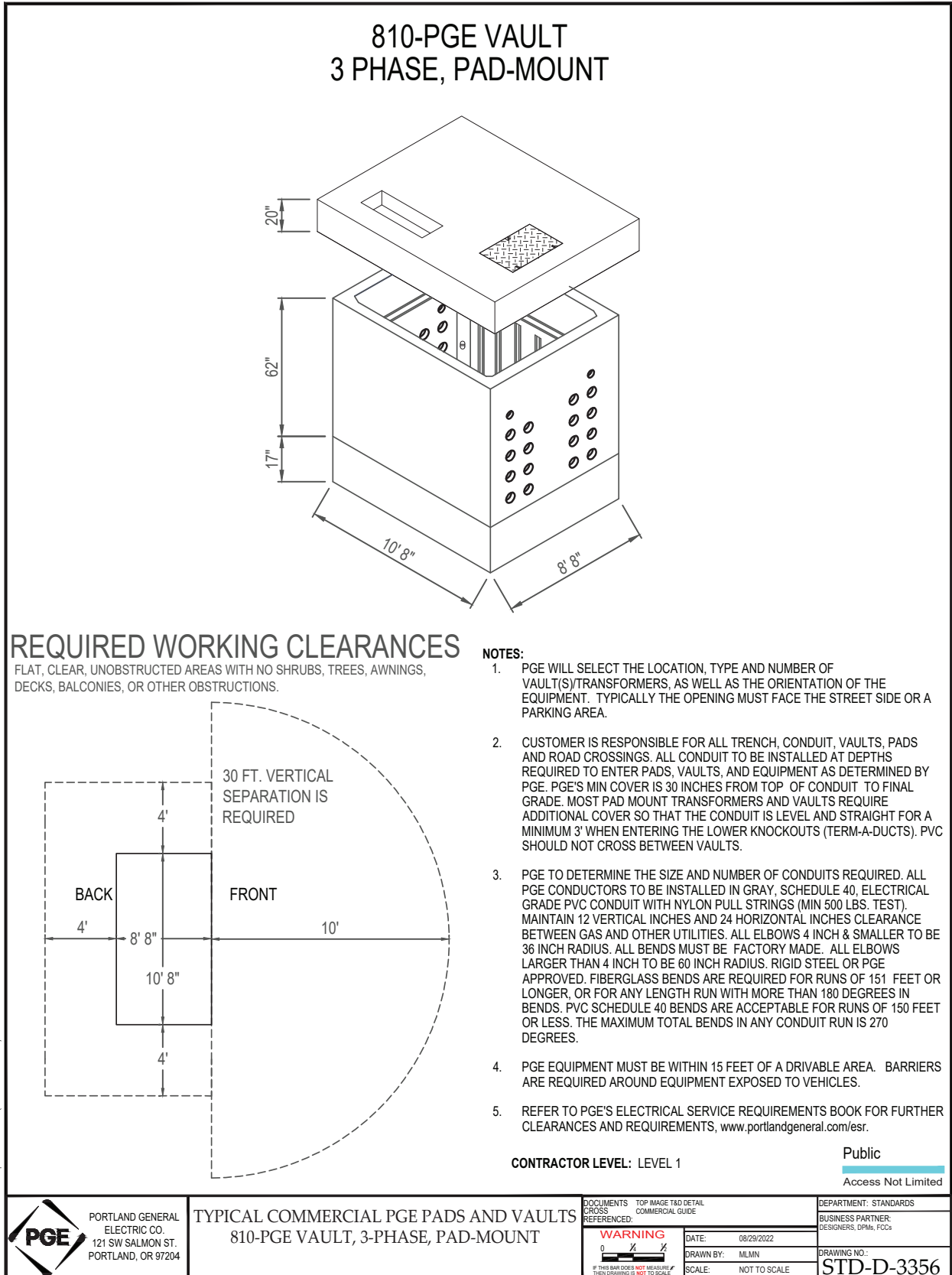


Figure 41. 810-PGE Vault 3 Phase Pad-mount (STD-D-3356)

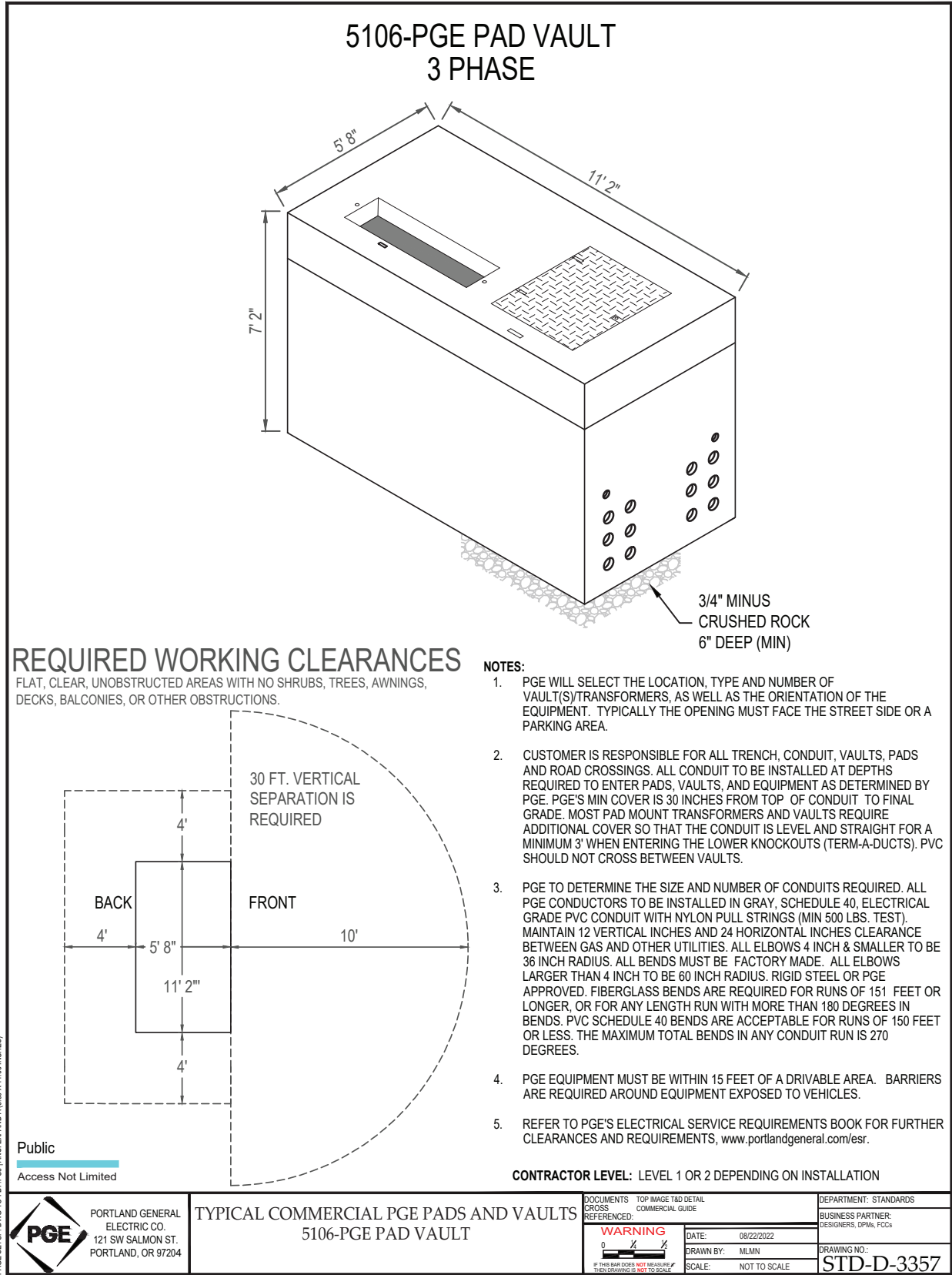


Figure 42. 5106-PGE Pad Vault 3 Phase (STD-D-3357)

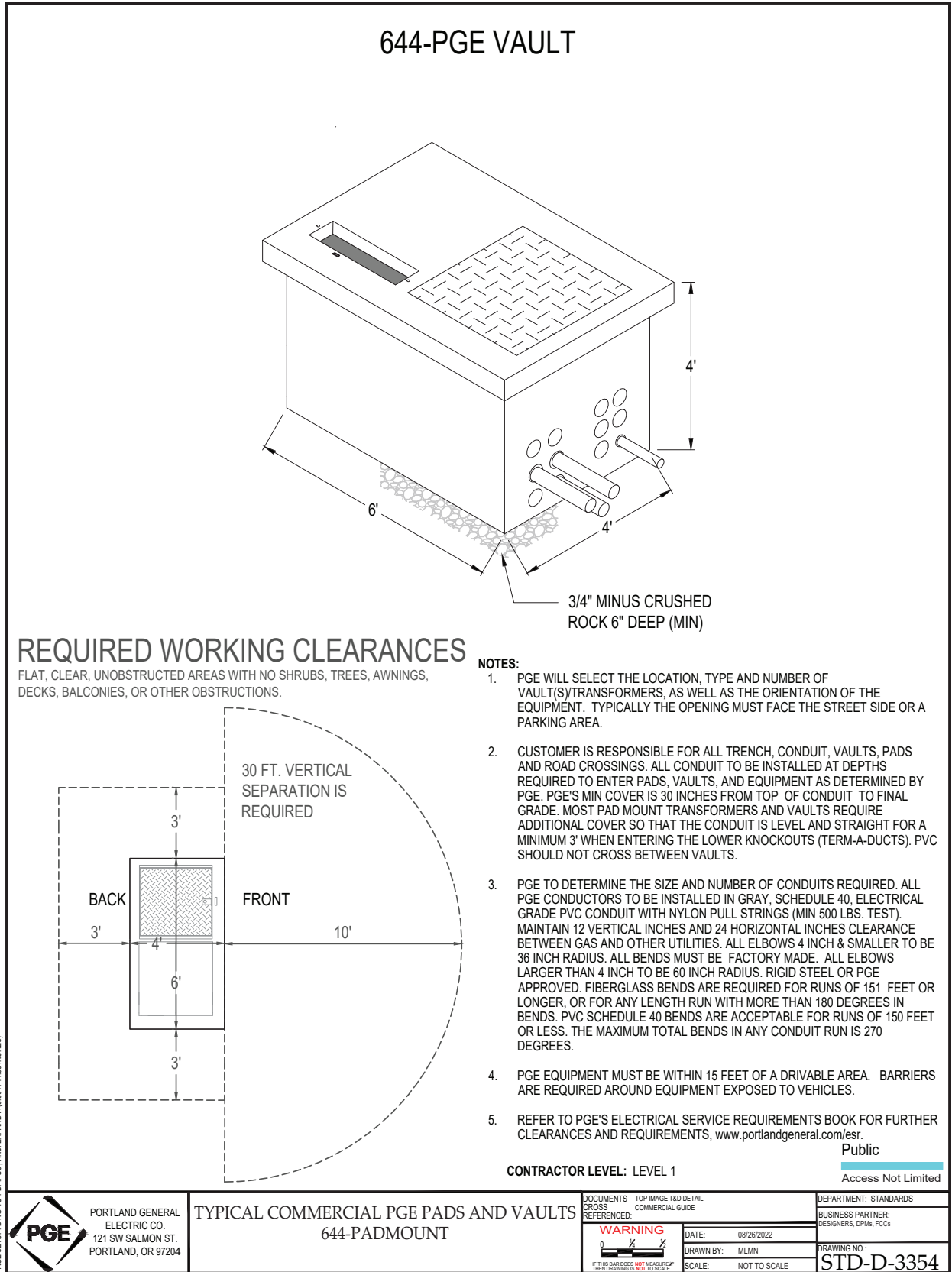


Figure 43. 644-PGE Vault (STD-D-3354)

C Initial Trench Inspection Checklist

For Commercial, Industrial, and Non-Residential Projects 400 A and Greater

Before calling your project's FCC to schedule a trench inspection, be sure the site meets these requirements:

- Trench depth depends on job sketch and project specific requirements. Maximum depth is 6 feet, unless approved by PGE.
- No more than 270 degrees in sweeps in any one conduit run. NO HEAT BENDS!
- Conduit runs over 150 feet require fiberglass sweeps. All runs over 180 degrees—regardless of length—require fiberglass sweeps.
- Conduit is installed, glued with proper glue for the application (PVC-to-PVC, PVC-to-ABS, etc.) has the proper sweeps: 36-inch radius sweeps on 4-inch and under conduit; 60-inch radius on 5-inch and over conduit and have 3" of separation between conduits.
- Vaults are installed on compacted $\frac{3}{4}$ minus rock with a 95% compaction rate within 5 feet of pad or vault. Vaults installed within 12 inches of sidewalk must be sidewalk grade. All other vault locations must be minimum 2 inches above finish grade.
- Minimum of 3 feet of straight conduit in and out of vaults before attaching any conduit sweeps or HDPE bore pipes.
- Minimum 5 feet straight conduit between conduit sweeps.
- Transformer pad vaults require primary conduit installed on field side of vault on end specified in design.
- Conduit generally is installed in the short sides (ends) of vaults. The PGE design will provide conduit routing and sequencing from/into the vault(s). PGE generally does not allow conduit ducts to enter the front or back (long side) of a vault. Always refer to the PGE job sketch for vault detail.
- All vaults and pads must be within 15 feet of a drivable surface. When installed, all vaults and pads must meet multiple clearance requirements including 10' of unobstructed, level, hard surface directly in front of the operational side. Barrier posts are required when transformers are less than 5 feet from drivable surface. Pad mount transformers must be at least 30 feet from switch vaults. For more information, refer to section [5.1 Trench and Conduit Inspections](#), and the [ESR, Chapter 6 Underground Requirements](#).

D Trench Inspection Checklist

For Commercial, Industrial, and Non-Residential Projects 400 A and Greater

- All trenches are completely backfilled and vaults are backfilled to final grade.
- All primary vaults, pads, secondary vaults, and secondary terminations have proper clearances around them. For more information, refer to the [ESR, Chapter 5 Clearances and Location Requirements](#), or contact the Design Project Manager (DPM) or Field Construction Coordinator (FCC).
- All pull strings have been installed with minimum 500-lb. tensile strength string using the proper size rigid mandrel (aka mouse, proofing piston) to ensure the conduit is clear of obstructions. No baggies or parachutes allowed for installing pull strings.
- When blowing string into or penetrating energized vaults, a PGE Standby Crew MUST be on-site.
- All primary vaults, secondary vaults, and pads are clean of mud, dirt, and debris. ¾ inch marine grade plywood is installed and secured over any openings in PGE vaults. Pallets or other covers are NOT acceptable.
- Ground rods are all installed in proper location. In rocky areas contact DPM or FCC for alternate location of ground rods.
- Be prepared to run a mandrel through any section of conduit installed for PGE. Contact the FCC to determine whether they must be on site while proofing.
- Conduit risers are attached to the standoff bracket, in the specified location, on the pole.
- All conduits are capped and free of debris.
- 6 feet of string is required at each end of conduit runs. All pull string MUST be tied to vault lid to pass final inspection.
- If streetlights are required by the municipality, the PGE demarcation 1730 vault is installed properly.
- All handholes (1730's, 1324's) have ground rods installed and penta-head bolts installed or taped together and lying in the base of the handhole for PGE crew installation.

E Underground Network Map

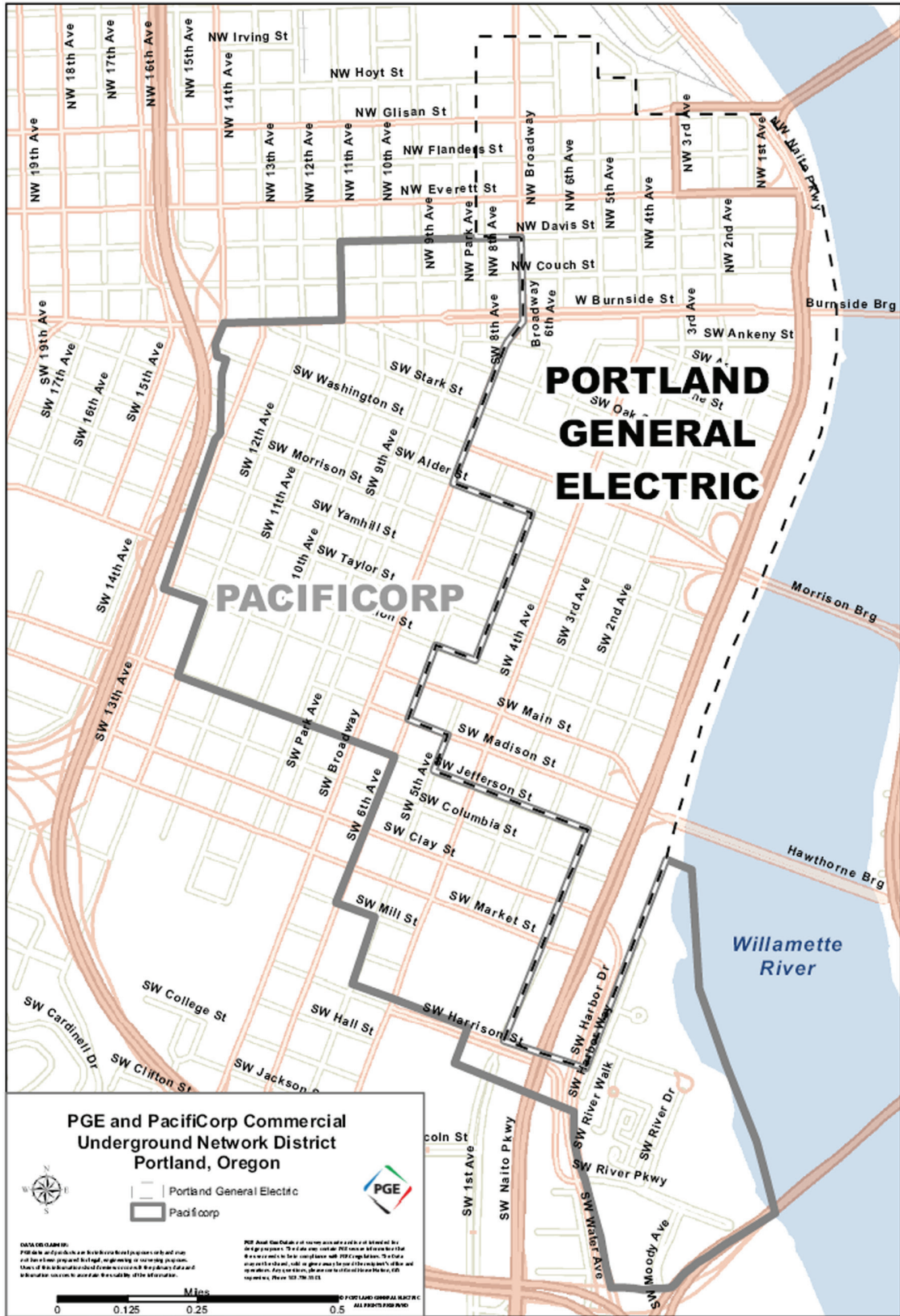


Figure 44. Underground Network Map

F Service Territory Salem Core Map

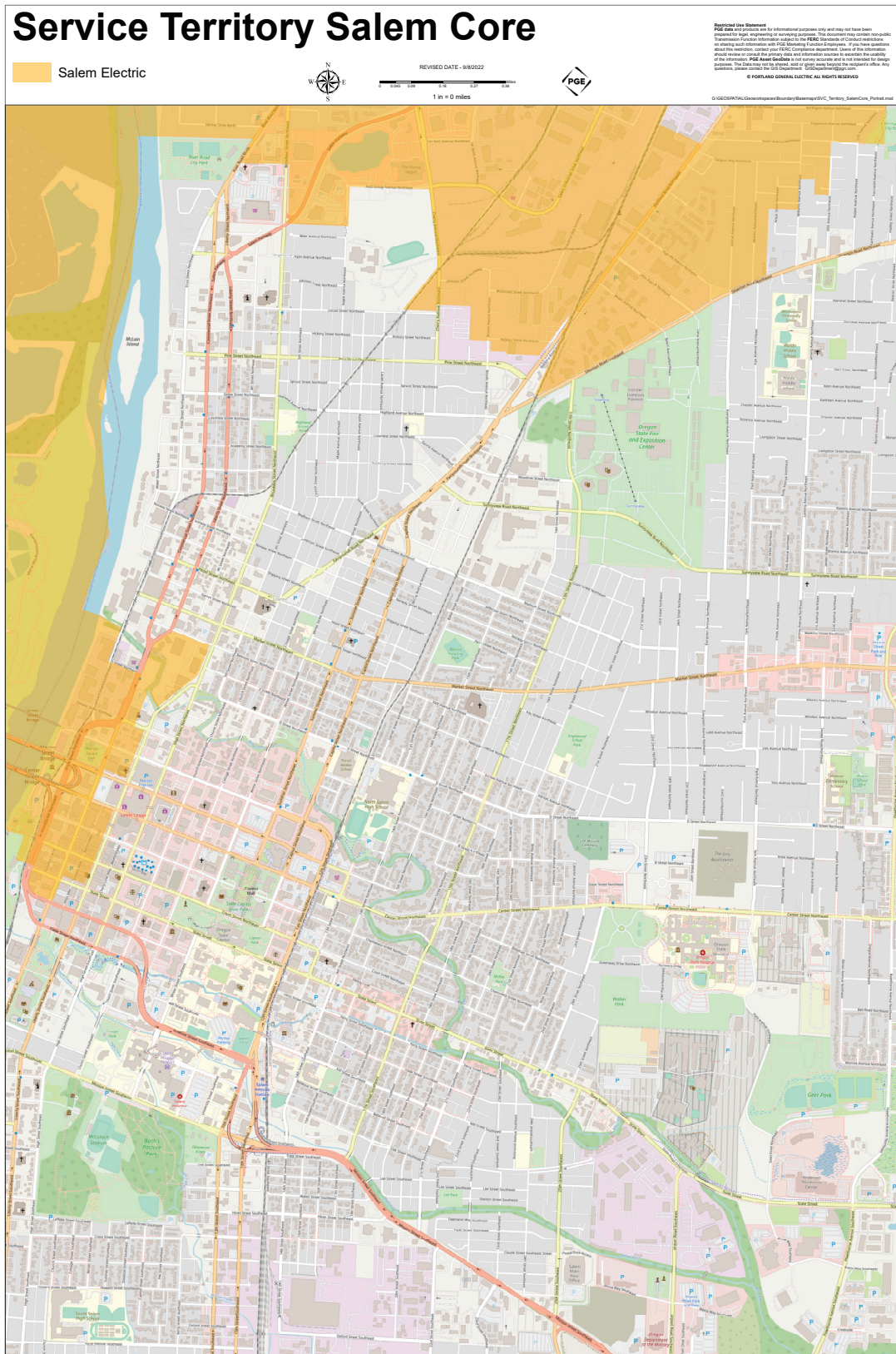


Figure 45. Service Territory Salem Core Map



PGE Corporate Headquarters

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portlandgeneral.com