

2-2.23 Electrical Systems

The Plans Preparation Manual specifies how the electrical design information for electrical systems work must be organized on the electrical plan sheets. Electrical work, identified by the applicable items in the Bid Item List, is described in the:

- project Special Provisions
- Standard Specifications

Electrical work, identified by the applicable items in the Bid Item List, is shown in the:

- project plans (“E,” “ED,” and “EQ” sheets)
- special electrical structures plans (“SES” sheets)
- Standard Plans (“ES” series, as revised)

Utility Policy

Caltrans Utilities Policy requires all new, relocated, or existing facilities (subsurface, aboveground, or overhead), to be shown on the advertised project plans unless a utility exception is granted by the Headquarters Division of Design Chief. Whether owned by Caltrans or others (public or private), existing utilities must be shown to notify the contractor of possible conflicts. Caltrans-owned electrical facilities (e.g., detectors, sensors, fiber optic, pull boxes, conduit and cables, direct-burial cables, etc.) must be shown using symbols and line styles consistent with the Standard Plans. Every project must have a completed Utility Policy Certification signed by a licensed civil engineer. The same engineer will usually produce and be responsible for the utility plans. The district utility coordinator and utility engineering workgroup (UEW) do not usually have information for Caltrans-owned electrical facilities. The UEW or project engineer will need to obtain locations of

Caltrans-owned electrical facilities to complete the utility plans and verification. Sources may include functional units that install and operate electrical systems, as-built plans, and district electrical maintenance.

Include utility sheets signed by a civil engineer for each project plan set that consists of electrical systems work only (no roadway layout sheets) unless the project is exempt from this requirement as defined in the Project Development Procedures Manual, Chapter 17. Responsibility for investigating and showing the utility information is under the purview of a civil engineer and the signature on the plan sheet establishes that responsibility.

Utility facilities should be shown on electrical plan view sheets when there may be a potential conflict with electrical systems work. When utility facilities are shown, in addition to them being shown on utility plan sheets, the line weight may be reduced to de-emphasize the utility line in comparison to project work.

Refer to Section 2-2.13 “Utility Facilities” for further information.

Right of Way

The defined right of way and easement limits should be shown on electrical plan view sheets. Projects with only electrical work must show the defined right of way and easement limits on electrical plan view sheets. Do not present or label any right of way as approximate on any plan sheet, including spot locations and details. Refer to Section 2-1.1 “Right of Way” for further information.

Master Files

The background for electrical system plan view sheets should utilize the base map. The base map consists of two (2) separate files:

- Master Topographic file
- Master Design file

The Master Topographic file (“bb” file) is developed and maintained by the Surveys and Photogrammetry units in the district. The “bb” file includes existing features that are always dropped out on plan view sheets.

The Master Design file (“aa” file) is developed and maintained by the roadway design unit in the district. The “aa” file contains the new permanent design features. An edited version of the “aa” file is typically used for electrical system plans (similar to pavement delineation plans version), with new design features such as pavement edges, dikes, sidewalks, etc., shown dropped out (as if they are already existing). Design features directly related to electrical systems must be shown.

Master files contain information that is not relevant to the electrical work. Merge information that pertains to the electrical plan sheets (active files). The roadway should always be shown. The right of way and alignment may be new or existing, but they are shown solid on all plan view sheets.

The base map is never diagrammatic; it is always delineated proportionally and accurately with correct coordinates. Therefore, aspects of electrical systems not depicted by standard symbols (i.e., conduit runs) are also to be delineated accurately in relation to the base map.

Refer to Section 3.8 “Master Files” of the CADD Users Manual for further information.

Composition of Project Plans

All work needed for each electrical bid item in the project must be shown on the electrical plan sheets. The contractor must be able to readily identify all components of work associated with each bid item. This applies to all projects on the state highway system (SHS) regardless of funding, including local projects utilizing federal funds, Department-advertised and Department-administered contracts.

Electrical plan sheets identified as "E" may include notes, legends, schedules, plan views, and staging work (new, modified, or temporary). Plan sheets that include only electrical details must be identified as “ED”. Electrical quantity tables are mandatory and must be shown on “EQ” sheets. Electrical plans may include special electrical structures (SES) sheets.

Plans Organization

Organize the electrical plan sheets for each bid item by location of work, increasing post mile, or by stage sequence. Specify location and stage construction when applicable (e.g., to match layout or stage construction sheets). Arrangement should match other sheets in the plan set (e.g., roadway layout, pavement delineation, etc.). Organize electrical details and electrical quantity sheets in the same sequential order as the plan view sheets. Bid item components must be shown on the electrical plan view sheets and tabulated on quantity sheets. When payment is by lump sum all the work shown on an electrical plan view sheet must be included for payment in a single bid item.

Non-Electrical Systems Work

It may be necessary to show work not included in electrical bid items, such as roadside signs, irrigation controller enclosure cabinet installations, or overhead signs (e.g., to support a CMS or sign illumination) on electrical plan sheets. This notifies the contractor where to connect or in what sequence to construct such items relative to electrical work. A note on electrical plan sheets must clearly identify under which bid item such work is paid. Do not include roadway work for payment in electrical lump sum bid items unless it is minor or incidental to the electrical work and the roadway bid item that would otherwise be used is not in the project Bid Item List. For example, a small amount of concrete curb or sidewalk associated with a cabinet foundation might be included in an electrical lump sum bid item, when there is no applicable minor concrete item in the project. Do not call out other unrelated roadway bid items on electrical plan sheets.

Drafting Presentation Standards

Use legends, symbols, acronyms, abbreviations, and line styles shown on the Standard Plans to prepare project plans. Do not redefine standard legends, symbols, abbreviations, or line styles for a project. Nonstandard acronyms, abbreviations, legends, symbols, and line styles must be shown on the first electrical sheet type (e.g., E, ED, EQ). Refer to Section 2-1.2 “Drafting Standards” for further information.

Notes and Legends

Include project specific notes and legends where applicable. Do not mix legends and notes. If an individual legend entry is called out at multiple locations it must have the same number at each location.

Notes

Notes are numbered but not enclosed in any geometric shape. Notes must be brief and direct. Do not include specifications in notes that belong in the special provisions (refer to Standard Drawings from Other Agencies in Section 2-1.6). Do not designate various types of notes (e.g., “GENERAL NOTES,” “STAGE CONSTRUCTION NOTES,” “PROJECT NOTES,” etc.). Notes should be placed on the plan view sheet where they apply. When notes are not placed on the applicable sheet, specify to which sheets they apply.

Legends

The legend should be placed on the same plan sheet where the work is called out. When an individual legend entry involves existing facilities, clearly, and in separate

sentences, state what is existing, what is new and what the contractor is to do.

Each legend (for one or more location) must be numbered and enclosed with a rectangle to match the callout at each location it applies. Do not use legends to specify conduit run numbers. Avoid using legends if the annotation can be shown clearly in the plan view sheet. Example:



Schedules

Add the conduit and conductor run schedule and the pole and equipment schedule on or before the plan view sheet that it corresponds to (see Plan View Sheets section below). A schedule may be placed on the same plan view sheet where the work is called out.

Equipment or material (e.g., pole) schedule entries and callouts are lettered and drawn inside a circle. Example:



Conduit and conductor run numbers, schedule entries, and callouts are numbered and drawn inside a triangle. Conduit run numbers are used for Traffic Signals and Ramp Metering. For conduit runs without Conductor Signal Cable, avoid using conduit run numbers. Example:



Plan View Sheets

Plan view sheets provide a visual representation of electrical work in relation

to highway facilities. Plan view sheets are to be coordinately correct. A scale of 1" = 20' is typically used for traffic signals. A scale of 1" = 50' (Caltrans standard base scale) is typically used for lighting. Refer to Section 2-1.3 "Scales" for further information. Each electrical plan view sheet must include the following statement: "APPROVED FOR ELECTRICAL WORK ONLY." This statement must be located at the bottom-center of the plan sheet. Do not place this statement on electrical system detail or quantity sheets. Structure electrical plan sheets are generally made from the general plan of the structure involved, with bridge design elements dropped out, and non-pertinent details and notes removed.

The only information to be shown at the lower right corner of the electrical plan view sheet is the plan sheet name the scale, and the plan sheet identification and number. When payment is by lump sum the plan view sheet name must match the lump sum bid item description verbatim. Avoid using non-standard bid items. Use a non-standard bid item if the predominant electrical work shown on the project plan sheets is not described by any of the standard approved bid items.

Use break lines in place of match lines between plan view sheets that are not contiguous. The number of electrical plan view sheets may not correspond numerically to the roadway layout sheets. A key map may be necessary to eliminate confusion on the number of each type of plan view sheet. Avoid the use of break lines if electrical components will be omitted (e.g., conduit runs, pull boxes, poles etc.). Refer to Section 2-1.1 "Composition of Project Plans and General Preparation Procedures" for further information.

Coordination with Roadway Layouts

Coordinate electrical plan sheets so that they present the same configuration as the roadway layout plans. This facilitates correct location of overhead sign structures, standards, poles, push button assembly posts, pull boxes, etc. in relation to items such as utilities, pavement edges and sidewalks. Coordinate electrical stage construction plan sheets with roadway stage construction plan sheets so that they present a compatible stage sequence. This clarifies the sequence of both removal of existing electrical components (e.g., standards and poles) and construction of new electrical components.

One Electrical System (Lump Sum Bid Item) per Plan Sheet

When payment is by lump sum bid item, callout work for only one electrical system or lump sum bid item on each plan view sheet. This is required for work on new, modified, existing, or temporary electrical systems. Electrical stage construction work also must be shown on a plan view sheet for only one electrical system or lump sum bid item.

Shared Components

When electrical components (e.g., pull boxes, conductors, conduits, cabinets, poles, etc.) are shared among multiple electrical systems and payment is by lump sum, select one specific new, temporary, or existing electrical system in which to include each shared component. On other plan view sheets on which the shared component appears, repeat the callout or legend entry but with added information that states under what electrical system the component is included (i.e., “Part of XXXXX System”).

This is required for all electrical systems when payment is by lump sum.

New Electrical Systems

For new electrical systems paid for by lump sum, work at all locations throughout the project is included in one bid item. Refer to the Bid Item List for the current standard bid items.

For each electrical system not listed in the current Bid Item List, obtain approval to create and use a nonstandard bid item with supporting specifications (e.g., EXTINGUISHABLE MESSAGE SIGN SYSTEMS, HIGHWAY ADVISOR RADIO SYSTEMS, etc.). The same requirements for standard bid items apply to nonstandard bid items.

Temporary Electrical Systems

For temporary electrical systems paid for by lump sum, all work at all locations throughout the project is included in one bid item. Refer to the Bid Item List for the current standard bid items for temporary electrical systems.

Removing and Modifying Existing Electrical Systems

Use lump sum removing existing electrical system bid items (e.g., REMOVING SIGNAL AND LIGHTING SYSTEMS, REMOVING RAMP METERING SYSTEMS, etc.) where only removal of work is called out on the plan sheets and no electrical components are to be added or modified. Use modifying existing electrical system bid items (e.g., MODIFYING CHANGEABLE MESSAGE SIGN SYSTEMS, MODIFYING FLASHING BEACON SYSTEMS, etc.) where a combination of removing, adjusting, or adding existing components is called out on the plan sheet.

Stage Construction

Work for stage construction involved in each new electrical system is included for payment in the same lump sum bid item as the permanent work that the stage work facilitates. Therefore, the stage construction sheet name remains the same as the permanent electrical system bid item description. Work for stage construction to remove or modify existing electrical systems is included in the bid item for removing or modifying the existing electrical system, respectively.

Present work to be performed in the current stage as new. Present existing facilities or

facilities remaining from previous stages as existing. Specify removed or relocated facilities accordingly. Do not show facilities when they have been removed in a previous stage. Refer to Section 2-2.16 “Stage Construction/Traffic Handling” for further information.

Modifiers

A modifier must be included on plan view sheets that are one of multiple sheets showing work:

- in the same location
- for the same bid item

For new or temporary electrical work, a modifier identifies the:

- location of work
- stage of work
- local agency that the work is for

Do not refer to multiple electrical systems in a modifier. For removing or modifying existing electrical systems lump sum bid item work, include a modifier to identify one type of existing electrical system that is being removed (partially or completely) or modified. This is required because you may call out work for only one new, temporary, or existing electrical system on each plan view sheet.

A modifier must be located near the bottom-center of the plan view sheet. Do not include a modifier as part of the electrical plan view sheet name. Modifiers must be specific. Use modifiers that follow the same conventions throughout the project plans. Modifiers are not required for all projects.

Details

Electrical details are project specific details for work shown on the electrical plan sheets

that is not included in the Standard Plans. Electrical details may include modifications to the Standard Plans. Refer to Section 2-2.6 “Construction Details” for further information. A modified standard plan detail or a combination of standard plan details must be shown and labeled as a modified detail. Provide sufficient dimensioning and callouts for the modified detail so that quantities involved are calculable. See Section 2-1.4 “Use of Standard Plans.”

Each detail must have a name or a designation (or both, e.g., “LOOP DETECTOR SPACING FOR RAMPS,” or “DETAIL B”). If a callout or legend entry invokes an electrical detail that is not on the same plan sheet, the callout or legend entry must include the sheet identification and number on which the detail is shown (e.g., “SEE SHEET ED-1 FOR DETAIL A”). Shared details called out in multiple plan sheets should be shown on ED sheets.

If a detail includes dimensions, the statement “NO SCALE” should be added below the name of the detail (unless it is drawn to scale). If a detail has no dimensions (e.g., a schematic wiring diagram), the statement “NO SCALE” is not necessary. When all details on one electrical detail plan sheet comply with either of the previously mentioned cases, inclusion, or absence of the statement “NO SCALE” applies to the entire electrical details plan sheet.

When an electrical plan view or detail sheet shows material that is paid for under a different bid item, identify which bid item is used for payment. Also identify all such bid items in a quantity table that includes the bid item description consistent with the project Bid Item List.

Standard drawings from other agencies, when applicable to the project, shall be included as part of the project plan set. Referring to a standard drawing number from another agency is not acceptable. Identify which bid item includes payment for the work involved. Refer to Section 2-1.6 “Standard Drawings from Other Agencies” for further information.

Quantities

Electrical quantities must be summarized in tabular format in "EQ" plan sheets. Quantity tables must show the bid item quantities, location, and their respective plan sheet. Quantity tables for electrical bid items must be included in the project plans for each bid item, except for removing existing electrical system bid items. When a bid item is called out on roadway plan sheets and electrical plan sheets (e.g., roadside signs) it must be quantified on the appropriate quantity table. Reference the electrical plan sheet on which those quantity table entries are shown. The quantity tables must include significant components included in the bid item. Significant components include, but are not limited to, Standards, poles, posts, pedestals, foundations, signal heads, pedestrian signal heads, APS's, BPA's, luminaires, cabinets, enclosures, conduit, pull boxes, vaults, conductors, cables, detectors, sensor, cameras, CMS's, EMS's, modems and UPS's by type and quantity.

Lump Sum Bid Item Quantity Tables

Most electrical system work is paid for by lump sum bid items. Quantity tables of material and components of work must be included for each electrical bid item except for removing electrical system bid items. Quantity tables must be included in "EQ" sheets. Material, components, and quantities

in quantity tables for lump sum bid items are for bidder and contractor information because not all material needed is identified (e.g., conduit couplers, fasteners, slack in conductors, etc.). The note "ELECTRICAL SYSTEMS QUANTITY TABLES SUMMARIZE SIGNIFICANT COMPONENTS. SEE ELECTRICAL SYSTEMS PLANS AND SPECIFICATIONS TO DETERMINE ALL MATERIALS NEEDED FOR EACH SYSTEM." must be included in each electrical system quantity sheet. The note "NOT A SEPARATE BID ITEM" must be included in each quantity table column or header for items of work which are not separate bid items. "(N)" may be used as an abbreviation for "NOT A SEPARATE BID ITEM". The title of the lump sum bid item quantity table must be consistent with the electrical system plan view sheet title (bid item description). When there are multiple locations or stages of work, include the material and components in a single quantity table or in multiple quantity tables with the same title. Repeat locations and stages exactly as they appear in modifiers used on the plan view sheets. Arrange quantity tables on electrical quantity sheets in the same order as the plan view sheets, they summarize (refer to Composition of Plans). Include incidental roadway work for payment in the applicable electrical system lump sum bid item, if shown on the plan sheets.

For further information on presenting bid items and quantities in a quantity table, refer to Section 2-2.19 "Summary of Quantities."

Special Electrical Structures

Special electrical structures (SES) sheets are not separate bid items. SES sheets include details that are part of one or more electrical bid item. Callouts on electrical plan view sheets must refer to the applicable sheet (e.g., SEE SHEET SES-1). When an SES detail is a component shared among multiple electrical systems, state under which electrical bid item the detail is paid (i.e., "Part of XXXXX Bid Item"). Include a similar cross reference on the electrical plan view sheet stating under which electrical bid item the detail is paid.

CHECKLIST FOR ELECTRICAL SHEETS

- District, county, route, and post miles are shown
- Unit, Project Number and Phase are shown
- Signature, date of signature, license number, printed name, and license expiration date are shown. (Signature is added as the last step before the project is ready to list)
- North arrow is shown on applicable sheets
- Scale centered below "E" and "ED" sheet titles
- Information on plan sheet development name blocks in left margin of border sheets. See Figures 2-10 and 2-11 in Section 2-1.6 for additional instructions
- Applicable sheet approval statement centered at bottom of "E" sheets (example: *"APPROVED FOR ELECTRICAL WORK ONLY"*)
- Right of way and easements shown on:
 - electrical system plan view sheets
 - spot locations where no other plan view sheet shows R/W
- Following statement shown on each plan sheet where right of way is shown: "FOR ACCURATE RIGHT OF WAY DATA, CONTACT RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE"
- Standard abbreviations conform to those listed in the Standard Plans.
- The first sheet of each electrical plan sheet (e.g., "E", "ED" and "EQ") contains project specific, symbols, and nonstandard abbreviations that are not included in the Standard Plans.
- Routes, streets, and lines are designated. Do not use route shields (markers).
- Plan view sheet name must match the bid item description for the work shown.
- Modifiers such as location number, city, county, intersection of local streets, stage construction, etc. are near the bottom center of sheet.
- Limit of roadbed shown on plan view sheets.
- Environmentally sensitive area (ESA) limits shown on plan view sheets
- Alignment line and stationing are shown solid on the plan view sheets. Stationing matches roadway layout sheets
- Fences, city, and county limits are shown
- Utility plans signed by a registered civil engineer
- Road approaches, street names, and on/off ramps are shown and labeled
- Bridge name and number (Show bridge limits when work is to be performed on the bridge)

**CHECKLIST FOR ELECTRICAL
QUANTITY SHEETS**

- For conduit runs in sidewalks, show limits of sidewalk, driveways, and curb ramps along the entire conduit
- Verify locations of irrigation controllers match the landscape plans
- Verify locations of standards, poles, posts, and APS's are ADA compliant, and consistent with the roadway layout plans and other applicable sheets
- Existing electrical systems are shown on plan view sheets
- Cross-references between SES, plan view and electrical detail sheets
- Name of quantity table for lump sum bid item matches bid item description and plan view sheet name
- Quantity sheets have the note "ELECTRICAL SYSTEMS QUANTITY TABLES SUMMARIZE SIGNIFICANT COMPONENTS. SEE ELECTRICAL SYSTEMS PLANS AND SPECIFICATIONS TO DETERMINE ALL MATERIALS NEEDED FOR EACH SYSTEM"
- Quantity tables for lump sum bid items include the symbol "(N)" or "NOT A SEPARATE BID ITEM" in each header or column
- Bid items that are not lump sum are summarized in quantity tables

THIS PAGE INTENTIONALLY LEFT BLANK