

2-2.23 Electrical Systems

The Plans Preparation Manual is the source manual for showing how the electrical design information must be presented on the electrical project plans for all projects. Electrical systems work identified by the applicable items in the Bid Item List is described in the;

- project Special Provisions
- Standard Specifications (including Revised Standard Specifications [RSS])

Electrical systems 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 that main lines or trunk lines of all existing facilities (subsurface, aboveground or overhead) and new/planned utility installations and relocations must be shown on the advertised project plans for every project (unless a utility exception is granted by the Chief, Headquarters Division of Design) whether owned by Caltrans or others (public or private), to notify the contractor of possible utility 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. Usually the same engineer will 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 plans set that consist 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.

As a convenience and reminder to the contractor and subcontractor, utility facilities may be shown on electrical systems plans when there may be a potential conflict with electrical systems work. When utility facilities are shown a second (2nd) time (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

For electrical systems only projects, the defined right of way must be shown on electrical systems plan view sheets that encompass the construction limits of the project. Do not present or label any right of way as approximate on any plan, including

spot locations and on details. If the defined right of way is shown on roadway layout sheets, the right of way may also be shown a second (2nd) time on electrical systems plan when it is determined that electrical systems work is located near the right of way or easement limit. Showing the defined right of way conveys to the bidder, contractor, and subcontractor that project work is within Caltrans' right of way or the limits of an easement. Refer to Section 2-1.1 "Right of Way" for further information.

Master Files

The background for electrical systems plan view sheets utilizes 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 systems 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 may contain a lot of information, but only the necessary information needed for any specific contract plan sheet, should be merged into that contract plan sheet (active

file). The roadbed is always 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, and is coordinately correct. Therefore, aspects of electrical systems design 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 systems bid item in the project must be shown on the electrical systems plans. 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, and Department-advertised and Department-administered contracts.

Electrical systems project plans may include notes and legends sheets, plan view sheets, temporary electrical systems work, and electrical systems staging work, each with the plan sheet identification "E." Plan sheets that include only electrical details have the plan sheet identification "ED." Electrical systems quantity tables are mandatory. All electrical systems quantity tables must be presented on plan sheets with the identification "EQ." Electrical systems project plans may also include special electrical structures (SES) sheets.

Plans Organization

Organize the electrical systems plan set so that all of the plan view sheets depicting one electrical systems bid item (including the bid items removing or modifying existing electrical systems) are consecutive. Arrange the plans for each bid item by locations of work and then by stage sequence at each location. Organize details that are on electrical systems detail sheets and quantity tables that are on electrical systems quantity sheets in the same order.

Non-Electrical Systems Work

It may be necessary to show work not included in electrical systems 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 systems sheets. This notifies the contractor where to connect or in what sequence to construct such items relative to electrical systems construction. A note on electrical systems sheets must clearly identify under which bid item such work is paid. Do not include roadway work for payment in electrical systems lump sum bid items unless it is relatively 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 a 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 systems plans.

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 sheet of the applicable type of electrical plans. Refer to Section 2-1.2 “Drafting Standards” for further information.

Notes and Legends

Include one set of project specific notes and one legend applicable to the entire project plan set on a dedicated sheet (or sheets) in the electrical systems plans. Do not mix a legend 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 should 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 different kinds of notes (e.g. “general,” “stage construction,” “project,” etc.). Depending on the type and size of the project, notes may be placed on the plan view sheet where they apply, if there is room. If needed, state to which sheets or details a set of notes apply.

Legends

Place a legend on the same sheet as the notes that apply to the same plan sheets if there is room. Depending on the type and size of the project (such as the specific nature and quantity of work), a legend may be placed on the same plan view sheet where the work is called out, if there is room. If an individual legend entry involves existing facilities,

clearly and separately state both what is existing and what the contractor is to do.

Each specific legend entry (for one or more locations) must be numbered and the number enclosed with a square to match the call out at each location it applies. Example:



Schedules

Identify to which plan view sheets each schedule (e.g. conduit and conductor run schedule, pole and equipment schedule) applies (see Plan View Sheets section below). Depending on the specific nature and quantity of work, a schedule may be placed on the same plan view sheet where the work is called out, if there is room.

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



Conduit and conductor run schedule entries and callouts are numbered and drawn inside a triangle. Example:



Plan View Sheets

Plan view sheets provide a visual representation of electrical system work in relation to highway facilities. Plan view sheets are to be coordinately correct. A horizontal scale of 1" = 20' is typically used for plan sheets of signal and lighting system work at road intersections. A scale of 1" = 50' (Caltrans standard base scale) is used for plan

view sheets of other electrical system work such as lighting system, ramp metering system, sign illumination system, etc. Refer to Section 2-1.3 "Scales" for further information. Each electrical systems 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 systems detail or quantity sheets. Structure electrical systems plans 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 system plan view sheet is the plan sheet name (bid item description), the scale, and the sheet identification and number. The plan view sheet name must match the bid item description verbatim. Avoid using a non-standard bid item. Use a non-standard bid item if the predominant electrical work shown on the project plan view sheet 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 systems 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. Refer to Section 2-1.1 "Composition of Project Plans and General Preparation Procedures" for further information.

Coordination with Roadway Layouts

Coordinate electrical systems plans so that they present the same final roadway 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 systems stage construction plans with roadway stage construction plans 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 systems.

One Electrical System per Plan Sheet

Call out work for only one electrical system or service (irrigation/booster pump) on each plan view sheet. This is required for work on existing electrical systems (when the applicable bid item is not a specific system) as well as work on new and temporary electrical systems. Include work for emergency vehicle detection in the signal system or signal and lighting system that it is associated with. See subsections “Shared Components,” “New Electrical Systems,” “Temporary Electrical Systems,” and “Removing and Modifying Existing Electrical Systems” below. Stage construction work also must not call out work for multiple electrical systems on a single plan view sheet.

If multiple electrical systems are coincidentally located, call out the work for each system on separate plan view sheets that each depict the same or similar area of the project. For example, a lighting system plan may call out components for a lighting system that is located in the same area as a

ramp metering system and a sign illumination system. The ramp metering system plan and the sign illumination system plan that depict the same area would then call out only those components dedicated to those systems, respectively.

Shared Components

Where electrical systems components (e.g. pull boxes, conductors, conduits, cabinets, poles, etc.) are shared among multiple electrical systems, 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 new electrical systems as well as work on existing electrical systems.

New Electrical Systems

For each type of new electrical system paid for by lump sum, all work at all locations throughout the project is included in one bid item. Current bid item descriptions for new electrical systems are limited to the following:

- SIGNAL AND LIGHTING (CITY)
- SIGNAL AND LIGHTING (CITY STREET LOCATION [1, 2, or 3])
- LIGHTING (CITY STREET)
- FLASHING BEACON SYSTEM
- RAMP METERING SYSTEM
- ELECTRIC SERVICE FOR IRRIGATION

- ELECTRIC SERVICE FOR BOOSTER PUMP
- LIGHTING SYSTEM
- SIGN ILLUMINATION SYSTEM
- SIGNAL AND LIGHTING SYSTEM
- TRAFFIC MONITORING STATION SYSTEM
- CHANGEABLE MESSAGE SIGN SYSTEM
- TEMPORARY LIGHTING SYSTEM

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. CLOSED CIRCUIT TELEVISION SYSTEM, HIGHWAY ADVISOR RADIO SYSTEM, etc.). Do not create a nonstandard bid item to combine multiple new electrical systems. The same requirements for standard bid items apply to nonstandard bid items.

Temporary Electrical Systems

For each type of temporary electrical system paid for by lump sum, all work at all locations throughout the project is included in one bid item. Do not create a nonstandard bid item to combine multiple temporary electrical systems. Current bid item descriptions for temporary electrical systems are limited to the following:

- TEMPORARY SIGNAL SYSTEM
- TEMPORARY SIGNAL AND LIGHTING
- TEMPORARY FLASHING BEACON
- TEMPORARY LIGHTING SYSTEM

Removing and Modifying Existing Electrical Systems

All work for removing various existing electrical systems (entire existing electrical systems or components of existing electrical systems) at various locations throughout the project is included in one bid item. The name for all plan sheets for removing work is REMOVING EXISTING ELECTRICAL SYSTEM. Use removing existing electrical systems where removal work only is called out at the location depicted on the plan and no electrical components are to be added or modified. Likewise, all work for modifying various existing electrical systems at various locations throughout the project is included in one bid item. The name for all plan sheets for modifying work is MODIFYING EXISTING ELECTRICAL SYSTEM. Use modifying existing electrical systems where a combination of removing, adjusting, or adding existing components is called out at the location depicted on the plan. Do not create a nonstandard bid item that includes one or more specific electrical systems in the description to be removed or modified.

Stage Construction

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

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

facilities remaining from previous stages as dashed or dropped out. Do not show facilities 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 systems 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 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. There is no compulsory convention for modifiers for all projects.

Details

Electrical details are project specific details for work shown on the electrical systems sheets that are not included in the Standard Plans, or are modified from 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., “Typical Loop Spacing for 2-Lane Ramp,” 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., “Detail B, See sheet E-1” or “Detail B, See sheet ED-1”). If a shared detail is called out at multiple locations, you may list all the sheets or systems or locations to which the detail applies, below the detail name. If the number of details does not warrant an entire sheet then they may be shown on the notes and legend sheet or electrical systems plan view sheet if there is room.

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

If an electrical systems plan view sheet or an electrical details sheet shows one or more details that are paid for under a bid item other than one or more of the electrical systems lump sum bid items, clearly identify under which bid item it is included 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

Quantities summarized in tabular format must show the bidder, contractor and resident engineer the bid items and their total quantities, their locations within the project limits, and the plan sheets on which they are shown. Quantity summary tables for electrical systems bid items are mandatory and must be included in the project plans for each bid item shown on the plans. When a bid item is called out both on roadway plans and electrical systems plans (for example, roadside signs) it shall be grand totaled on the appropriate table in the summary of quantities including references to the electrical systems plans sheets on which those quantity table entries are shown.

Lump Sum Bid Item Tables

Electric service (irrigation/booster pump) bid items and most electrical systems bid items are paid for on a lump sum basis. A table of materials and components of work and their

quantities must be included for each lump sum electrical systems bid item except Removing Existing Electrical System. Materials, components and quantities in quantity tables for lump sum bid items are for bidder and contractor information because not all materials needed are identified (e.g. hardware, consumables, 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." along with the note “(N) - NOT A SEPARATE BID ITEM” must be included with a stand-alone quantity table for lump sum bid items or on electrical systems quantity sheets with any combination of lump sum bid item quantity tables. Each column header in the table or group of column headers or group of rows in a quantity table showing items of work which are not separate bid items, must include the symbol “(N)” to clearly identify non-bid item(s). The title of the lump sum bid item quantity table must be consistent with the electrical systems plan view sheet name [bid item description]. If there are multiple locations or stages, include them either within the table or in the title of multiple tables for the bid item. Repeat locations and stages exactly as they appear in modifiers used on the plan view sheets. Arrange quantity tables on electrical quantities sheets in the same order as the plan view sheets they summarize (refer to Composition of Plans). Include minor, incidental roadway work included for payment in electrical systems lump sum payment, if any is shown on the plans.

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

A special electrical structures (SES) sheet is not a separate bid item. SES sheets typically include details that are part of one or more lump sum electrical system bid items. Call outs on an electrical systems plan view sheet must refer to the specific applicable sheet (e.g. See Sheet SES-1). If an SES detail is a component shared among multiple electrical systems, state under which electrical system the detail is paid (i.e. “Part of XXXXX System Bid Item”). Include a similar cross reference note on the electrical systems plan view sheet stating under which electrical system the detail is paid.

**CHECKLIST FOR ELECTRICAL
PLAN VIEW SHEETS**

- | | |
|---|---|
| <p><input type="checkbox"/> District, county and route</p> <p><input type="checkbox"/> Post miles</p> <p><input type="checkbox"/> Unit and Project Number and Phase</p> <p><input type="checkbox"/> Signature, date of signature, license number, printed name, and license renewal date. (Signature is added as the last step before the project goes to PS&E)</p> <p><input type="checkbox"/> Standard roadway north arrow</p> <p><input type="checkbox"/> Scale centered below sheet name</p> <p><input type="checkbox"/> Information on plan sheet development name blocks in left margin of border sheet. See Figures 2-10 and 2-11 in Section 2-1.6 for additional instructions</p> <p><input type="checkbox"/> Correct sheet approval statement centered at bottom of sheet (example: "APPROVED FOR ELECTRICAL WORK ONLY")</p> <p><input type="checkbox"/> Right of way and easements shown on;</p> <ul style="list-style-type: none"> • all electrical systems plan view sheets on electrical systems only projects • each electrical systems spot location where no other coextensive plan view sheets shows R/W <p>Following statement shown on each plan sheet where determinate right of way is shown: "FOR ACCURATE RIGHT OF WAY DATA, CONTACT RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE"</p> <p><input type="checkbox"/> Standard abbreviations conform to those listed in the Standard Plans</p> | <p><input type="checkbox"/> The first sheet of each electrical plan shall contain project specific notes, legends, symbols, and nonstandard abbreviations that are not included in the Standard Plans</p> <p><input type="checkbox"/> Identify routes within the project limits. Line designations and routes must be identified and are typically placed above the alignment line. Do not use route shields.</p> <p><input type="checkbox"/> Plan view sheet name must match the bid item description for the work shown</p> <p><input type="checkbox"/> Modifiers such as location number, city, county, intersection of local streets, stage construction, etc. near the at bottom center of sheet</p> <p><input type="checkbox"/> Limit of roadbed shown</p> <p><input type="checkbox"/> Environmentally sensitive area (ESA) limits shown</p> <p><input type="checkbox"/> Alignment line and stationing are shown solid. Stationing matches roadway layout sheets</p> <p><input type="checkbox"/> Fences, city and county limits are shown</p> <p><input type="checkbox"/> Utility plans signed by a registered civil engineer</p> <p><input type="checkbox"/> Road approaches, street names, and on/off ramps are shown and labeled</p> <p><input type="checkbox"/> Bridge name and number (Show bridge limits only when work is to be performed on the bridge)</p> <p><input type="checkbox"/> For conduit runs in sidewalks, show limits of sidewalk, driveways and curb ramps along the entire conduit</p> |
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- Verify that locations of irrigation controllers are at the same locations as shown on the landscape plans
- Verify that locations of standards, poles, posts, APS are compatible with final roadway configuration shown on the roadway layout plans
- Show existing electrical systems dropped out
- Cross-references to electrical systems details
- Cross-references to SES sheets

**CHECKLIST FOR ELECTRICAL
DETAIL PLAN SHEETS**

- Acronyms, symbols, and abbreviations are defined and consistent with those shown in the legend for any local agency requested details
- Cross-references and detail designations consistent with electrical systems plan view sheets

**CHECKLIST FOR ELECTRICAL
QUANTITY SHEETS**

- Name of quantity table for lump sum bid item matches bid item description and plan view sheet name where work is shown
- Quantity tables for lump sum bid items have a note "ELECTRICAL SYSTEMS QUANTITY TABLES SUMMARIZE SIGNIFICANT COMPONENTS. SEE ELECTRICAL SYSTEMS PLANS AND SPECIFICATIONS TO DETERMINE ALL MATERIALS NEEDED FOR EACH SYSTEM" placed below table or as a note on the sheet with quantity tables
- Quantity tables for lump sum bid items that show items of work which are not separate bid items, include the symbol "(N)" in each header row or show the symbol (N) above a group of columns headers
- Quantity tables for lump sum bid items that show items of work which are not separate bid items, have a note "(N) - NOT A SEPARATE BID ITEM" placed below the table
- Bid items that are not lump sum are summarized in quantity tables

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