

- Electrical Drawing Preparation
   Types of Drawings
   Diagrammatic or Line Drawings
   Scaled or Dimensioned Drawings
   Supporting Documents
- Electrical Drawing Preparation
   Diagrammatic (Line) Drawings
   Power Flow

   One Lines
   Three Lines
   Risers
- Electrical Drawing Preparation
   Diagrammatic (Line) Drawings
   Schematics

   Ladder Logic
   Motor Elementaries
   Block Diagrams

   Wiring

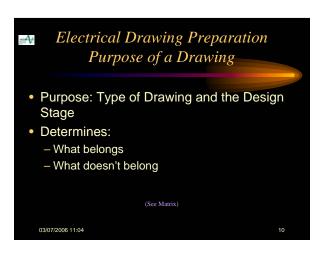
   Connection
   Interconnection
- Electrical Drawing Preparation
   Scaled (Dimensioned) Drawings
   Plan drawings

   Site Layout
   Power Plans, Lighting Plans
   Equipment Room Layouts
   Grounding Plans
   Cable Tray Layout

## Electrical Drawing Preparation Scaled (Dimensioned) Drawings Elevations Installation / Mounting Details (Transformer & Panel) Front view Layouts (Switchboard, MCC) Drilling Template (Control Panel) Isometrics Cable Tray Layout



## Electrical Drawing Preparation Status of a Drawing Design Stages Conceptual Design Design Development Pre-Final Design Final Design Bid Construction Record Drawings



	Conceptual Design (35%)	Design Development (50%)	Pre-Final Design (90%) [Note 7]	Final Design, Bid, Construction	Record
<u>Diagrammatic</u>					
Power Flow					
One Lines	Large Equip.	50% (Note 1)	90%	Complete	IEEE 902
Three Lines					
Risers					
Schematics					
Ladder Logic					
Motor Elementaries					
Block Diagrams					
Wiring					
Connection					
Interconnection					
Scaled					
Plan drawings					
Site Layout (& Demo)	Sketches	50%	90%	Complete	
Power Plans	Prelim	Note 1	90%	Complete	IEEE 902
Lighting Plans		Note 2	90%	Complete	
<b>Equipment Room Layouts</b>	Large Equip.	50%	90%	Complete	
Grounding & Lightning Prot.		Note 3	90%	Complete	
Cable Tray Layout					
Special Systems (Phone, etc.)		Note 4	90% (Note 4.1)	Complete	
Elevations					
Power Panel Layouts					
MCC Layouts					
<b>Equipment Mounting Details</b>					
Cable Tray Racks					
Isometrics					
Cable Tray Routing					
Supporting Documents					
Legend & Abbrev.		Complete			
Bill of Material		·			
Panelboard			90%	Complete	IEEE 902
Fixtures			90%	Complete	
Cabling					
Specifications		Note 5, 6	Note 5.1 & 6.1	Final	

This document derived from AFCEE UFC 1-300-09N. Reproduction of this document shall include the appropriate reference to the source document.

- 1 Show a building's full floor plan (first, second, etc.) with the location of receptacles, panelboards, switchboards, motor control centers, transformers and any other major equipment. No wiring or circuits required. Scale must be 1:100 (1/8" = 1'-0") minimum.
- 2 Show a building's full floor plan (first, second, etc.) with the layout and type of fixtures to be used. No wiring or circuits required. Scale will be 1:100 (1/8" = 1'-0") minimum.
- 3 Lightning Protection Plan: No details required.; Cathodic Protection Plan: Include the location of soil resistivity measurements. No details required.
- 4 Special Systems Plans: Show location of devices (e.g., telephone, IDS, others as required).
- 4.1 Include: Telephone Riser Diagram, Intercommunication Riser Diagram, Fire Alarm Riser Diagram (only when separate Fire Protection Drawings are not included in the design), Other Riser Diagrams for Television, Security, Etc.
- 5 Submit Design Calculations to substantiate design level shown including: Lighting: Interior and Exterior Foot-candles, Load Analysis, Service size, Feeder size, Larger special circuit sizes, Lightning Risk Assessment
- 5.1 Updated Calculations from previous submittal to substantiate design level shown including the following as applicable: Short Circuit, Voltage Drop, Motor Starting/Flicker Analysis, Sag, Tension, and Guying Analysis, Manhole Design Calculations, Cable Pulling Tension Calculations, Cathodic Protection Calculations, CATV Network Loss Calculations
- 6 Submit Outline Specifications
- 6.1 Submit Redlined Specifications, Sequence of Construction (when applicable)
- 7 Drawings and specifications must be substantially complete at this stage and require only minor corrections if any. Documents should include response to previous submittal review comments.

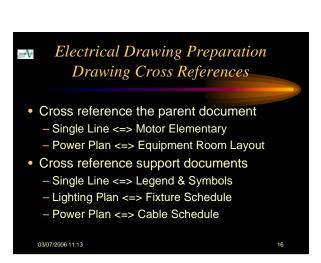
## Electrical Drawing Preparation General Guidelines Electronic File Tips Specific drawings Single Lines Plan Drawings (Incl. Equipment Layout) Panelboard Schedules

## Electrical Drawing Preparation General Guide Lines Use a drawing LIST Use NUMBERING schemes Follow the equipment list NAMES. Cross REFERENCE correctly: Between drawings Between drawings AND specifications

## Electrical Drawing Preparation General Guide Lines DON'T include specific vendor information on equipment RFQ's Include FULL part numbers once vendor selection has been made. Show information only ONCE if possible. Use a CHECKLIST.

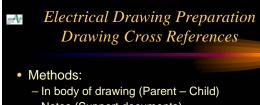
# Electrical Drawing Preparation Electronic File Tips Use LAYERS with a standard layer NAMING convention Practice FONT simplicity. Use standard SYMBOLS. Adhere to CLIENT preferences

# Electrical Drawing Preparation Electronic File Tips Follow line break & connection CONVENTIONS. Use a DATABASE for accuracy of information. Don't OVERCROWD a drawing.



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### Electrical Drawing Preparation Drawing Cross References Cross reference "sibling" documents - Between types (single lines, key power plans) - Between categories of plans (grounding, power, lighting) - Between disciplines (structural, mechanical)



- Notes (Support documents)
- References Table (Sibling documents)
- Match Lines
- Key Plans
- Traceability: two to three cross references

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### Electrical Drawing Preparation Single Lines

Follow the LEGEND sheet.

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- Don't mix ANSI and IEC symbols for the same item type.
- · Indicate FUTURE expansion capability.
- Indicate normal operational mode (OPEN/ CLOSE) for all switching devices

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• Provide a front VIEW.

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### Electrical Drawing Preparation Single Lines (IEEE 141-1993)

### Include the following:

- Utility Supply System
  - Line supply voltage
  - High-voltage protective devices and switches
  - Show the normal operating mode
  - Available SC current
  - Type(s) of relays

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### Electrical Drawing Preparation Single Lines (IEEE 141-1993)

- Transformers
  - Nameplate rating(s) (kVA and kV) and temperature rise
  - High-voltage winding voltage taps and winding connection (delta/wye)
  - Low-voltage winding voltage taps and winding connection (delta/wye)
  - Impedance and kVA base

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### Electrical Drawing Preparation Single Lines (IEEE 141-1993)

- Transformers (cont.)
  - Grounding scheme and ohmic value of neutral resistor(s) if used; show connections
  - Surge arrestors and capacitors (show switching if switched), and connections
  - Metering of utility supply
  - Primary protective devices

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## Electrical Drawing Preparation Single Lines (IEEE 141-1993)

- Feeder cables
  - Number of feeders
  - Cable insulation and type
  - Installation design (conduit, IAC in tray, size of tray, number of cables in tray, etc.)
  - Nominal maximum current rating and basis
  - Cable callouts are consistent

## Electrical Drawing Preparation Single Lines (IEEE 141-1993)

- Switchgear
  - Manufacturer(s), type, model, current rating,
     MVA class
  - Symmetrical interrupting current rating, and asymmetrical momentary/closing-and-latching current rating for main, tie, and feeder devices
  - Phase arrangement, voltage, ampacity, bracing of bus

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### Electrical Drawing Preparation Single Lines (IEEE 141-1993)

Motor loads

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- List individual medium-voltage motors including HP/KW, RPM, and type (induction, synchronous)
- Include powerhouse motors (chillers, compressors, etc.)
- LV motors on MCC's: Categorize load by size(s) at a minimum

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- Indicate all VFD motors

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## Electrical Drawing Preparation Single Lines (IEEE 141-1993)

- Other
  - Dedicated lighting loads
  - Special purpose loads, such as data processing and computer applications
  - -Capacitor banks, including switching
  - Relay coordination and protective-device settings (on separate documentation)

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## A Electrical Drawing Preparation Plan Drawings

- Overall Plan
  - North Arrow
  - Column line numbers
  - Matchlines
  - Reference drawings
  - General arrangement of process equipment
  - Scale: Consistent, include graphic bar

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## Electrical Drawing Preparation Plan Drawings

- Cable tray layouts checked for physical interferences
- Cable trays dimensioned from tray to column lines
- All trays have appropriate bend radii (especially 5 and 15 kV cables)

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### Electrical Drawing Preparation Plan Drawings

- Cable tray fill calculations are verified
- · All cable tray sections are identified
- Each cable tray elevation is shown
- Cable tray and cables routed in air plenums are suitable for use in air plenums.

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## Electrical Drawing Preparation Plan Drawings

- Wall and floor openings
  - Coordinated with architectural and structural drawings
  - Appropriate for the cable tray and conduit designs
- Installation detail maintains the integrity of the wall (fire stops)
- Blast-proof walls have not been penetrated

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### Electrical Drawing Preparation Plan Drawings

- Motors at least 1-½ feet (450mm) away from walls, tanks, columns, etc.
  - Motors may overheat due to poor air flow
  - Maintain adequate maintenance clearance
  - Local disconnecting means (where required)
- Equipment at both ends of each cable on the cable schedule is shown

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### → Electrical Drawing Preparation Equipment Layout

- Electric equipment locations are dimensioned
- Sufficient access and working space is provided about all electrical equipment
- At least two doors are provided, remotely located from each other, in every electric room
- All electrical equipment can be installed and removed without removing structural members, piping, or other pieces of equipment

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## Electrical Drawing Preparation Panelboard Schedules

- Specifications for the panelboard are appropriate
  - Panelboard identification number and location are correct
  - Main bus rating
  - Neutral bus, Ground bus
  - Main breaker, Branch breakers

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## Electrical Drawing Preparation Panelboard Schedules

- Main bus
  - Tin-plated copper, Aluminum
  - Bracing adequate
  - Ampere rating appropriate (125% FLA, Spare capacity)
  - Voltage matches the supply system
  - Supply system kVA rating is adequate
  - Number of conductors, sizes, and overcurrent protection are correct

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## Electrical Drawing Preparation Panelboard Schedules Neutral conductor is appropriately sized Neutral bus material matches main Isolated neutral bus Always preferred Required for a separately derived system Ground bus material matches main and neutral



