Process Industry Practices
Electrical

PIP ELCGL01D
Data Sheets for Electrical Design Criteria
PURPOSE AND USE OF PROCESS INDUSTRY PRACTICES

In an effort to minimize the cost of process industry facilities, this Practice has been prepared from the technical requirements in the existing standards of major industrial users, contractors, or standards organizations. By harmonizing these technical requirements into a single set of Practices, administrative, application, and engineering costs to both the purchaser and the manufacturer should be reduced. While this Practice is expected to incorporate the majority of requirements of most users, individual applications may involve requirements that will be appended to and take precedence over this Practice. Determinations concerning fitness for purpose and particular matters or application of the Practice to particular project or engineering situations should not be made solely on information contained in these materials. The use of trade names from time to time should not be viewed as an expression of preference but rather recognized as normal usage in the trade. Other brands having the same specifications are equally correct and may be substituted for those named. All Practices or guidelines are intended to be consistent with applicable laws and regulations including OSHA requirements. To the extent these Practices or guidelines should conflict with OSHA or other applicable laws or regulations, such laws or regulations must be followed. Consult an appropriate professional before applying or acting on any material contained in or suggested by the Practice.

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PUBLISHING HISTORY

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## SYSTEM DESIGN (3.1):

**SYSTEM STUDIES (3.1.3):**
- LOAD FLOW
- SHORT CIRCUIT
- MOTOR STARTING
- HARMONIC
- TRANSIENT STABILITY
- UNDERGROUND CABLE THERMAL
- GROUND GRID
- LOAD SUMMARY
- DEVICE COORDINATION
- ARC FLASH STUDY:
  - USE IEEE 1584
  - USE NFPA 70E
- OTHER STUDY
- SOFTWARE:

## OTHER APPLICABLE CODES (3.1.2):

**SOFTWARE:**

**UTILITY INTERFACE PARAMETERS (3.1.4):**
- MAX. VOLTAGE:
- MIN. VOLTAGE:
- FREQUENCY:
- MAX. SHORT CIRCUIT MVA 3-PHASE:
- MIN. SHORT CIRCUIT MVA 3-PHASE:
- X/R:
- MAX SHORT CIRCUIT MVA L-G:
- MIN. SHORT CIRCUIT MVA L-G:
- X/R:

## THREE-PHASE SYSTEM VOLTAGE PARAMETERS (3.1.5):

<table>
<thead>
<tr>
<th>BUS VOLTAGE</th>
<th>TRANSFORMER SECONDARY CONNECT.</th>
<th>GROUNDING METHOD</th>
<th>MOTOR HORSEPOWER RANGE</th>
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<td>WYE</td>
<td>SOLID</td>
<td>THROUGH</td>
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<td>120/240</td>
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| NO. | DATE | REVISION DESCRIPTION | BY | APVD. |
**MOTOR-STARTING VOLTAGE DROP (3.1.7):**

ACCELERATION STUDY (3.1.7.2): [ ] REQUIRED [ ] NOT REQUIRED

MOTOR-RATED VOLTAGE:

- ≤ 600 VOLTS (3.1.7.3):
  - [ ] 90%
  - [ ] 600 VOLTS AND < 5000 VOLTS
  - [ ] ≥ 5000 VOLTS

MOTOR-RATED VOLTAGE:

- > 600 VOLTS AND ≤ 5000 VOLTS (3.1.7.6):
  - [ ] 85%
  - [ ] 5000 VOLTS

- > 5000 VOLTS:
  - [ ] 85%

**MOTOR-RATED VOLTAGE: REQUIRED SYSTEM STARTING VOLTAGE AT BUS:**

- < 600 VOLTS (3.1.7.3):
  - [ ] 90%

- > 600 VOLTS AND < 5000 VOLTS (3.1.7.6):
  - [ ] 85%

- > 5000 VOLTS:
  - [ ] 85%

**MOTOR-RATED VOLTAGE: REQUIRED SYSTEM-STARTING VOLTAGE AT MOTOR TERMINALS:**

- > 600 VOLTS AND ≤ 5000 VOLTS (3.1.7.7):
  - [ ] 80%

- > 5000 VOLTS:
  - [ ] 80%

**> 600-VOLT REDUCED VOLTAGE STARTING METHOD (3.1.7.8):**

- [ ] SOFT START
- [ ] CAPTIVE XFMR
- [ ] SOFT START
- [ ] AUTO TRANSFORMER

**DESIGN ALLOWANCE (3.1.8):**

- SPARE CAPACITY
  - FEEDER AMPACITY:
    - [ ] 20%
  - TRANSFORMER CAPACITY:
    - [ ] 20%

- REQUIREMENTS (3.1.8.1):
  - SWITCHGEAR BUS AMPACITY:
    - [ ] 20%
  - MCC BUS AMPACITY:
    - [ ] 20%
  - PANELBOARDS:
    - [ ] 20%

- SPARE DEVICES (3.1.8.2):
  - MY STARTERS:
    - [ ] 2 PER LINE-UP
  - MY SWITCHGEAR CIRCUIT BRKR:
    - [ ] 2 PER LINE-UP
  - MED VOLTAGE FUSED SWITCHES:
    - [ ] 2 PER LINE-UP
  - LOW-VOLTAGE SWITCHGEAR CIRCUIT BREAKERS:
    - [ ] 2 PER LINE-UP
  - LOW-VOLTAGE STARTERS (PER MCC):
    - SIZE 1:
    - SIZE 2:
    - SIZE 3:
    - SIZE 4:
    - SIZE 5:
    - SIZE 6:
  - FEEDER BREAKERS:
  - FUSED SWITCHES:

- EQUIPPED SPACES (3.1.8.3):
  - MY STARTERS (PER LINE-UP):
    - [ ] 2 PER LINE-UP
  - LOW-VOLTAGE SWITCHGEAR CIRCUIT BREAKERS:
    - [ ] 2 PER LINE-UP
  - MY SWITCHGEAR CIRCUIT BREAKERS:
    - [ ] 2 PER LINE-UP
  - UNEQUIPPED SPACES:
    - MY STARTERS (PER LINE-UP):
      - [ ] 2 PER LINE-UP
    - LOW-VOLTAGE SWITCHGEAR CIRCUIT BREAKERS:
      - [ ] 2 PER LINE-UP
    - MV SWITCHGEAR CIRCUIT BREAKERS:
    - MV SWITCHGEAR CIRCUIT BRKR:
      - [ ] 2 PER LINE-UP
    - MED VOLTAGE FUSED SWITCHES:
      - [ ] 2 PER LINE-UP

- FUTURE UNIT SPACES (3.1.8.4):
  - LOW-VOLTAGE STARTERS (PER MCC):
    - SIZE 1:
    - SIZE 2:
    - SIZE 3:
    - SIZE 4:
    - SIZE 5:
    - SIZE 6:
  - FEEDER BREAKERS:
  - FUSED SWITCHES:

**POWER FACTOR (3.1.9):**

- POWER FACTOR CORRECTION REQUIRED: [ ] NO [ ] YES

- MINIMUM SYSTEM POWER FACTOR: [ ] AT UTILITY INTERFACE [ ] OTHER:

- METHOD(S) OF POWER FACTOR CORRECTION:
  - CAPACITORS
  - ON MAJOR POWER BUS
  - ON MCC BUS
  - AT MOTOR
  - FIXED
  - SWITCHED

- OTHER:

**ELECTRICAL EQUIPMENT ROOMS (3.1.11):**

- [ ] 2 OR MORE DOORS
- [ ] 1 DOOR IF ALLOWABLE PER NEC
- [ ] NO Locks
- [ ] LOCKS WITH "NIGHT LATCH" FEATURE

**AREA CLASSIFICATION (3.2):**

- [ ] PER PIP ELEHA01
- [ ] OTHER:
- [ ] DIVISION METHOD
- [ ] ZONE METHOD
### POWER DISTRIBUTION (3.3):

- **SYSTEM CONFIGURATION (3.3.1):**
  - SYSTEM CONFIGURATION ARRANGEMENTS:
    - [ ] SIMPLE RADIAL SYSTEM
    - [ ] EXPANDED RADIAL SYSTEM
    - [ ] PRIMARY SELECTIVE SYSTEM
    - [ ] PRIMARY LOOP SYSTEM
    - [ ] SECONDARY SELECTIVE SYSTEM
    - [ ] ONE LINES ATTACHED
  - DOCUMENT NUMBER:

### UTILITY INTERFACE AND UNIT SUBSTATIONS (3.3.2):

- PRIMARY OR UTILITY INTERFACE SUBSTATION (3.3.2.3):
  - OUTDOOR
    - OPEN BUS
    - NEMA 3R WALK-IN
    - NEMA 3R NON-WALK-IN
  - INDOOR
    - PREFABRICATED POWER CENTER
    - FABRICATED IN PLACE BUILDING
  - PRESSURIZATION REQUIRED:
    - [ ] YES
    - [ ] NO
  - HVAC REQUIRED:
    - [ ] YES
    - [ ] NO
  - INTERNAL TEMPERATURE RANGE:
  - ELEVATION:
    - [ ] AT GRADE
    - [ ] ELEVATED:

- PROCESS AREA SUBSTATIONS:
  - OUTDOOR
    - NEMA 3R WALK-IN
    - NEMA 3R NON-WALK-IN
  - INDOOR
    - PREFABRICATED POWER CENTER
    - FABRICATED IN PLACE BUILDING
  - HVAC REQUIRED:
    - [ ] YES
    - [ ] NO
  - INTERNAL TEMPERATURE RANGE:
  - ELEVATION:
    - [ ] AT GRADE
    - [ ] ELEVATED:

- SINGLE-ENDED SUBSTATION EXPANSION (3.3.2.4):
  - ONE DIRECTION
  - TWO DIRECTIONS
  - NUMBER OF SECTIONS:
  - NONE REQUIRED

- FUTURE CONVERSION OF SINGLE-ENDED TO DOUBLE-ENDED SUBSTATION (3.3.2.5):
  - REQUIRED
  - NOT REQUIRED

- DOUBLE-ENDED SUBSTATION EXPANSION (3.3.2.6):
  - ONE DIRECTION
  - TWO DIRECTIONS
  - NUMBER OF SECTIONS:
  - NONE REQUIRED

### TRANSFORMERS (3.3.3):

- POWER TRANSFORMERS (3.3.3.1):
  - LIQUID FILLED:
    - INDOOR
    - OUTDOOR
  - DRY TYPE:
    - INDOOR
    - OUTDOOR
  - CAST COIL:
    - INDOOR
    - OUTDOOR
  - TRANSFORMER SIZE BASED ON (3.3.3.2):
    - 55°C RISE
    - 65°C RISE
    - OTHER:
  - LIQUID-FILLED TRANSFORMERS (3.3.3.4):
    - LIQUID TYPE:
      - MINERAL-BASED DIELECTRIC OIL
      - OTHER:
  - POWER TRANSFORMER LOCATION (3.3.3.5):
    - OUTDOOR
    - OTHER:
  - OUTDOOR TRANSFORMER SPEC:
    - PIP ELSTRO1
    - OTHER:
  - INDOOR TRANSFORMER SPEC:
    - OTHER:
  - CONTROL POWER AND LIGHTING TRANSFORMERS (3.3.3.6):
    - 80°C / 220°C
    - OTHER:
  - OUTDOOR CONTROL POWER AND LIGHTING TRANSFORMERS (3.3.3.7):
    - EPOXY-ENCAPSULATED
    - OTHER:
  - TRANSFORMER FIRE PROTECTION (3.3.3.8):
    - REQ'D AS PER IEEE 979
    - NOT REQUIRED
  - TRANSFORMER SPILL CONTAINMENT (3.3.3.9):
    - REQ'D AS PER IEEE 980
    - NOT REQUIRED
  - TRANSFORMER DIFFERENTIAL RELAY PROTECTION REQUIRED (3.3.3.10):
    - REQUIRED ABOVE __________ MVA

### METERING, MONITORING, RELAYING AND SCADA (3.3.4):

- METERING (3.3.4.1):
  - VOLTMETER
  - AMMETER
  - POWER FACTOR METER
  - WATT-HOUR METER
  - KW DEMAND METER
  - MICROPROCESSOR-BASED MULTIFUNCTION METERING
  - ANALOG METERS WITH SELECTOR SWITCHES
  - OTHER:
  - INDIVIDUAL PHASE ANALOG METERS

- COMMUNICATIONS (3.3.4.2):
  - TYPE:
    - NONE
    - RS232
    - RS422
    - RS485
    - OTHER:
  - DEVICES MONITORED:
    - CIRCUIT BREAKER PROTECTIVE RELAYS
    - CIRCUIT BREAKER TRIP UNITS
    - MULTIFUNCTION METERING DEVICES
    - OTHER:

- RELAY SELECTION (3.3.4.3):
  - MICROPROCESSOR-BASED RELAY(S)
  - SOLID STATE RELAYS
  - ELECTRO-MECHANICAL RELAYS

- SCADA:
  - SCADA REQUIREMENTS:
## Electrical Design Criteria

### Switchgear (3.3.5):
- **Low-Voltage Switchgear (3.3.5.1):**
  - Metal-Enclosed Drawout (PIP ELSSG01)
  - Other:
- **Medium-Voltage Switchgear (3.3.5.2):**
  - Metal-Clad (PIP ELSSG02)
  - Metal-Enclosed (PIP ELSSG03)
  - Metal-Enclosed (PIP ELSSG03) for Transformer Main Only
  - SF6 Breaker Elements
- **Control Voltage (3.3.5.3):**
  - LV Metal-Enclosed:
    - VDC Trips
    - AC Close
  - MV Metal-Clad:
    - VDC Trips
    - AC Close
  - MV Metal-Enclosed:
    - VDC Trips
    - AC Close

### Switchgear / Substation Batteries (3.3.6):
- Flooded-Cell Lead-Acid Per PIP ELSSAP11
- Other:

### Switchgear Rooms (3.3.7):
- Power Center Per PIP ELSSG11
- NEMA 3R Walk-In Per PIP ELSSG12
- Built-In-Place Metal Walls
- Built-In-Place Block Walls
- Other:

### Bus Duct (3.3.8):
- Bus Duct Per PIP ELSSBD01
- Other:

### Automatic Transfer Switch (3.3.9):
- ATS Per PIP ELSSAP20
- Other:

### Motors (3.4):
- Use PIP ELSMT01 and/or ELEM01
- Other:
- Installed Per PIP Motor Details
- Other:

### Motor Control (3.5):
- **480-Volt Motor Control (3.5.2):**
  - MCC Type (3.5.2.1):
    - Fused Disconnect Switch
    - Motor Circuit Protector
    - Molded-Case Circuit Breaker
    - Other:
  - MCC Indoor Enclosure Type (3.5.2.2):
    - NEMA 1 Gasketed
    - NEMA 12
    - NEMA 4X
    - Other:
  - MCC Outdoor Enclosure Type (3.5.2.4):
    - NEMA 3R
    - Other:
  - MCC Enclosure Arrangement (3.5.2.5):
    - Front Only
    - Back-To-Back
    - Other:
  - Indoor MCC Floor Space (3.5.2.6):
    - 20% Growth
    - Other:
  - Outdoor Starters (Non-Classified) (3.5.2.8):
    - NEMA 4X
    - NEMA 3R
    - Other:
  - Explosion-Proof Starter Enclosures (3.5.2.9):
    - Bolted
    - Threaded
    - Other:
  - Minimum Starter Size (3.5.2.11):
    - Size 1
    - Other:
  - Overload Protection (3.5.2.12):
    - Electronic
    - Eutectic Alloy
    - Bi-Metallic
    - Ambient Comp
    - Non-Ambient Comp
    - Class 10
    - Class 20
    - Class 30
    - Other:

### Low-Voltage Adjustable Speed Drives (3.5.3):
- Per PIP ELSSMC20
- Other:

### Medium-Voltage Motor Control (3.5.4):
- Circuit Breaker Used as Motor Starter (3.5.4.1):
  - For 2.3-KV Motors, At: HP and Above
  - For 4-KV Motors, At: HP and Above
- Contactor (3.5.4.2):
  - Drawout (Roll-Out)
  - Stationary (Bolt-In)
  - Per PIP ELSSMC11
- Type:
  - Differential Protection (3.5.4.6):
    - ≥ 1500 HP
    - ≥ 1500 HP
    - Other:
GROUNDING (3.6):

GROUND GRID CONDUCTOR (3.6.1.2):  □ BARE  □ COVERED

SYSTEM GROUNDING (3.6.2.2) (ALSO SEE 3.1.5):

480-VOLT (3.6.2.3):

- WYE PER PIP ELSGS01
- DELTA PER PIP ELSGS01
- HIGH RESISTANCE PER ELSGS01
- LOW RESISTANCE
- SOLIDLY GROUNDED

MEDIUM-VOLTAGE MOTOR CONTROL BUS (3.6.2.5):

- HIGH RESISTANCE - PER PIP ELSGS07
- LOW RES USING TRANS NEUT RES AS PER PIP ELSGS11

DISTRIBUTION SYSTEM GROUNDING METHOD (3.6.2.6):

- LOW RESISTANCE XFMR WYE NEUTRAL RESISTOR PER PIP ELSGS11
- HIGH RESISTANCE GROUNDING PER PIP ELSGS07
- ZIG-ZAG TRANSFORMER

EQUIPMENT GROUNDING (3.6.3):

EQUIPMENT GROUNDING (3.6.3.2):

PRIMARY:

- EQUIPMENT GROUNDING CONDUCTOR RUN WITH POWER WIRING
- UNINSULATED COPPER CONDUCTOR
- USE RACEWAYS AND CABLE TRAY
- ANY METHOD PERMITTED BY NEC

MEDIUM-VOLTAGE MOTOR SUPPLEMENTAL GROUNDING (3.6.3.5):

- ADJACENT BUILDING OR STRUCTURE STEEL
- REINFORCING MESH OR BARS IN THE CONCRETE FOUNDATION
- BARE COPPER CONDUCTOR
- UNINSULATED TIN-COATED COPPER CONDUCTOR

460-VOLT MOTOR SUPPLEMENTAL GROUNDING (3.6.3.6):

- ADJACENT BUILDING OR STRUCTURE STEEL
- REINFORCING MESH OR BARS IN THE CONCRETE FOUNDATION
- BARE COPPER CONDUCTOR
- UNINSULATED TIN-COATED COPPER CONDUCTOR

PLANT GROUNDING (3.6.4):

PLANT GROUNDING SYSTEM (3.6.4.1):

- EFFECTIVELY GROUNDED METAL STRUCTURE
- DRIVEN ELECTRODE SYSTEM
- CONCRETE-ENCASED ELECTRODE SYSTEM
- GROUND LOOP
- IMPEDANCE TO EARTH 5 OHM
- OTHER VALUE

GROUND LOOP CONDUCTOR (3.6.4.5):

- NO. 2/0 AWG
- BARE
- INSULATED XHHW THW

GROUND ELECTRODES:

- DRIVEN RODS
- REBAR
- BURIED PLATE

CONNECTIONS TO GROUND LOOP:

- COMPRESSION
- EXOTHERMIC

GROUND CONDUCTOR MINIMUM DEPTH (BELOW SURFACE):

- IN

BARE UNDERGROUND CABLES (3.6.4.7):

- TIN-COATED COPPER CABLE
**LIGHTING (3.7):**
- ILLUMINATION LEVEL (3.7.1):
  - **PER API RP540**
  - **OTHER:**

**LUMINAIRES AND CIRCUITS:**

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<th>AREAS (3.7.2)</th>
<th>LUMINAIRE TYPE</th>
<th>VOLTAGE RATING</th>
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<td>208</td>
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<td></td>
<td>OTHER</td>
<td>480</td>
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<td>SHOPS, WAREHOUSE, ETC.:</td>
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<td>METAL HALIDE</td>
<td>208</td>
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**PHOTOELECTRIC CELL CONTROL (3.7.3):**
- DEDICATED PHOTOELECTRIC CELLS
- PHOTOELECTRIC CELL CONTROLLED PANELS

**EMERGENCY (3.7.4):**
- LED
- FLUORESCENT
- HIGH-PRESSURE SODIUM
- INSTANT RESTRIKE
- BATTERY PACK
- TIME DELAY OFF REQUIRED

**BATT POWERED LIGHTING LOCATIONS (3.7.4.4):**
- **PER PIP ELCGL01, SECT. 3.7.4.4**
- **PER 3.7.4.4 AND OTHER:**

**POWER RECEPTACLES AND CONVENIENCE OUTLETS (3.8):**

**RECEPTACLES (3.8.1):**
- **NO RECEPTACLES ALLOWED IN DIV. 1 AREAS**

**GFCI PROTECTED RECEPTACLE LOCATIONS (3.8.1.4):**
- **PER NEC**
- **AND-**
- **OTHER LOCATIONS:**

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<th>VOLTAGE</th>
<th>PHASE</th>
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**WIRING METHODS (3.9):**

**CABLE TRAY AND CONDUIT SEPARATION REQUIREMENTS**

**CABLE TRAY (3.9.2):**
- **ALUMINUM**
- **HOT DIPPED GALVANIZED STEEL**
- **STAINLESS STEEL**
- **FIBERGLASS (POLYESTER)**
- **FIBERGLASS (VINYL-ESTER)**

**SPARE SPACE IN TRAY:**
- **20%**
- **40%**

<table>
<thead>
<tr>
<th>CABLE TRAY CLASS</th>
<th>12C</th>
<th>16C</th>
<th>20C</th>
<th>OTHER</th>
</tr>
</thead>
<tbody>
<tr>
<td>CABLE TRAY TYPE</td>
<td>LADDER</td>
<td>TROUGH</td>
<td>20C</td>
<td>OTHER</td>
</tr>
<tr>
<td>CABLE TRAY RUNG SPACING</td>
<td>8&quot;</td>
<td>9&quot;</td>
<td>12&quot;</td>
<td>OTHER</td>
</tr>
<tr>
<td>CABLE TRAY COVERS (3.9.2.12)</td>
<td>REQUIRED</td>
<td>NOT REQUIRED</td>
<td>COMMENTS</td>
<td></td>
</tr>
<tr>
<td>SEPARATE TRAYS FOR EACH VOLTAGE CLASS (3.9.2.13)</td>
<td>OTHER</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### ABOVEGROUND CONDUIT AND FITTINGS (3.9.3):

<table>
<thead>
<tr>
<th>Acceptable Types of Conduit (3.9.3.1):</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rigid Galvanized Steel (RGS)</td>
</tr>
<tr>
<td>Rigid Aluminum</td>
</tr>
<tr>
<td>EMT (see PIP ELCGL01, Sect. 3.9.3.2)</td>
</tr>
<tr>
<td>Other</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Acceptable Conduit Sizes (3.9.3.1):</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/2&quot;</td>
</tr>
<tr>
<td>3/4&quot;</td>
</tr>
<tr>
<td>1&quot;</td>
</tr>
<tr>
<td>1-1/4&quot;</td>
</tr>
<tr>
<td>1-1/2&quot;</td>
</tr>
<tr>
<td>2&quot;</td>
</tr>
<tr>
<td>2-1/2&quot;</td>
</tr>
<tr>
<td>3&quot;</td>
</tr>
<tr>
<td>4&quot;</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Aboveground - Corrosive Areas (3.9.3.10):</th>
</tr>
</thead>
<tbody>
<tr>
<td>RGS</td>
</tr>
<tr>
<td>Rigid Aluminum</td>
</tr>
<tr>
<td>PVC- Coated Galv Steel</td>
</tr>
<tr>
<td>PVC</td>
</tr>
<tr>
<td>Fiberglass</td>
</tr>
<tr>
<td>Other</td>
</tr>
</tbody>
</table>

### UNDERGROUND CONDUIT AND DUCT BANKS (3.9.4):

<table>
<thead>
<tr>
<th>Duct Bank (3.9.4.1):</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rigid Galvanized Steel Conduit</td>
</tr>
<tr>
<td>Schedule 40 PVC Conduit</td>
</tr>
<tr>
<td>PVC- Coated Galv Steel</td>
</tr>
<tr>
<td>Other</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Acceptable Underground Conduit Sizes (3.9.4.3):</th>
</tr>
</thead>
<tbody>
<tr>
<td>1&quot;</td>
</tr>
<tr>
<td>1-1/4&quot;</td>
</tr>
<tr>
<td>1-1/2&quot;</td>
</tr>
<tr>
<td>2&quot;</td>
</tr>
<tr>
<td>2-1/2&quot;</td>
</tr>
<tr>
<td>3&quot;</td>
</tr>
<tr>
<td>4&quot;</td>
</tr>
<tr>
<td>5&quot;</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Minimum Depth (Below Surface) (3.9.4.6):</th>
</tr>
</thead>
<tbody>
<tr>
<td>18&quot;</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Spare Conduits (3.9.4.9):</th>
</tr>
</thead>
<tbody>
<tr>
<td>20%</td>
</tr>
<tr>
<td>Other</td>
</tr>
</tbody>
</table>

### DIRECT BURIAL (3.9.5):

<table>
<thead>
<tr>
<th>Not Allowed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Armored Cable</td>
</tr>
<tr>
<td>Non-Armored Cable</td>
</tr>
</tbody>
</table>

### OVERHEAD POLE LINES (3.9.6):

<table>
<thead>
<tr>
<th>Not Allowed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open Wire</td>
</tr>
<tr>
<td>Messenger</td>
</tr>
</tbody>
</table>

### MESSENGER CABLE (3.9.7):

### POWER AND CONTROL WIRING (3.10):

### CABLE CONSTRUCTION (3.10.3):

<table>
<thead>
<tr>
<th>Low-Voltage Cable:</th>
</tr>
</thead>
<tbody>
<tr>
<td>TC:</td>
</tr>
<tr>
<td>THWN/PVC</td>
</tr>
<tr>
<td>THWN/CPE</td>
</tr>
<tr>
<td>THWN/CSPE</td>
</tr>
<tr>
<td>Other:</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Ground Wires:</th>
</tr>
</thead>
<tbody>
<tr>
<td>REQUIRED</td>
</tr>
<tr>
<td>NOT REQUIRED</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Composite Cable:</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACCEPTABLE</td>
</tr>
<tr>
<td>NOT ACCEPTABLE</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Max Conductor:</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO. 4</td>
</tr>
<tr>
<td>NO. 2</td>
</tr>
<tr>
<td>OTHER:</td>
</tr>
</tbody>
</table>

### SHIELDED:

<table>
<thead>
<tr>
<th>ASD Motor Feeder Cable:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MC Required</td>
</tr>
<tr>
<td>MC Not Required</td>
</tr>
</tbody>
</table>

### MEDIUM-VOLTAGE POWER CABLE:

<table>
<thead>
<tr>
<th>Copper Conductors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aluminum Conductors</td>
</tr>
</tbody>
</table>

| XLPE/PVC                |
| XLPE/CPE                |
| XLPE/CSPE               |
| Other:                  |

| EPR/PVC                 |
| EPR/CPE                 |
| EPR/CSPE                |

<table>
<thead>
<tr>
<th>Shielded</th>
</tr>
</thead>
<tbody>
<tr>
<td>90 Deg C</td>
</tr>
<tr>
<td>100% Insulation</td>
</tr>
</tbody>
</table>

| 105 Deg C               |
| 133% Insulation         |

| Armered                 |
| Galvanized Steel        |
| Aluminum                |

### MULTICONDUCTOR MIN. SIZE (3.10.5):

### COMPOSITE POWER/CONTROL CABLE (3.10.6):

<table>
<thead>
<tr>
<th>Allowed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not Allowed</td>
</tr>
</tbody>
</table>

### POWER CABLE TERMINATION METHODS (3.10.8):

<table>
<thead>
<tr>
<th>600-V Cable:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not Specified</td>
</tr>
<tr>
<td>TAPE</td>
</tr>
<tr>
<td>REUSABLE BOOT</td>
</tr>
<tr>
<td>Other:</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>5-KV Cable:</th>
</tr>
</thead>
<tbody>
<tr>
<td>TAPE</td>
</tr>
<tr>
<td>COLD SHRINK</td>
</tr>
<tr>
<td>HEAT SHRINK</td>
</tr>
<tr>
<td>Other:</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>15-KV Cable:</th>
</tr>
</thead>
<tbody>
<tr>
<td>TAPE</td>
</tr>
<tr>
<td>COLD SHRINK</td>
</tr>
<tr>
<td>HEAT SHRINK</td>
</tr>
<tr>
<td>Other:</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>25-KV Cable:</th>
</tr>
</thead>
<tbody>
<tr>
<td>TAPE</td>
</tr>
<tr>
<td>COLD SHRINK</td>
</tr>
<tr>
<td>HEAT SHRINK</td>
</tr>
<tr>
<td>Other:</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>35-KV Cable:</th>
</tr>
</thead>
<tbody>
<tr>
<td>TAPE</td>
</tr>
<tr>
<td>COLD SHRINK</td>
</tr>
<tr>
<td>HEAT SHRINK</td>
</tr>
<tr>
<td>Other:</td>
</tr>
</tbody>
</table>
### FREEZE PROTECTION AND PROCESS HEAT-TRACING SYSTEMS (3.12):

**PROCESS HEATERS:**
- ≤ 1.8 KW: 120 V 1-PHASE
- > 1.8 KW: 480 V 1-PHASE

### ELECTRIC HEAT TRACING (3.12.2):

<table>
<thead>
<tr>
<th>Types Allowed</th>
<th>Voltage</th>
<th>Sheath Required</th>
<th>Outer Jacket Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>SELF-LIMITING CABLE</td>
<td>120 V</td>
<td>TINNED COPPER</td>
<td>FLUOROPOLYMER</td>
</tr>
<tr>
<td></td>
<td>208 V</td>
<td>STAINLESS STEEL</td>
<td>THERMOPLASTIC RUBBER</td>
</tr>
<tr>
<td>IN ACCORDANCE WITH ELSHT01</td>
<td>240 V</td>
<td>OTHER:</td>
<td>NONE</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>OTHER:</td>
</tr>
<tr>
<td>CONSTANT WATTAGE CABLE</td>
<td>120 V</td>
<td>TINNED COPPER</td>
<td>FLUOROPOLYMER</td>
</tr>
<tr>
<td></td>
<td>208 V</td>
<td>STAINLESS STEEL</td>
<td>THERMOPLASTIC RUBBER</td>
</tr>
<tr>
<td></td>
<td>240 V</td>
<td>OTHER:</td>
<td>NONE</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>OTHER:</td>
</tr>
<tr>
<td>MINERAL INSULATED CABLE</td>
<td>120 V</td>
<td>COPPER</td>
<td></td>
</tr>
<tr>
<td></td>
<td>208 V</td>
<td>STAINLESS STEEL</td>
<td></td>
</tr>
<tr>
<td></td>
<td>240 V</td>
<td>INCONEL</td>
<td></td>
</tr>
<tr>
<td></td>
<td>277 V</td>
<td>OTHER:</td>
<td></td>
</tr>
<tr>
<td>IMPEDANCE HEATING</td>
<td>480 V</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### CONTROL TYPES ALLOWED:
- MECHANICAL THERMOSTATS
- ELECTRONIC CONTROLLERS
- MICROPROCESSOR BASED SYSTEM
- UPPER TEMPERATURE LIMIT REQUIRED

### CONTINUITY MONITORING:
- NONE
- THIRD-WIRE MONITOR CIRCUIT
- CURRENT FLOW DETECTION
- END LIGHTS
- CURRENT INDICATION
- OTHER: _______________________

### GROUND FAULT PROTECTION:
- EPD BREAKER
- INTEGRAL IN CONTROLLER
- OTHER: _______________________

### UNINTERRUPTIBLE / STANDBY POWER (3.14):

### CRITICAL POWER SUPPLY REQUIREMENTS (3.14.1):

### UPS REQUIRED (3.14.2):
- NO
- YES
- PWM
- FERRORESONANT
- OTHER: _______________________

BATTERY-OPERATING TIME @ 25°C (77°F): ____________________ MINUTES

BATTERY TYPE:
- FLOODED CELL PER PIP ELSP15
- OTHER: _______________________

### GENERATOR REQUIRED (3.14.3):
- YES
- NO

ALTERNATE UTILITY/PLANT FEEDER:
- YES
- NO

### SKID-MOUNTED OR PACKAGED EQUIPMENT (3.15):
- PER PIP ELSPS01
- OTHER: _______________________

OTHER REQUIREMENTS:

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