PIP ELSGS11
Design and Fabrication of Low Resistance Neutral Grounding Resistor for 2.4 to 15 kV Systems
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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# PIP ELSGS11

## Design and Fabrication of Low Resistance Neutral Grounding Resistor for 2.4 to 15 kV Systems

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**Data Form**

*PIP ELSGS11D* - Data Sheet for Low Resistance Neutral Grounding Resistor for 2.4 to 15 kV Systems
1. **Scope**

This Practice describes the requirements for a grounding resistor assembly to be used in a 2.4 to 15 kV low resistance grounding system with a neutral available.

2. **References**

Applicable parts of the following industry codes and standards shall be considered an integral part of this Practice. The edition in effect on the date of contract award shall be used, except as otherwise noted. Short titles will be used herein where appropriate.

**Industry Codes and Standards**

- American Society of Civil Engineers
- Institute of Electrical and Electronic Engineers (IEEE)
  - IEEE C57.32 – *IEEE Standard Requirements, Terminology, and Test Procedure for Neutral Grounding Devices*

3. **Definitions**

- **owner**: Party who owns the facility wherein the low-resistance grounding system will be used
- **purchaser**: Party who awards the contract to the supplier. The purchaser may be the owner or the owner’s authorized agent.
- **supplier**: Party responsible for furnishing the low-resistance grounding system

4. **Requirements**

4.1 **Service Conditions**

4.1.1 Equipment shall be designed to perform satisfactorily with site conditions in accordance with the purchaser’s PIP ELSGS11D Data Sheet.

4.1.2 Unless otherwise specified on the purchaser’s PIP ELSGS11D Data Sheet, equipment shall be designed for an outdoor, non-classified location.

4.1.3 When specified on the purchaser’s data sheet, PIP ELSGS11D, electrical components and their support to the site’s structure shall meet the seismic design requirements of ASCE/SEI 7 for nonstructural components. Unless specified otherwise on the purchaser’s PIP ELSGS11D Data Sheet the following shall apply when seismic design is required:
   
   a. Risk Category IV
   b. Component Importance Factor (IP) of 1.5
   c. Site Class D

4.2 **Resistor**

4.2.1 Unless otherwise specified on the purchaser’s PIP ELSGS11D Data Sheet, resistor units shall be stainless steel, edgewound around a ceramic core, and individually supported at each end by either porcelain insulators.
4.2.2 Connections between elements shall be welded.

4.2.3 Resistors shall be rated for current and voltage in accordance with the purchaser’s *PIP ELSGS11D* Data Sheet.

4.2.4 When specified on the *PIP ELSGS11D* Data Sheet for the resistor to be installed in a classified area, the neutral grounding system temperature rise shall not exceed 80% of the auto-ignition temperature of the flammable liquids, or gases, associated with the classified area. The auto-ignition temperatures are listed on the data sheet.

### 4.3 Current Transformers

4.3.1 Unless otherwise specified on the purchaser’s *PIP ELSGS11D* Data Sheet, each assembly shall include an outdoor type, relaying accuracy current transformer between the source and the resistor.

4.3.2 Unless otherwise specified on the purchaser’s *PIP ELSGS11D* Data Sheet, the current transformer shall have a primary rating of half the resistor current rating and a secondary rating of 5 amperes.

4.3.3 Current transformer secondary wiring shall be wired to a shorting terminal block designed for the specific ring tongue type lugs.

4.3.4 The terminal block shall be installed in a separate NEMA 4X junction box mounted on the exterior of the enclosure if installed outdoors.

4.3.5 Current transformer secondary wiring shall be no smaller than No. 10 AWG.

### 4.4 Assembly

4.4.1 Unless otherwise specified on the purchaser’s *PIP ELSGS11D* Data Sheet, the resistor and neutral current transformer shall be mounted inside a ventilated metal safety enclosure.

4.4.2 The enclosure shall be designed to prevent the entry of small animals and birds.

4.4.3 Unless otherwise specified on the purchaser’s *PIP ELSGS11D* Data Sheet, the enclosure frame shall be designed for top of transformer mounting.

4.4.4 Unless otherwise specified on the purchaser’s *PIP ELSGS11D* Data Sheet, the resistor support frame, enclosure frame, and enclosure screen shall be hot dipped galvanized steel.

4.4.5 All bolts, nuts, and other hardware items shall be 316 stainless steel.

4.4.6 Provisions for lifting the entire assembly shall be included.

4.4.7 Cable lugs shall be provided in accordance with the purchaser’s *PIP ELSGS11D* Data Sheet.

4.4.8 Unless otherwise specified on purchaser’s *PIP ELSGS11D* Data Sheet, the cable between the source and the resistor shall be provided by the purchaser.

4.4.9 Adequate space shall be provided inside the enclosure for bending, training, and termination of the cable.

4.4.10 Cable connection points shall be in accordance with the purchaser’s *PIP ELSGS11D* Data Sheet.

4.4.11 The resistor enclosure shall be equipped with grounding/bonding pads placed at diagonally opposite corners.
4.5 Testing

4.5.1 Routine tests in accordance with IEEE C57.32 shall be performed.

4.5.2 Certified copies of the test results shall be provided.

4.6 Documentation

4.6.1 Documentation of the type and quantity shown in Table 1 and the purchaser’s PIP ELSGS11D Data Sheet shall be provided.

4.6.2 Drawings shall have a space on the right-hand bottom corner for the purchaser’s title block.

Table 1: Documentation Requirements

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>General layout of equipment showing all dimensions, weights, and required clearances</td>
</tr>
<tr>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td>Current transformer data, including type, class, accuracy, and saturation curves</td>
</tr>
<tr>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td>Detailed plans and elevation drawings showing location of all components</td>
</tr>
<tr>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td>Certified type test reports</td>
</tr>
<tr>
<td>g</td>
<td>d</td>
<td>d</td>
<td></td>
<td>Detailed (d) or general (g) bill of material including name of the manufacturer and catalog number of all components</td>
</tr>
<tr>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td>Recommended spare parts list</td>
</tr>
</tbody>
</table>

Notes:

- A. These documents shall be provided with proposal.
- B. These documents shall be provided for purchaser’s review and authorization to proceed before fabrication.
- C. These documents shall be provided as part of the final certified document submittal.
  - (1) Include one set of installation, operation, and maintenance manuals with the equipment when shipped.
  - (2) Include one complete set of drawings with the equipment when shipped.
- D. Certified as-built shall be furnished within 2 weeks following shipment. (Certified Documents shall match the equipment shipped)

4.7 Conflict Resolution

Any conflicts between the following documents shall be identified to the purchaser in writing for resolution. If resolving conflicts, the following order of precedence shall apply:

a. Purchase order
b. One-line diagram(s)
c. PIP ELSGS11D Data Sheet
d. This Practice, PIP ELSGS11
e. Referenced standards
ASSOC. PIP ELSGS11 DATA SHEET ELSGS11D

LOW RESISTANCE NEUTRAL GROUNDING RESISTOR
FOR 2.4 kV TO 15 kV SYSTEMS

MAY 2019

DOCUMENT NO. ALTERNATE DOCUMENT NO.

ISSUED FOR: ☐ PROPOSAL ☐ PURCHASE ☐ AS BUILT

FACILITY NAME/LOCATION:

ITEM NAME: PURCHASER/LOCATION: 

ITEM TAG NO.: JOB NO: 

SERVICE: PURCHASER ORDER NO.: 

UNIT: SUPPLIER/LOCATION: 

DWG. NO.: SUPPLIER ORDER/SERIAL NOS.: 

DATA PROVIDED BY: ● PURCHASER ■ SUPPLIER ▲ SUPPLIER IF NOT BY PURCHASER

REFER TO PIP ELSGS11 FOR GENERAL REQUIREMENTS

APPLICABLE STATE AND LOCAL CODES:

● SERVICE CONDITIONS (4.1):

| AMBIENT TEMPERATURE: MAX: ______ °C MIN: ______ °C HUMIDITY: ______ % |
| ALTITUDE: M OTHER: |
| GROUNDING RESISTOR LOCATION: X OUTDOOR □ INDOOR |
| AREA CLASSIFICATION: X NON-CLASSIFIED □ CLASSIFIED |
| CLASS: ______ DIVISION: ______ GROUP: ______ AUTO IGNITION TEMP: ______ °C |
| SEISMIC DESIGN: □ REQUIRED X NOT REQUIRED |
| SITE LOCATION: ______ LATITUDE ______ LONGITUDE |
| OTHER: |
| RISK CATEGORY: X IV □ III □ OTHER: |
| COMPONENT IMPORTANCE FACTOR (Iₚ): X 1.5 □ OTHER: |
| SITE CLASS: X D □ OTHER: |
| SEISMIC CERTIFICATE: □ REQUIRED X NOT REQUIRED |
| □ OTHER: |
| ☐ EXPOSED TO A MOIST/MODERATE CORROSIVE ENVIRONMENT |
| ☐ SITE ENVIRONMENTAL DATA SHEET ATTACHED |
| ☐ OTHER: |

● ELECTRICAL SYSTEM PARAMETERS:

| VOLTS: ______ kV PHASE: 3 Hertz: 60 □ THREE WIRE ☐ FOUR WIRE |
| ☐ WYE ☐ DELTA □ OTHER: |
| AVAILABLE FAULT CURRENT: ______ kA ASYMMETRICAL X/R RATIO: ______ |
| ☐ ONE LINE DIAGRAM |
| ☐ OTHER: |

| NO. DATE REVISION DESCRIPTION BY APPROVED |
| ☐ ☐ ☐ ☐ |
| ☐ ☐ ☐ ☐ |
| ☐ ☐ ☐ ☐ |
| ☐ ☐ ☐ ☐ |
### RESISTOR (4.2):

- **Resistor Element (4.2.1):**
  - [X] Edgewound
  - [ ] Other:
  - [X] Stainless Steel
  - [ ] Other:
  - [X] Ceramic Core
  - [ ] Other:
  - [ ] Other:

- **Resistor Frame Insulators (4.2.1):**
  - [ ] Porcelain
  - [ ] Cycloaliphatic Epoxy
  - [ ] Other:
  - [ ] Other:

- **Resistor Rating (4.2.3):**
  - Volts (L-N): [ ] kV
  - Hertz: [ ] 60
  - [ ] Amps for [ ] seconds
  - [ ] Amps for ten (10) seconds rating at 760°C rise
  - [ ] Other:
  - [ ] Other:

### CURRENT TRANSFORMER (4.3):

- **Current Transformer (4.3.1):**
  - [X] Required
  - [ ] Not Required
  - [X] Outdoor
  - [ ] Indoor
  - [X] Class 10
  - [ ] Other:

- **CT Ratio (4.3.2):**
  - [X] Per section 4.3.2
  - [ ] Ratio [ ] Accuracy Class [ ]
  - [ ] Other:
  - [ ] Other:

### ASSEMBLY (4.4):

- **Mounting (4.4.1 & 4.4.3):**
  - [X] Inside a ventilated metal enclosure
  - [ ] Other:
  - [X] Top of transformer
  - [ ] Wall
  - [ ] Grade
  - [ ] Other:
  - [ ] Other:

- **Enclosure Material (4.4.4):**
  - [X] Hot dipped galvanized steel
  - [ ] Aluminum
  - [ ] Stainless Steel
  - [ ] NEMA 3R (IP23)
  - [ ] MFG. Std.,
  - [ ] Other:

- **Frame Material (4.4.4):**
  - [X] Hot dipped galvanized steel
  - [ ] Aluminum
  - [ ] Stainless Steel
  - [ ] MFG. Std.,
  - [ ] Other:

- **Screen Material (4.4.4):**
  - [X] Hot dipped galvanized steel
  - [ ] Aluminum
  - [ ] Stainless Steel
  - [ ] MFG. Std.,
  - [ ] Other:

- **Cable Lugs (4.4.7):**
  - Quantity:
  - Size:
  - Type:
  - [ ] Other:

- **Neutral Grounding Conductor (4.4.8):**
  - [X] Furnished by others
  - [ ] Furnished by supplier

- **Connection Details (4.4.10):**
  - [ ] Top
  - [ ] Bottom
  - [ ] Side
  - [ ] MFG. Std.
  - [ ] Other:
  - [ ] Other:
ASSOC. PIP
ELSGS11

DATA SHEET

ELSGS11D

LOW RESISTANCE NEUTRAL GROUNDING RESISTOR
FOR 2.4 kV TO 15 kV SYSTEMS

MAY 2019

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ITEM TAG NO.:  JOB NO.:  REV. DATE:

DATA PROVIDED BY:  ● PURCHASER  ■ SUPPLIER  ● SUPPLIER IF NOT BY PURCHASER

● INSPECTION & TESTING (4.5):

X PER IEEE C57.32  □ MANUFACTURES STD.
□ OTHER:
□ WITNESSED  □ NOT WITNESSED
□ CERTIFIED TEST REPORTS:  X REQUIRED  □ NOT REQUIRED

● SHIPPING:

□ SUPPLIERS STD PREPARATION  □ OTHER:
PRE-SHIPMENT SHOP INSPECTION:  □ REQUIRED  □ NOT REQUIRED

● DOCUMENTATION (4.6):

ELECTRONIC DOCUMENT FORMAT:  X DWG  X PDF  □ OTHER:
SUPPLIER TO PROVIDE:  1 REPRODUCIBLE PLUS

COPIES OF ALL DOCUMENTS PLUS

COPIES OF OPERATING MANUALS

● OTHER REQUIREMENTS:


