



PROCESS
INDUSTRY
PRACTICES

April 2018

Electrical

PIP ELEGL01 Overall Electrical One-Line Diagram Guideline

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.

This Practice is subject to revision at any time.

© Process Industry Practices (PIP), Construction Industry Institute, The University of Texas at Austin, 3925 West Braker Lane (R4500), Austin, Texas 78759. PIP Member Companies and Subscribers may copy this Practice for their internal use. Changes or modifications of any kind are not permitted within any PIP Practice without the express written authorization of PIP. Authorized Users may attach addenda or overlays to clearly indicate modifications or exceptions to specific sections of PIP Practices. Authorized Users may provide their clients, suppliers and contractors with copies of the Practice solely for Authorized Users' purposes. These purposes include but are not limited to the procurement process (e.g., as attachments to requests for quotation/ purchase orders or requests for proposals/contracts) and preparation and issue of design engineering deliverables for use on a specific project by Authorized User's client. PIP's copyright notices must be clearly indicated and unequivocally incorporated in documents where an Authorized User desires to provide any third party with copies of the Practice.

PUBLISHING HISTORY

April 2018

Issued

Not printed with State funds

[This is a preview. Click here to purchase the full publication.](#)

PIP ELEGL01

Overall Electrical One-Line Diagram Guideline

Table of Contents

1. Scope	2	7.18 Low Resistance Ground (LRG)	11
2. References	2	7.19 Low Voltage (LV) Breaker	11
Industry Codes and Standards	2	7.20 Motor Control Center (MCC)	11
3. Definitions	3	7.21 Off-Page Connector	12
4. General	3	7.22 Synchronous Generator	12
5. Symbol Usage	4	7.23 Synchronous Motor	12
6. Format.....	6	7.24 Tap Changer	12
7. Equipment Data.....	7	7.25 Transfer Switch	12
7.1 General.....	7	7.26 Turbine Driver	13
7.2 Two-Winding Transformer.....	7	7.27 User Defined	13
7.3 Three-Winding Transformer.....	8	7.28 Utility.....	13
7.4 Arrester.....	8	8. CAD Layers	13
7.5 Auto Transformer	9	8.1 E-POWR	13
7.6 Breaker.....	9	8.2 E-POWR-BKRS	13
7.7 Bus Duct/Cablebus	9	8.3 E-POWR-BUSW	14
7.8 Capacitor	9	8.4 E-POWR-DEVC	14
7.9 Current Limiting Reactor (CLR)	10	8.5 E-POWR-FEED	14
7.10 Disconnect Switch	10	8.6 E-POWR-GRND	14
7.11 Drawout Connection	10	8.7 E-POWR-SWCH	14
7.12 Electrical Bus	10	8.8 E-POWR-XFMR.....	14
7.13 Engine Driver	10	Appendix A: Electrical One Line	
7.14 Fuse.....	10	Symbols	
7.15 High Resistance Ground (HRG)	11	Appendix B: Individual AutoCAD	
7.16 Induction Generator.....	11	Symbol Drawings	
7.17 Induction Motor.....	11	Appendix C: Single AutoCAD	
		Drawing with All Symbols	
		Appendix D: Tutorials	

1. Scope

This Practice is a guideline for developing Overall Electrical One-Line Diagrams (OEOLDs) by engineers and designers. It covers the generation of new OEOLDs and may not apply to the revision of existing OEOLDs.

This Practice applies to one-line diagrams that fit the definition of an OEOLD in Section 3. This Practice uses *ANSI/IEEE 315 - IEEE Graphic Symbols for Electrical and Electronics Diagrams* and *IEEE C57.12.80 - IEEE Standard Terminology for Power and Distribution Transformer symbols*.

The main purpose of an OEOLD is to provide an initial view of the electrical system for use in early design discussions. Then, the OEOLD can be updated as the project develops and kept current to provide a reference document that shows a high level view of the overall electrical system.

As a secondary purpose and function the symbols provided for use in a OEOLD are intended to provide basic information. The basic information is shown in visible fields by default. Many OEOLD symbols have hidden or invisible fields that provide extra information or details. The invisible or hidden fields can be changed to be visible based on owner requirements.

This Practice can be applied to CAD systems used for developing OEOLDs, and is not supplier, hardware, or software specific. Electronic native files for the text, symbols, and cover sheets are available from PIP for use in CAD systems and have been developed in AutoCAD 2015. While the symbols can also be developed in Microstation DGN files, the functionality from AutoCAD may not be available in Microstation. Development of project-specific legend sheets is recommended using the PIP native files as a starting point. Additions and/or deletions are permitted to meet project requirements. Drawing borders and title blocks can be altered to be project specific.

The guidelines in this Practice provide a balance between showing all data on OEOLDs and making OEOLDs legible and easy to read. Although this Practice describes major components in the electrical system, specific applications may require additional or alternative components. Determinations concerning fitness for purpose and matters of application of the Practice to a particular project or engineering situation should not be made solely on the information contained in this Practice.

The OEOLD symbols included in the Appendices of this Practice are not intended to recommend specific design details or requirements. An example OEOLD is included to provide an illustration of how the elements of this Practice are combined into an OEOLD.

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 issue or revision of this guideline shall be used, except as otherwise noted. Short titles are used herein where appropriate.

Industry Codes and Standards

- Institute of Electrical and Electronic Engineers (IEEE)
 - IEEE Std C57.12.80 - *IEEE Standard Terminology for Power and Distribution Transformers*
 - IEEE 315 – *IEEE Graphic Symbols for Electrical and Electronics Diagrams (Including Reference Designation Letters)*

- National Fire Protection Association (NFPA)
 - NFPA 70E - *Standard for Electrical Safety in the Workplace*
- American Institute of Architects (AIA)
 - *United States National CAD Standard (NCS)*

3. Definitions

electrical bus: Metallic strip, pipe or bar that conducts electricity either enclosed or exposed.

one-line diagram: A representation of an electrical system by means of lines and graphic symbols showing the major components of a three phase power system (i.e., breakers, busses, transformers, capacitor banks, major loads, sources). One-Line diagrams may also be known as Single-Line diagrams.

Overall Electrical One-Line Diagram (OEOLD): Is a simplified graphical representation of an electrical power system for an entire plant or a specific unit within a plant that depicts only the major components of the power system and the electrical attributes of each component.

4. General

- 4.1 *NFPA 70E-2018*, Article 205.2 requires that a single-line diagram shall be maintained in a legible condition and shall be kept current.
- 4.2 The content of an OEOLD should include the following:
 - a. Source grounding connections
 - b. Sources of power
 - c. Conductors (e.g. cable, bus, bus duct, etc.)
 - d. Major power equipment, loads and components (e.g., transformers, motors, MCC, etc.)
 - e. Ownership, Location/Process units, Demarcation line.
- 4.3 The content of an OEOLD should not include the following:
 - a. Overall Ground System
 - b. Current Transformers
 - c. Potential Transformers
 - d. Control Power Transformers
 - e. Meters, Relays, and Devices
 - f. Contacts
 - g. Capacitors on individual motors
 - h. Batteries
 - i. Fans
 - j. Terminals
 - k. Shunts
 - l. Lights
 - m. Interlocks
 - n. RTD
 - o. Thermostats

- p. Space Heaters
- q. Controls
- r. Alarms
- s. Electrical Network Monitoring and Control System Points
- t. Low Voltage Motor Control Center loads

5. Symbol Usage

- 5.1 The Appendixes of this Practice contain tables of commonly used symbols, abbreviations and other identifiers; typical details; and example OEOLDs.
- 5.2 Appendix A provides the individual symbols and text for the common,y used symbols. The symbols and text are shown the same size as would be used for a standard, full-size (e. g., 22 inches x 34 inches) OEOLD.

Table 1. Symbols for Equipment Types

One-Line Symbols	Appendix	One-Line Symbols	Appendix
2 Winding Transformer	A-1	Induction Motor	A-16
3 Winding Transformer	A-2	Low Resistance Ground (LRG)	A-17
Arrester	A-3	LV Breaker	A-18
Auto Transformer	A-4	MCC	A-19
Breaker	A-5	Off-Page Connector	A-20
Bus Duct/Cablebus	A-6	Synchronous Generator	A-21
Capacitor	A-7	Synchronous Motor	A-22
Current Limiting Reactor (CLR)	A-8	Tap Changer	A-23
Disconnect Switch	A-9	Transfer Switch	A-24
Drawout Connection	A-10	Turbine Driver	A-25
Electrical Bus	A-11	User Defined	A-26
Engine Driver	A-12	Utility	A-27
Fuse	A-13		
High Resistance Ground (HRG)	A-14		
Induction Generator	A-15		

- 5.3 Appendix B contains the single AutoCAD drawing which contains all the OEOLD symbols that is recommended to be used to add toolbars to AutoCAD for ease of use of the OEOLD symbols per the tutorials in Appendix D.
- 5.4 Appendix C shows a sample OEOLD that explains how to use the symbols. The symbols for the various types of equipment shown on an OEOLD should be in accordance with the associated Appendix A pages identified in Table 1.
- 5.5 Appendix D provides tutorials with recommendations about how to best use the OEOLD symbols in AutoCAD.
- 5.6 The following information in this Section provides additional recommendations regarding the use of the OEOLD symbols. If options or choices are available when using the symbol, additional recommendations are provided. When the symbol does not have options or choices the symbol name will be followed by “No options”: