

Recommended Practice for Design, Installation, and Maintenance of Electrical Systems for Fixed and Floating Offshore Petroleum Facilities for Unclassified and Class I, Zone 0, Zone 1, and Zone 2 Locations

API RECOMMENDED PRACTICE 14FZ
SECOND EDITION, MAY 2013

REAFFIRMED, APRIL 2020



AMERICAN PETROLEUM INSTITUTE

Special Notes

API publications necessarily address problems of a general nature. With respect to particular circumstances, local, state, and federal laws and regulations should be reviewed.

Neither API nor any of API's employees, subcontractors, consultants, committees, or other assignees make any warranty or representation, either express or implied, with respect to the accuracy, completeness, or usefulness of the information contained herein, or assume any liability or responsibility for any use, or the results of such use, of any information or process disclosed in this publication. Neither API nor any of API's employees, subcontractors, consultants, or other assignees represent that use of this publication would not infringe upon privately owned rights.

API publications may be used by anyone desiring to do so. Every effort has been made by the Institute to assure the accuracy and reliability of the data contained in them; however, the Institute makes no representation, warranty, or guarantee in connection with this publication and hereby expressly disclaims any liability or responsibility for loss or damage resulting from its use or for the violation of any authorities having jurisdiction with which this publication may conflict.

API publications are published to facilitate the broad availability of proven, sound engineering and operating practices. These publications are not intended to obviate the need for applying sound engineering judgment regarding when and where these publications should be utilized. The formulation and publication of API publications is not intended in any way to inhibit anyone from using any other practices.

Any manufacturer marking equipment or materials in conformance with the marking requirements of an API standard is solely responsible for complying with all the applicable requirements of that standard. API does not represent, warrant, or guarantee that such products do in fact conform to the applicable API standard.

Classified areas may vary depending on the location, conditions, equipment, and substances involved in any given situation. Users of this Recommended Practice should consult with the appropriate authorities having jurisdiction.

Users of this Recommended Practice should not rely exclusively on the information contained in this document. Sound business, scientific, engineering, and safety judgment should be used in employing the information contained herein.

API is not undertaking to meet the duties of employers, manufacturers, or suppliers to warn and properly train and equip their employees, and others exposed, concerning health and safety risks and precautions, nor undertaking their obligations to comply with authorities having jurisdiction.

Work sites and equipment operations may differ. Users are solely responsible for assessing their specific equipment and premises in determining the appropriateness of applying the Recommended Practice. At all times users should employ sound business, scientific engineering, and judgment safety when using this Recommended Practice.

All rights reserved. No part of this work may be reproduced, translated, stored in a retrieval system, or transmitted by any means, electronic, mechanical, photocopying, recording, or otherwise, without prior written permission from the publisher. Contact the Publisher, API Publishing Services, 1220 L Street, NW, Washington, DC 20005.

Foreword

Nothing contained in any API publication is to be construed as granting any right, by implication or otherwise, for the manufacture, sale, or use of any method, apparatus, or product covered by letters patent. Neither should anything contained in the publication be construed as insuring anyone against liability for infringement of letters patent.

Shall: As used in a standard, “shall” denotes a minimum requirement in order to conform to the specification.

Should: As used in a standard, “should” denotes a recommendation or that which is advised but not required in order to conform to the specification.

This document was produced under API standardization procedures that ensure appropriate notification and participation in the developmental process and is designated as an API standard. Questions concerning the interpretation of the content of this publication or comments and questions concerning the procedures under which this publication was developed should be directed in writing to the Director of Standards, American Petroleum Institute, 1220 L Street, NW, Washington, DC 20005. Requests for permission to reproduce or translate all or any part of the material published herein should also be addressed to the director.

Generally, API standards are reviewed and revised, reaffirmed, or withdrawn at least every five years. A one-time extension of up to two years may be added to this review cycle. Status of the publication can be ascertained from the API Standards Department, telephone (202) 682-8000. A catalog of API publications and materials is published annually by API, 1220 L Street, NW, Washington, DC 20005.

Suggested revisions are invited and should be submitted to the Standards Department, API, 1220 L Street, NW, Washington, DC 20005, standards@api.org.

Contents

	Page
1 General	1
1.1 Scope	1
1.2 Applicability of National Electrical Code	2
2 Normative References	2
2.1 General	2
2.2 Industry Codes, Guides, and Standards	2
2.3 Government Codes, Rules, and Regulations	11
2.4 Code of Federal Regulations (CFR)	11
2.5 Classification Society Rules and Regulations	12
3 Acronyms, Terms, and Definitions	12
3.1 Acronyms	12
3.2 Definitions, Abbreviated	14
3.3 Definitions Specific to Floating Facilities	29
4 Electrical Equipment for Hazardous (Classified) Locations	30
4.1 General	30
4.2 High-temperature Devices	31
4.3 Protection Techniques Related To Equipment Suitable for use in Locations Classified as Division 1 or Division 2	31
4.4 Protection Techniques Related to Equipment Approved for Zone 0, Zone 1, or Zone 2 Locations	34
4.5 General Purpose Equipment	36
4.6 Listing, Marking and Documentation	37
4.7 Gas Group	38
5 Electric Power Generating Stations	38
5.1 General	38
5.2 Prime Movers	38
5.3 Generators	42
5.4 Generator Station Packaging Considerations	48
5.5 Switchboards	48
5.6 Special Requirements for Floating Facilities	51
6 Electrical Distribution Systems	54
6.1 Scope	54
6.2 Voltage Level Selection	54
6.3 Conductor Selection	55
6.4 Wiring Methods for Hazardous (classified) Locations	63
6.5 Wiring Methods for Unclassified Locations	67
6.6 Wiring Methods for Drilling and Workover Rigs	68
6.7 General Wiring Considerations	68
6.8 Conduits and Cable Seals and Sealing Methods	72
6.9 Circuit Protection	85
6.10 Grounding	87
6.11 Electrical Enclosures	89
6.12 Working Space About Electrical Equipment and Means of Access	93
6.13 Additional Requirements for Floating Facilities	95
7 Electric Motors	96
7.1 General	96
7.2 Selection	96

Contents

	Page
7.3 Motor Space Heaters	98
7.4 Motor Control	99
8 Transformers	100
8.1 General	100
8.2 Selection	101
8.3 Installation	102
8.4 Connections	102
8.5 Protection	103
9 Lighting	104
9.1 General	104
9.2 Lighting Levels	104
9.3 Fixture Selection and Installation	106
9.4 Standby Lighting	109
9.5 Lighting for Helicopter Operations	110
10 Battery-powered DC Supply Systems	111
10.1 General	111
10.2 Specific Applications	111
10.3 Batteries	112
10.4 Battery Chargers	115
10.5 Uninterruptible Power Supply (UPS) Systems	117
11 Special Systems	119
11.1 Electrical Platform Safety Control Systems	119
11.2 Gas Detection Systems	121
11.3 Fire Detection Systems	123
11.4 Aids-to-Navigation Equipment	124
11.5 Communications Equipment	126
11.6 Heat Trace Systems	126
11.7 Fire Pumps	126
11.8 Adjustable Speed Drives (Variable Frequency Drives)	127
11.9 Submarine Cables	134
11.10 Electric Oil-immersion Heaters	134
11.11 Electric Power-operated Boat Winches for Survival Craft	134
11.12 Electric Power-operated Water-tight Doors	134
11.13 Hull Mechanical Systems Controls	135
11.14 Cargo Tanks on Floating Facilities	136
11.15 Cargo Handling Rooms on Floating Facilities	136
11.16 General Alarm System	136
11.17 Cathodic Protection	139
11.18 Subsea Electrical Systems	141
12 Special Considerations	143
12.1 Construction Practices	143
12.2 Electronic Instrumentation	144
12.3 Electrical Tools	145
12.4 Electrical Appliances	145
12.5 Extension Cords	145
12.6 Electrical Equipment Buildings	146

Contents

	Page
12.7 Laboratory Buildings	146
12.8 Signs	146
12.9 Lockout and Tagout Procedures	146
12.10 Portable Electronic Devices	146
12.11 Abandoned Raceways and Conductors	146
13 System Checkout	147
13.1 General	147
13.2 Generators and Motors	147
13.3 Instrumentation and Control Circuits	147
14 Maintenance	147
15 Safety	148
Annex A (informative) Inspection Intervals	149
Annex B (informative) ABS Rules For Building and Classing Steel Vessels—1999, PART 4	151
Annex C (informative) USCG Requirements, 46 CFR, Subchapter J, Part 111.95	160
Annex D (informative) USCG Requirements, 46 CFR, Subchapter J, Part 111.7	162
Annex E (informative) USCG Requirements, 46 CFR, Subchapter J, Part 111.105	164
Annex F (informative) Electrical Inspection Checklist	176
Figures	
1 Typical Class I, Zone 1 Electrical Installation Conduit System Utilizing Class I, Division I Equipment and Wiring Methods	73
2 Typical Class I, Zone 1 Electrical Installation Cable System Utilizing Class I, Division 1 Equipment and Wiring Methods	74
3 Typical Class I, Division Zone 2 Electrical Installation Conduit or Cable System Utilizing Class I, Division 2 Equipment and Wiring Methods	75
4 Typical Class I, Zone 1 or Zone 2 Electrical Installation Conduit System Utilizing Class I, Zone 1 Equipment and Wiring Methods	76
5 Typical Class I, Zone 1 or Zone 2 Electrical Installation Cable System Utilizing Class I, Zone 1 Equipment and Wiring Methods	77
6 Typical Class I, Zone 2 Electrical Conduit or Cable Installation Utilizing Class I, Zone 2 Equipment and Wiring Methods	78
7 Typical Class I, Zone 1 or Zone 2 Electrical Installation Conduit or Cable Connections to Flammable Fluid Process-Connected Nonarcing Devices with Single-Seal Diaphragms or Tubes	79
8 Typical Class I, Zone 1 or Zone 2 Electrical Installation Conduit and Cable Connections to Flammable Fluid Process-Connected Nonarcing Devices with Multiple-Seal Diaphragms or Tubes	80
9 Typical Class I, Zone 1 or Zone 2 Electrical Installation Conduit or Cable Connections to Flammable Fluid Process-Connected Nonarcing Devices with Multiple-Seal Diaphragms or Tubes	81
10 Typical Class I, Zone 1 or Zone 2 Electrical Installation Placement of Drain Seals	82
11 Typical Speed Torque Curve for Variable Torque Load	129
12 Typical Speed Torque Curve for Constant Torque Load	130
13 Typical Speed Torque Curve for Constant Horsepower Load	130
14 Typical Speed Torque Characteristics for Impact-type Loads	131
4/5C.1 Limiting Curves for Loading 4-stroke Diesel Engines Step by Step from No-load to Rated Power as Function of the Brake Mean Effective Pressure	157

Contents

Page

Tables

1	Types of Protection Designation	20
2	Ampacities for Marine Shipboard Distribution, Control, and Signal Cables, 2000 Volts or Less, AC or DC, Copper Conductors, Single-banked (Single-layered), Maximum Current-carrying Capacity Based on 45 °C (113 °F) Ambient.	36
2A	Allowable Ampacities of Insulated Nickel Coated Copper Conductors (27 % Nickel) Rated Through 2000 Volts, 75 °C (140 °F), Not More Than Three Current-Carrying Conductors in Raceway, Cable Maximum Current-carrying Capacity Based on 45 °C (113 °F) Ambient	57
3	Ampacities for Marine Shipboard Single-conductor Distribution Cables, 2000 Volts or Less, DC Only, Copper Conductors, Single-banked (Single-layered), Maximum Current-carrying Capacity Based on 45 °C (113 °F) Ambient.	57
4	Ampacities for Three-conductor Medium Voltage Power Cable, 2001 Volts to 35 kV, Copper Conductor Single-banked (Single-layered), Maximum Current-carrying Capacity Based on 45 °C (113 °F) Ambient.	59
5	Ampacities for Medium Voltage Power Cable, 2001 Volts to 35 kV, Copper Conductor, Single-conductor in Triplexed or Triangular Configuration, Maximum Current-carrying Capacity Based on 45 °C (113 °F) Ambient.	60
6	Ampacities for Single-conductor Medium Voltage Power Cable, 2001 Volts to 35 kV, Copper Conductor Single-banked (Single-layered), Maximum Current-carrying Capacity Based on 45 °C (113 °F) Ambient, Shields Grounded on One End (Open-circuited Shields)	61
7	Wiring Methods for Hazardous (classified) Locations	63
8	Common Power and Control Cables Sizes and Configurations	72
9	Common Instrumentation Cable Sizes and Configurations	72
10	Circuit Protection Devices—Advantages and Disadvantages	86
11	NEMA Enclosures	90
12	Degree of Protection of Enclosures in Accordance with IEC 60529	92
13a	Selection of IEC 60529 IP Rated Enclosures to Meet NEMA Requirements	94
13b	Selection of NEMA Enclosures to Meet IP Designations	94
14	Working Clearances	95
15	NEMA Motor Starter Sizing	99
16	Minimum Recommended Levels of Illumination for Efficient Visual Tasks	105
16A	Minimum Recommended Levels of Illumination for Hazard Recognition	105
17	Minimum Recommended Levels of Illumination for Safety	106
18	Comparison of Batteries by Cell Type	114
19	Possible combinations of Tones for Fixed Platforms	137
20	One Possible Combination of Tones for Floating Facilities	139
A.1	Inspection Intervals	149

Design, Installation, and Maintenance of Electrical Systems for Fixed and Floating Offshore Petroleum Facilities for Unclassified and Class I, Zone 0, Zone 1, and Zone 2 Locations

1 General

1.1 Scope

1.1.1 This document recommends minimum requirements and guidelines for the design, installation, and maintenance of electrical systems on fixed and floating petroleum facilities located offshore. For facilities classified as Division 1 or Division 2, reference API 14F. These facilities include drilling, producing and pipeline transportation facilities associated with oil and gas exploration and production. This recommended practice (RP) is not applicable to Mobile Offshore Drilling Units (MODUs) without production facilities. This document is intended to bring together in one place a brief description of basic desirable electrical practices for offshore electrical systems. The recommended practices contained herein recognize that special electrical considerations exist for offshore petroleum facilities. These include:

- a) inherent electrical shock possibility presented by the marine environment and steel decks;
- b) space limitations that require that equipment be installed in or near hazardous (classified) locations;
- c) corrosive marine environment;
- d) motion and buoyancy concerns associated with floating facilities.

1.1.2 This RP applies to both permanent and temporary electrical installations. The guidelines presented herein should provide a high level of electrical safety when used in conjunction with well-defined area classifications. This RP emphasizes safe practices for hazardous (classified) locations on offshore petroleum facilities but does not include guidelines for classification of areas; for guidance on the classification of areas refer to API 505.

1.1.3 Advantages of area classification using zones are as follows.

1.1.3.1 Often, particularly for new installations and for installations that are subject to upgrade or revision, it is advantageous to classify locations as “Zones” in accordance with Article 505 of the *NEC* versus “Divisions” as per Article 500. These advantages may include reduced initial capital expenditures, enhanced safety, or facilities that are more easily and more economically maintained.

1.1.3.2 In the Zone classification system, locations classified as Division 1 in the Division classification system can now be classified and further divided into Zone 0 and Zone 1 locations. Electrical equipment suitable for Zone 1 locations is not required to be suitable for locations where flammable gases and vapors may be present continuously or for long periods of time, i.e. Zone 0 locations. Thus, the protection techniques for equipment to be installed in Zone 1 locations can be less demanding than the protection techniques for equipment to be installed in Division 1 locations. This may result in more cost effective installations or equipment that is more easily maintained.

1.1.3.3 Due to the application of increased safety (protection Type “e”) equipment, fewer field-installed sealing fittings are required for Zone 1 and Zone 2 equipment than for Division 1 and Division 2 equipment. Fewer field-installed sealing fittings reduce the chance for installation errors, enhancing safety. Much of the equipment approved for Zone 1 and Zone 2 uses plastics (versus metals), reducing corrosion, which can result in reducing maintenance costs and enhancing safety. Also, since the most hazardous locations (Zone 0 locations) are identified, such locations can be avoided for the installation of most electrical equipment. This also can enhance safety.