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IEEE Recommended Practice for Electrical Installations on Shipboard—Marine Sectors and Mission Systems

IEEE Industry Applications Society

Sponsored by the
Petroleum and Chemical Industry Committee

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IEEE Recommended Practice for Electrical Installations on Shipboard—Marine Sectors and Mission Systems

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Abstract: Recommendations for the grouping of ships and their predominant mission systems to define and highlight unique features and requirements of a ship's electrical power system driven by the ship's mission for classification and use by the IEEE 45™ series of standards

Keywords: IEEE 45.4™, marine electrical engineering, marine vessels, naval vessels, shipboard electrical systems, ships

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Introduction

This introduction is not part of IEEE Std 45.4–2018, IEEE Recommended Practice for Electrical Installations on Shipboard—Marine Sectors and Mission Systems.

The IEEE 45™ series of standards comprises eight recommended practices addressing electrical installations on ships and marine platforms. IEEE Std 45.4 provides recommended practices for identifying unique electrical system requirements or attributes based on the vessels intended use or function (“Mission”). Once these attributes have been identified, the recommended practices outlined in the IEEE 45 series should be followed.

Previous editions of IEEE 45 standards were developed as single documents addressing all areas. On 9 June 2005, the Project Authorization Request (PAR) for the revision of IEEE Std 45-2002 was approved and the revision of IEEE Std 45 as a single document began. It soon became apparent that attempting to cover all issues in a single document would produce a document that was very large and therefore difficult to ballot due to the wide range of issues needed to be addressed. In September 2008, it was decided that the revision of IEEE Std 45 should be developed as a base document with separate documents addressing specific areas.

On 10 December 2008, separate PARs were approved for seven separate recommended practices. Additional PARs were approved on 11 September 2009 for switchboards and on 9 December 2009 for cable systems, bringing the total number of standards in the IEEE 45 series to eight:

— IEEEStd45.1™-2017,IEEERecommendedPracticeforElectricalInstallationsonShipboard—Design

— IEEE Std 45.2™-2011, IEEE Recommended Practice for Electrical Installations on Shipboard—Controls andAutomation

— IEEE Std 45.3™-2015, IEEE Recommended Practice for Shipboard Electrical Installations—Systems Engineering

— IEEE P45.4, Draft Recommended Practice for Electrical Installations on Shipboard—Marine Sectors and Mission Systems

— IEEE Std 45.5™-2014, IEEE Recommended Practice for Electrical Installations on Shipboard—Safety Considerations

— IEEE P45.6, IEEE Recommended Practice for Electrical Installations on Shipboard—Electrical Testing

— IEEE Std 45.7™-2012, IEEE Recommended Practice for Electrical Installations on Shipboard—AC Switchboards

— IEEE 45.8™-2016, IEEE Recommended Practice for Electrical Installations on Shipboard—Cable Systems

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IEEE Recommended Practice for Electrical Installations on Shipboard—Marine Sectors and Mission Systems

1. Overview

1.1 Scope

This recommended practice identifies the various marine segments and ships covered in the IEEE 45™ series of standards. It provides grouping of ships and their predominant mission systems for classification and used by other parts of IEEE 45. This document is intended to be used in conjunction with other IEEE 45 standards.

1.2 Purpose

An extension of the baseline technology and methods covered by IEEE 45, this standard provides a consensus of recommended practices for marine sectors and mission systems in marine electrical engineering as applied specifically to ships, shipboard systems, and equipment.

2. Normative references

The following referenced documents are indispensable for the application of this document (i.e., they must be understood and used, so each referenced document is cited in text and its relationship to this document is explained). For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments or corrigenda) applies.

IEEE Std 45.1™-2017, IEEE Recommended Practice for Electrical Installations on Shipboard—Design.[1,2]

IEEE Std 45.3™-2015, IEEE Recommended Practice for Shipboard Electrical Installations—Systems Engineering.

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3. Marine sectors and mission systems

3.1 Background

Figure 1 shows the design process from concept design to product baseline and the relationship between IEEE Std 45.1-2017 and IEEE Std 45.3-2015, which provide the recommended practice for electrical installations shipboard.[3] This standard provides the definition of which ship types the IEEE 45 series of recommended practices are applicable to.

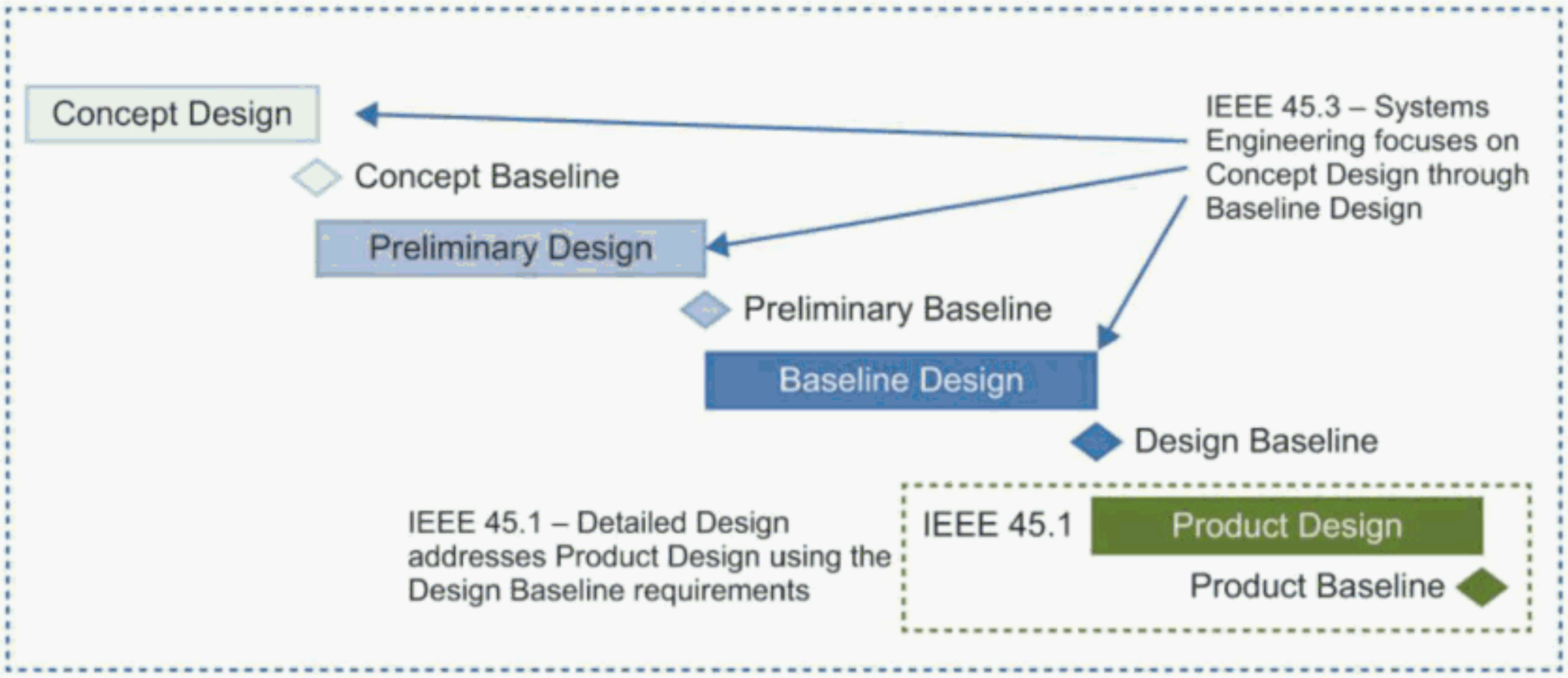

Figure 1—Ship electrical system design process

3.2 Ship types

There are innumerable schemes developed to classify ships and vessels. Figure 2 provides a simplified taxonomy of ship and vessel types, broadly divided between commercial and naval vessels. There may be commonality between vessel types, and often a vessel can be suitable for multiple roles. For instance, commercial ocean liners have often been re-designated naval troop carriers in time of conflict. In addition to the taxonomy of subdividing ships and vessels by function, there are also classifications by governing authority which include (not an exhaustive list):

- Sovereign government: Military specifications and standards for naval vessels
- American Bureau of Shipping (ABS)
- Germanischer Lloyd (GL)
- Bureau Veritas
- Det Norske Veritas
- Lloyd's Register
- Russian Maritime Register of Shipping
- Nippon Kaiji Kyokai
- Korean Register of Shipping
- Indian Register of Shipping

[3]Information on references can be found in Clause 2.

- Polish Register of Shipping
- Registro Italiano Navale
- Croatian Register of Shipping
- China Classification Society

The vessel owner, based on the vessel's purpose, will determine which classification standards to require. The vessel designer and vessel builder must design and build the vessel to those standards.

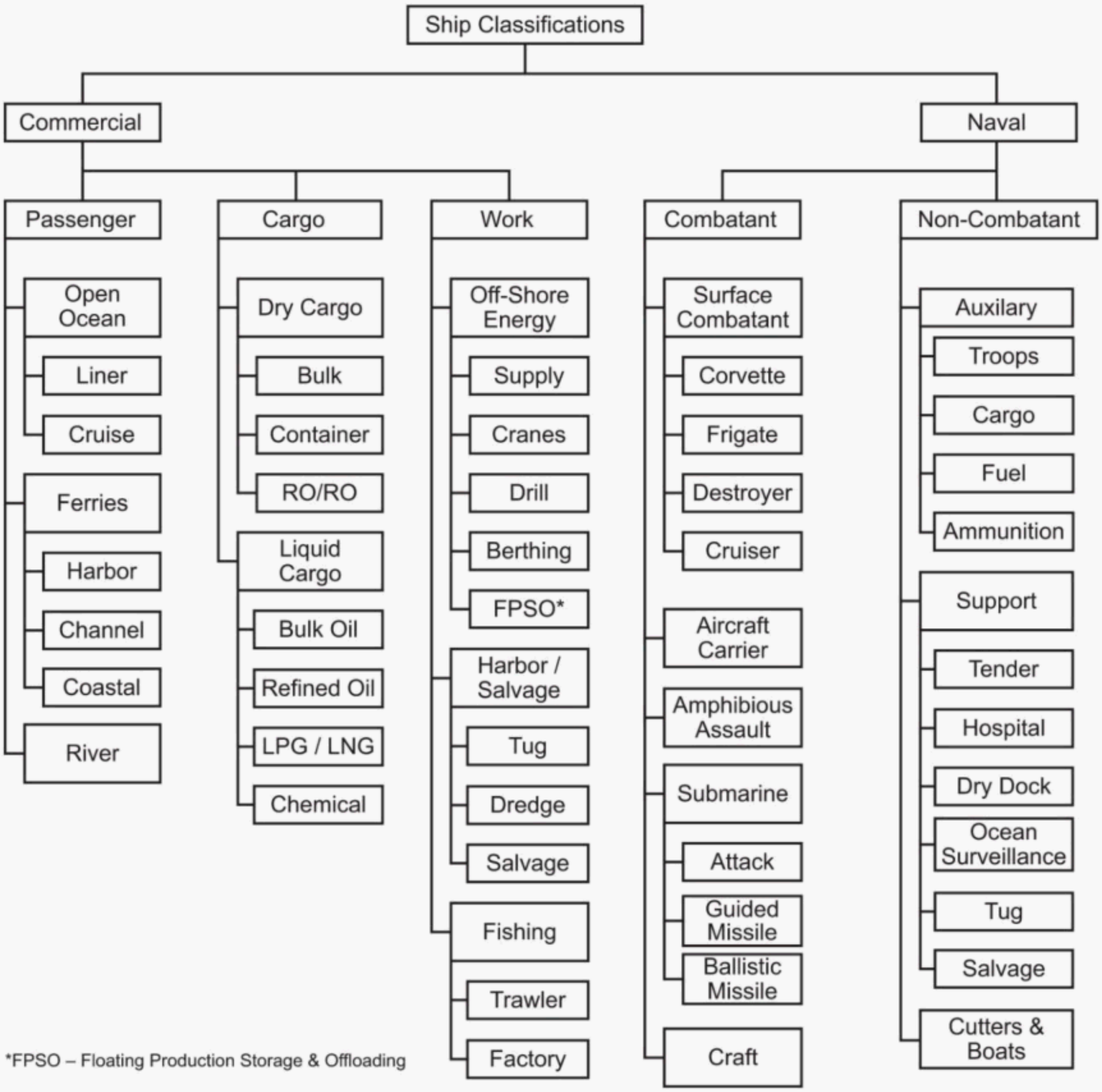

Figure 2—Simplified ship-type taxonomy

3.3 Applicability

3.3.1 Applicable vessels

The IEEE 45 series of recommended practices have been prepared for application a broad range of both commercial and naval vessels, as outlined in Figure 2, including:

a) Passenger vessels:
   1) All vessels of 100 gross tons or more whose principle purpose is the carrying of passengers.
   2) Passenger vessels under 100 gross tons carrying more than six but less than 150 passengers or that has overnight accommodations for less than 50 passengers.
   3) Passenger vessels carrying more than 150 passengers or with overnight accommodations for more than 49 passengers.

b) Cargo vessels:
   1) Liquid: All vessels whose principle purpose is the carrying of combustible, flammable, or hazardous liquid cargo in bulk (e.g., crude oil, refined oil, gasoline, liquid chemicals, etc.).
   2) Dry: All vessels carrying freight for hire (e.g., bulk, containerized, automobiles, etc.).

c) Work vessels:
   1) Offshore supply vessels.
   2) Nautical school vessels.
   3) Oceanographic research vessels—All vessels engaged in oceanographic research.
   4) Mobile offshore drilling units (MODU)—A vessel, other than a “mobile inland drilling unit,” which is capable of engaging in drilling or workover operations for the explorations and exploitation of subsea mineral resources. These recommendations apply to all types of MODUs without production facilities, including, but not limited to, semi-submersible units, submersible units, self-elevating or jack-up units, and drill ships and tenders.
   5) Mobile inland drilling units (MIDU)—A vessel, other than a “mobile offshore drilling unit,” which is capable of engaging in drilling or workover operations for the exploration or exploitation of subsea mineral resources and is designed and intended for use in US waters, rivers, inland lakes, bays, or sounds. These recommendations apply to all types of MIDU without production facilities, including, but not limited to, inland barges and posted inland barges.

d) Miscellaneous vessels—All vessels not covered in other groups, all tugboats and tow boats, and all seagoing barges not covered in other groups.

e) Naval vessels:
   1) Noncombatant vessels—Including all naval auxiliary ships, military supply vessels, and icebreakers.
   2) Combatant vessels

3.3.2 Non-applicable facilities and vessels

Vessel classification and facilities the IEEE 45 series recommended practices are not applicable to:

a) Fixed petroleum facilities.

b) Floating petroleum facilities—A buoyant facility that is securely and substantially moored so that it cannot be moved without a special effort. The term includes, but is not limited to, tension leg

platforms, floating production systems, floating production storage and offloading (FPSO), and spar buoy or deep draft caisson vessel.These types of floating facilities are site-specific and not intended for periodic relocation. Other types of floating facilities include permanently moored semi-submersibles and shipshape hulls. All of these types of floating facilities produce hydrocarbons from the well and process them on board and either store them on board and pump the produced hydrocarbon into a pipeline or directly onto another vessel.

c) Recreational vessels.

NOTE—These recommendations have not been prepared for application for the facilities and vessels listed in item a) item b), and item c) because they are outside the scope of this recommended practice and are covered under national and international standards.[4]

3.4 Vessel classification electric load distinctions

For the purposes of this recommended practice, a major difference between vessel classifications within the commercial sub-class is the type of electrical load supplied by the electrical plant. A non-exhaustive list is given below.

a) COMMERCIAL—Passenger: Primary load is propulsion (for hulls with electric propulsion). Sizeable loads include pumps and low-voltage lighting and heating/cooling.

b) COMMERCIAL—Cargo: Primary load is propulsion (for hulls with electric propulsion). Sizeable loads include material handling and pumps. Material handling may be physically located above or below main deck level.

c) COMMERCIAL—Work: Primary load is propulsion (for hulls with electric propulsion). Sizeable loads include process equipment – which varies by vessel purpose – and pumps. Special notice should be taken for vessels involved in oceanographic or atmospheric observation, where an abundance of “clean” power is required for the scientific equipment

d) NAVAL—Auxiliary: Primary load is propulsion (for hulls with electric propulsion). Sizeable loads may be similar to either commercial passenger OR commercial work, depending on application. Special notice should be taken for ocean surveillance, where an abundance of “clean” power is required for the scientific equipment.

e) NAVAL—Combatant: High priority given to overall system redundancy and decentralized power generation. Primary load may be propulsion (for hulls with electric propulsion) – but not necessarily. Additional design constraints may apply to specific hull arrangements such as electromagnetic interference and structure-borne noise. Both of these constraints can be addressed when creating the electrical distribution to minimize adverse effects.

In addition, all vessels dealing with potentially hazardous materials will have additional system constraints driven by the nature of the hazard.

3.5 Cross References for Specific Ship Types

Most of the recommended practices provided in the IEEE 45 series of recommended practices potentially apply to all the commercial and naval vessel types identified in section 4.3. In a few cases, IEEE Std 45.1-2017 provides specific recommendations for specific ship types as detailed in Table 1.

[4]Notes in text, tables, and figures of a standard are given for information only and do not contain requirements needed to implement this standard.

Table 1—IEEE Std 45.1-2017 Cross Reference for specific ship types

Ship type	IEEE Std 45.1-2017 Subclause	Topic
Commercial-Passenger-Ferries	7.3.9	Time factor for supply of emergency power
Commercial-Cargo-Liquid Cargo	27.3.3	Hazardous locations, installations, and equipment
Commercial-Cargo-Dry Cargo-RO/RO	27.3.4	Hazardous locations, installations, and equipment
Commercial-Work-Off-Shore Energy-Drill	27.3.5	Hazardous locations, installations, and equipment
Commercial-Cargo-Dry Cargo-Bulk	27.3.6	Coal Carriers - Hazardous locations, installations, and equipment
Commercial-Cargo-Dry Cargo-Bulk	27.3.7	Hazardous locations, installations, and equipment
Commercial-Cargo-Liquid-Cargo	27.7.7	Hazardous locations, installations, and equipment
Commercial-Cargo-Dry Cargo-Bulk	27.7.12	Coal Carriers - Hazardous locations, installations, and equipment

Consensus

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