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Responsible committee: JPEL/18 Electrical installations of ships and of mobile and fixed offshore units

Interested committees:

Title: BS IEC 61892-2 Mobile and fixed offshore units - Electrical installations

Part 2: System design

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Introduction

This draft standard is based on national and international discussions. Your comments on this draft are invited and will assist in the preparation of the consequent standard.

For international standards, comments will be reviewed by the relevant UK national committee before sending the consensus UK vote and comments to the international committee, which will then decide appropriate action. If the international standard is approved, it is usual for the text to be published as a British Standard.

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UK Vote

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Submission of Comments

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Template for comments and secretariat observations

Date: xx/xx/20xx	Document: ISO/DIS xxxx
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1	2	(3)	4	5	(6)	7
MB	Clause No./ Subclause No./Annex (e.g. 3.1)	Paragraph/Figure/ Table/Note	Type of comment	Commend (justification for change) by the MB	Proposed change by the MB	Secretariat observations on each comment submitted
	3.1	Definition 1	ed	Definition is ambiguous and needs clarifying.	Amend to read '...so that the mains connector to which no connection...'	
	6.4	Paragraph 2	te	The use of the UV photometer as an alternative cannot be supported as serious problems have been encountered in its use in the UK.	Delete reference to UV photometer.	



18/1834/CD

COMMITTEE DRAFT (CD)

PROJECT NUMBER:

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18/1747/RR

IEC TC 18 : ELECTRICAL INSTALLATIONS OF SHIPS AND OF MOBILE AND FIXED OFFSHORE UNITS

SECRETARIAT:

Norway

SECRETARY:

Mr Arild Røed

OF INTEREST TO THE FOLLOWING COMMITTEES:

TC 2,TC 8,SC 8A,SC 8B,TC 17,SC 17A,SC 17C,SC 18A,TC 20,TC 21,SC 21A,TC 22,SC 22H,TC 31,SC 31J,TC 64,TC 65,SC 65A,SC 65B,SC 65C,SC 65E,TC 73,TC 77,SC 77A,SC 77B,SC 77C,TC 80,TC 88,TC 94,TC 99,TC 120,TC 121,SC 121A,SC 121B

PROPOSED HORIZONTAL STANDARD:



Other TC/SCs are requested to indicate their interest, if any, in this CD to the secretary.

FUNCTIONS CONCERNED:

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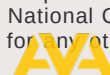
TITLE:

Mobile and fixed offshore units - Electrical installations - Part 2: System design

NOTE FROM TC/SC OFFICERS:

MT 18 has revised the seven parts of the IEC 61892 series. There are several technical changes made in all seven parts. However, we would like to highlight that IEC 61892-7 has been restructured with separate clauses that deals with IEC 61892-10-1 and IEC

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

MOBILE AND FIXED OFFSHORE UNITS –
ELECTRICAL INSTALLATIONS –

Part 2: System design

FOREWORD

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IEC 61892-2 has been prepared by IEC technical committee 18: Electrical installations of ships and of mobile and fixed offshore units. It is an International Standard.

This **fourth** edition cancels and replaces the **third** edition published in **2019-04**. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

This list will be developed when preparing the CDV. See instead the red line version provided as a supplementary working document.

- a) ...;
- b)

333 The text of this International Standard is based on the following documents:

Draft	Report on voting
XX/XX/FDIS	XX/XX/RVD

334
335 Full information on the voting for its approval can be found in the report on voting indicated in
336 the above table.

337 The language used for the development of this International Standard is **English**.

338 This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in
339 accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available
340 at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are
341 described in greater detail at www.iec.ch/publications.

342 The committee has decided that the contents of this document will remain unchanged until the
343 stability date indicated on the IEC website under webstore.iec.ch in the data related to the
344 specific document. At this date, the document will be

- 345 • reconfirmed,
346 • withdrawn,
347 • replaced by a revised edition, or
348 • amended.

349

350

INTRODUCTION

351 IEC 61892 forms a series of International Standards for safety in the design, selection,
352 installation, maintenance and use of electrical equipment for the generation, transmission,
353 storage, distribution and utilization of electrical energy for all purposes in offshore units which
354 are used for the purpose of exploration or exploitation of petroleum resources.

355 This part of IEC 61892 incorporates and coordinates, as far as possible, existing rules and
356 forms a code of interpretation, where applicable, of the requirements of the International
357 Maritime Organization (IMO), and constitutes a guide for future regulations which may be
358 prepared and a statement of practice for offshore unit owners, designers, installers and
359 appropriate organizations.

360 This document is based on solutions and methods which are in current use, but it is not intended
361 to impede the development of new or improved techniques.

362 This document does not set any voltage limitations. However, voltage limitations may be given
363 in the referenced equipment standards. Excluding voltage limitations in this document is
364 considered necessary to allow for high voltage interconnection of, and supply from shore to
365 offshore units. In such cases, transmission voltages up to 132 kV AC and 150 kV DC are used
366 and higher voltages are being planned.

367 The IEC 61892 was initially developed to constitute a set of International Standards for the
368 offshore petroleum industry, but it is also possible to use beyond petroleum installations.

369

370

MOBILE AND FIXED OFFSHORE UNITS – ELECTRICAL INSTALLATIONS –

Part 2: System design

1 Scope

This document is applicable to system design of electrical installations and equipment in mobile and fixed offshore units including pipeline, pumping or "piggings" stations, compressor stations and single buoy moorings, used in the offshore industry for drilling, production, accommodation, processing, storage and offloading purposes.

It applies to all installations, whether permanent, temporary, transportable or hand-held, to AC installations and DC installations, without any voltage level limitation. Referenced equipment standards may give voltage level limitations.

This document specifies requirements such as those concerning

- sources of electrical power for manned and unmanned units,
- system earthing, both for low-voltage and high-voltage installations,
- interface for electric transmission systems with power supplied from shore, between interconnected offshore units, and with power supplied by offshore units to subsea installations,
- interface for electric transmission systems with power supplied from independent offshore power plant with renewable sources (i.e. wind farm)
- distribution systems,
- cables and wiring systems,
- system studies and calculations,
- protection against electrical faults,
- lighting,
- energy control, monitoring and alarm systems, and
- turret/swivel.

This document gives information and guidance on topics such as

- applicable examples of HVDC VSC technology, and
- guidelines for design of unmanned units
- alternative sources of electrical power
- guidelines for illumination level.

This document does not apply to

- fixed equipment for medical purposes,
- electrical installations of tankers, and
- control of ignition sources other than those created by electrical equipment.

NOTE 1 Requirements for medical rooms are given in IEC 60364-7-710

NOTE 2 Requirements for tankers are given in IEC 60092-502.

NOTE 3 Requirements for protection of non-electrical equipment are given in e.g. ISO 80079-36, ISO 80079-37 and IMO 2009 MODU Code, 6.7.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60038:2009, *IEC standard voltages*

IEC 60092-504:2016, *Electrical installations in ships – Part 504: Automation, control and instrumentation*

IEC 60331-1, *Tests for electric cables under fire conditions – Circuit integrity – Part 1: Test method for fire with shock at a temperature of at least 830 °C for cables of rated voltage up to and including 0,6/1,0 kV and with an overall diameter exceeding 20 mm*

IEC 60331-2, *Tests for electric cables under fire conditions – Circuit integrity – Part 2: Test method for fire with shock at a temperature of at least 830 °C for cables of rated voltage up to and including 0,6/1,0 kV and with an overall diameter not exceeding 20 mm*

IEC 60331-21, *Tests for electric cables under fire conditions – Circuit integrity – Part 21: Procedures and requirements – Cables of rated voltage up to and including 0,6/1,0 kV*

IEC 60447, *Basic and safety principles for man-machine interface, marking and identification – Actuating principles*

IEC 60533, *Electrical and electronic installations in ships – Electromagnetic compatibility (EMC) – Ships with a metallic hull*

IEC 60909-0, *Short-circuit currents in three-phase a.c. systems – Part 0: Calculation of currents*

IEC TR 60909-1, *Short-circuit currents in three-phase a.c. systems – Part 1: Factors for the calculation of short-circuit currents according to IEC 60909-0*

IEC 60947-2:2016, *Low-voltage switchgear and controlgear – Part 2: Circuit-breakers*

IEC 60947-4-2, *Low-voltage switchgear and controlgear – Part 4-2: Contactors and motor-starters – AC semiconductor motor controllers and starters*

IEC 61131-1, *Programmable controllers – Part 1: General information*

IEC 61131-2, *Industrial-progress measurement control – Programmable controllers – Part 2: Equipment requirements and tests*

IEC 61363-1, *Electrical installations of ships and mobile and fixed offshore units – Part 1: Procedures for calculating short-circuit currents in three-phase a.c.*

IEC 61892-1:2019, *Mobile and fixed offshore units – Electrical installations – Part 1: General requirements and conditions*

IEC 61892-3:2019, *Mobile and fixed offshore units – Electrical installations – Part 3: Equipment*

IEC 61892-4:2019, *Mobile and fixed offshore units – Electrical installations – Part 4: Cables*

IEC 61892-6:2019, *Mobile and fixed offshore units – Electrical installations – Part 6: Installation*

IEC 61892-7, *Mobile and fixed offshore units – Electrical installations – Part 7: Hazardous areas*

IEC 62040-1, *Uninterruptible power systems (UPS) – Part 1: Safety requirements*

IEC 62040-2, *Uninterruptible power systems (UPS) – Part 2: Electromagnetic compatibility (EMC) requirements*

IEC 62040-3:2011, *Uninterruptible power systems (UPS) – Part 3: Method of specifying the performance and test requirements*

IEC 62271-100, *High-voltage switchgear and controlgear – Part 100: Alternating current circuit-breakers*

IALA, *Recommendation O-139 on The Marking of Man-Made Offshore Structures*

ICAO, *Convention on International Civil Aviation, Annex 14, Aerodromes*

IMO, *Code on Alerts and Indicators*

IMO, *Convention on the International Regulations for Preventing Collisions at Sea (COLREG)*, 1972

IMO, *International Convention for the Safety of Life at Sea (SOLAS)*, consolidated edition 2014

IMO, 2009 MODU Code, *Code for the Construction and Equipment of Mobile Offshore Drilling Units*, 2009, 2010 edition

IMO, MSC/Circ. 645, *Guidelines for vessels with dynamic positioning systems, Annex I*

IMO MSC.1/Circ. 1580 *Annex Guidelines for vessels and units with dynamic positioning systems*

3 Terms, definitions and abbreviations

For the purposes of this document, the terms and definitions given in IEC 61892-1 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

3.1 Terms and definitions

3.1.1

AC systems of distribution

3.1.1.1

single-phase two-wire AC system

AC system comprising two conductors only, between which the load is connected

Note 1 to entry: This system can be used for phase-to-phase connection of the load and phase-to-neutral connection of the load.

483 Note 2 to entry: In some countries, this system with phase-to-phase connection of the load is designated as a two-
484 phase system.

485 **3.1.1.2**

486 **three-phase three-wire AC system**

487 AC system comprising three conductors connected to a three-phase supply

488 **3.1.1.3**

489 **three-phase four-wire AC system**

490 AC system comprising four conductors of which three are connected to a three-phase supply
491 and the fourth to a neutral point in the source of supply

492 **3.1.2**

493 **arc-flash hazard**

494 dangerous condition associated with the release of energy caused by an electric arc

495 [SOURCE: IEEE 1584:2018]

496 **3.1.3**

497 **availability**

498 state of an item of being able to perform its required function

499 [SOURCE: IEC 603-05-04]

500 **3.1.4**

501 **backup protection**

502 protection which is intended to operate when a system fault is not cleared in due time because
503 of:

- 504 – failure or inability of a protective device closest to the fault to operate, or
- 505 – failure of a protective device, other than the protective device closest to the fault, to operate

506 [SOURCE: IEC 448-11-14, modified – The definition has been rewritten.]

507 **3.1.5**

508 **battery energy storage system, BESS**

509 electrical energy storage system with an accumulation subsystem based on batteries
510 with secondary cells

511 [SOURCE: IEC 631-01-03]

512

513 **3.1.6**

514 **battery management system, BMS**

515 electronic system associated with a battery which has functions to cut off control current in
516 case of overcharge, overcurrent, overdischarge, and overheating and which monitors and/or
517 manages the battery's state, calculates secondary data, reports that data and/or controls its
518 environment to influence the battery's safety, performance and/or service life

519 [SOURCE: IEC 62619:2023, 3.12, modified, Notes are deleted]

520 **3.1.7**

521 **blackout <offshore unit>**

522 state characterised by the fact that

- 523 – normal operations have ceased due to the unplanned loss of the main source of electrical
524 power and if installed,
- 525 – the essential source of power has not been established in a timely manner,
- 526 – the emergency generator(s) has not started

527 but the transitional power system is still operational, for example by means of the UPS
528 accumulator batteries

3.1.8**dead start** <offshore unit>

restoration of power and services after a major event in which the following has occurred:

- i) all sources of electrical power have been shut down, and
- ii) all stored energy systems have been completely exhausted

3.1.9**centralized control**

control of all operations of a controlled system from one central control position

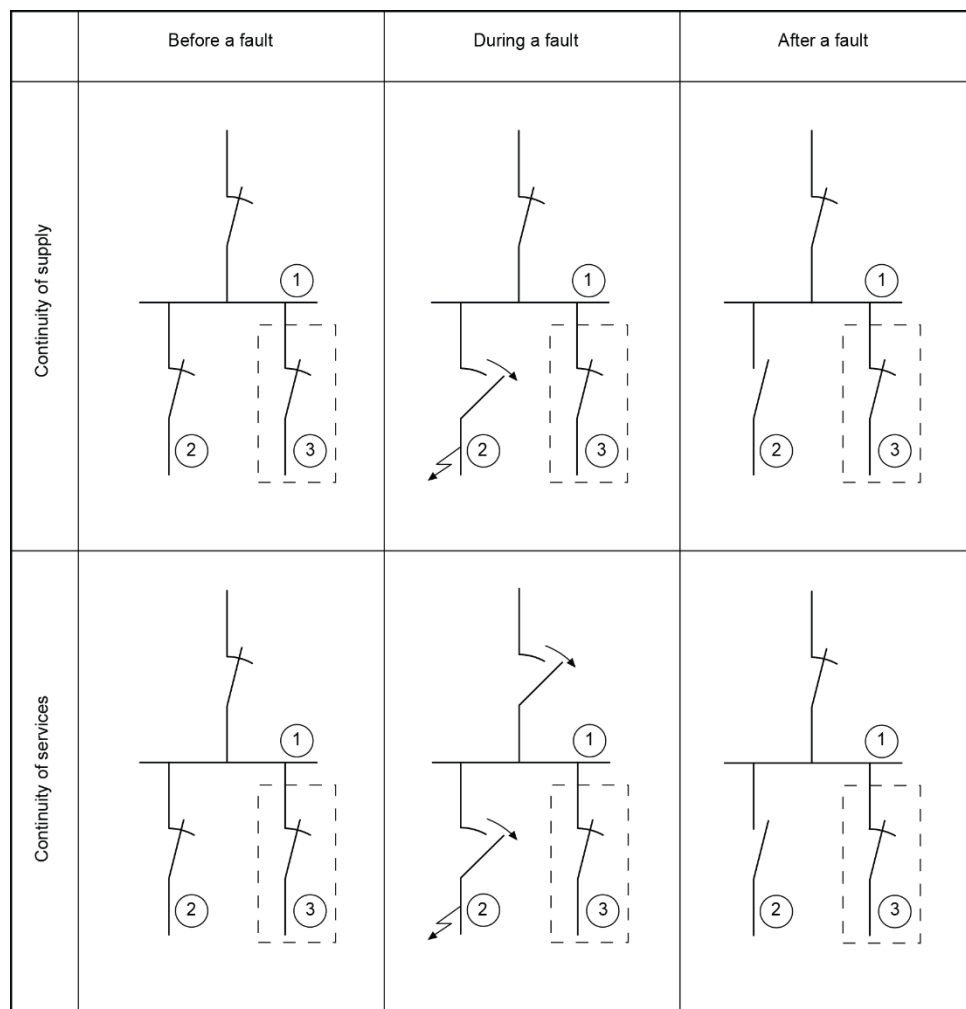
3.1.10**computer-based system**

system that consists of one or more programmable electronic devices with their connections, peripherals and software necessary to carry out automatically specified functions

3.1.11**continuity of service**

condition where, after a fault in a circuit has been cleared, the supply to healthy circuits is re-established

Note 1 to entry: See circuit 3 in Figure 1.



IEC

Figure 1 – Continuity of supply/continuity of service

3.1.12**continuity of supply**

condition where, during and after a fault in a circuit, the supply to healthy circuits is permanently ensured

Note 1 to entry: See circuit 3 in Figure 1.

3.1.13**control function**

functions intended to regulate the behaviour of equipment or systems

3.1.14**control position****control station**

group of control devices by which an operator can control the performance of a machine, apparatus, process or assembly of machines and apparatuses

3.1.15**DC systems of distribution****3.1.15.1****two-wire DC system**

DC system comprising two conductors only, between which the load is connected

3.1.15.2**three-wire DC system**

DC system comprising two conductors and a middle wire, the supply being taken from the two outer conductors or from the middle wire and either outer conductor, the middle wire carrying the difference-current only

3.1.16**demand factor**

ratio, expressed as a numerical value or as a percentage, of the maximum demand of an installation or a group of installations, to the corresponding total installed load of the installation(s)

[SOURCE: IEC 691-10-05, modified – The words "within a specified period" have been deleted from the definition and the note to entry has been deleted.]

3.1.17**coincidence factor**

ratio, expressed as a numerical value or as a percentage, of the simultaneous maximum demand of a group of electrical appliances or consumers within a specified period, to the sum of their individual maximum demands within the same period

[SOURCE: IEC 691-10-03, modified – The note to entry has been deleted.]

3.1.18**diversity factor**

ratio, expressed as a numerical value or as a percentage, of the sum of the individual maximum demands of a group of electrical appliances or consumers within a specified period, to their simultaneous maximum demand within the same period

Note 1 to entry: The diversity factor is the reciprocal of the coincidence factor.

3.1.19**fiscal metering**

metering at a point of logged transaction that takes place any time measurable quantities of electric energy are passed from the possession of one party to another

3.1.20**function**

elementary operation performed by the system which, in conjunction with other elementary operations (system functions), enables the system to perform a task

3.1.21**high voltage**

set of voltage levels in excess of low voltage

[SOURCE: IEC 601-01-27, modified – The restrictive sense of the term and the abbreviated term have been omitted.]

3.1.22**lithium cell**

cell containing a non-aqueous electrolyte and a negative electrode of lithium or containing lithium

Note 1 to entry: Depending on the design features chosen, a lithium cell may be primary or secondary.

[SOURCE: IEC 482-01-06]

3.1.23**low voltage**

set of voltage levels used for the distribution of electricity and whose upper limit is generally accepted to be 1 000 V AC or 1 500 V DC

[SOURCE: IEC 601-01-26, modified – The DC voltage has been added.]

3.1.24**hull return system**

system in which insulated conductors are provided for connection to one pole or phase of the supply, the structure of the unit or other permanently earthed structure being used for effecting connections to the other pole or phase

3.1.25**integrity**

capability of a system to satisfactorily perform the required functions under all the stated conditions within a stated period of time

3.1.26**control room**

room or spaces where centralized controls and measuring and monitoring equipment for main equipment and essential auxiliary machinery are located together with the appropriate means of communication

3.1.27**molten salt cell**

cell with an electrolyte consisting of one or more hydrous molten salts

Note 1 to entry: The molten salt may be in a solid(inactivated) state and is activated by heat.

SOURCE: IEC 482-01-07)

3.1.28**overcurrent**

current exceeding the rated current

[SOURCE: IEC 441-11-06]

3.1.29**overcurrent discrimination**

co-ordination of the operating characteristics of two or more overcurrent protective devices such that, on the incidence of overcurrents within stated limits, the device intended to operate within these limits does so, while the other(s) does (do) not

[SOURCE: IEC 441-17-15, modified – The note to entry has been deleted.]

3.1.30**overload**

operating conditions in an electrically undamaged circuit, which cause an overcurrent

[SOURCE: IEC 441-11-08]

3.1.31**partial discrimination****partial selectivity**

overcurrent discrimination where, in the presence of two or more overcurrent protective devices in series, the protective device closest to the fault effects the protection up to a given level of short-circuit current without causing the other protective devices to operate

3.1.32**thermal runaway**

unstable condition arising during constant voltage charge in which the rate of heat dissipation capability, causing a continuous temperature increase, with resulting further charge current increase, which can lead to the destruction of the battery

Note 1 to entry: In lithium batteries thermal runaway may cause melting of lithium.

[SOURCE: IEC 482-05-54]

3.1.33**total discrimination**

overcurrent discrimination where, in the presence of two or more overcurrent protective devices in series, the protective device on the load side effects the protection without causing the other protective devices to operate

3.1.34**reliability**

probability that an item can perform a required function under given conditions for a given time interval

3.1.35**safety function**

functions intended to prevent harm or danger to personnel, equipment and unit

3.1.36**short-circuit**

accidental or intentional conductive path between two or more conductive parts forcing the electric potential differences between these conductive parts to be equal to or close to zero

[SOURCE: IEC 60050-195:1998, 195-04-11]

3.1.37**software**

programme, procedures and associated documentation pertaining to the operation of a computer system and including application (user) programme, middleware and operating system (firmware) programme

3.1.38
sources of electrical power

3.1.38.1

emergency source of electrical power

source of electrical power intended to supply the emergency system in the event of failure of the supply from the main source of electrical power

3.1.38.2

essential source of electrical power

source of electrical power intended to supply the services necessary to maintain the unit in habitable condition and the equipment necessary for asset preservation, standby and re-starting

Note 1 to entry: A fuel or energy source independent of the production status shall be available.

3.1.38.3

main source of electrical power

source of electrical power intended to supply all services necessary for maintaining the unit in normal operational and habitable condition

3.1.39

system

collection of components organised to accomplish a specific function or set of functions

3.1.40

energy management and control system

EMCS

comprehensive monitoring and control system covering entire energy systems with a typical focus on operational status, operational forecasts, transfer between operational modes, periodic testing of equipment, and identification of operational fall-backs during a fault

Note 1 to entry: This note applies to the French language only.

3.1.41

voltage dip

sudden reduction of the voltage at a point in the system, followed by voltage recovery after a short period of time, from a few cycles to a few seconds

[SOURCE: IEC 60050-161:1990, 161-08-10, modified – The wording "an electrical system" has been replaced by "the system".]

3.1.42

voltage drop

change of the voltage between two given terminals of an electric circuit due to the change of the operating conditions

[SOURCE: IEC 60050-151:2001, 151-15-09, modified – The second preferred term "tension drop" has been omitted.]

3.1.43

single point mooring

mooring to the seabed arranged from a single location on a floating unit with multiple mooring lines

3.1.44

spread mooring system

multi-point mooring system that moor a floating unit to the seabed using multiple mooring lines and where the mooring lines can be directly attached to strong structural points in the hull of the vessel as well as indirectly using conventional buoy mooring systems on the sea surface

3.1.45**turret**

cylindrical single point mooring system geostationary with the seabed allowing rotation of the FPSO or FSO vessel in response to wave and wind conditions (weathervaning)

3.1.46**fluid transfer system****FTS**

method of transfer of fluids via a geostationary turret to the floating unit's process plant, its storage systems and subsea transport systems, including exchange of electric power and information

Note 1 to entry: This note applies to the French language only.

3.1.47**weathervaning**

rotation of the floating unit about a geostationary turret in response to wind, wave and sea current conditions

3.1.48**free weathervaning**

free-wheeling turret systems which allow rotation through 360° and are equipped with swivels in the fluid transfer system

3.1.49**partial weathervaning**

restricted rotation of the floating unit about the turret

EXAMPLE For turrets with drag chain fluid transfer systems, the unit's sector orientation is limited up to maximum of $\pm 270^\circ$ in either direction.

3.1.50**unmanned offshore unit**

offshore unit normally unmanned, remote controlled without need of human presence for operability and without living quarter facilities

Note 1 to entry: An unmanned offshore unit may also contain a survival shelter to support occasional site maintenance.

3.1.51**manned offshore unit**

offshore unit with need of human presence for operation and maintenance, and provided with living quarter facility

3.1.52**satellite unit**

small offshore unit, normally unmanned, connected to a larger unit by means of a pipeline, power cable and/or umbilical

3.1.53**distribution board**

assembly containing different types of switchgear and controlgear associated with one or more outgoing electric circuits fed from one or more incoming electric circuits, together with terminals for the neutral and protective conductors, if required

[SOURCE: IEC 826-16-08, modified – The words "if required" have been added.]

main earth (reference earth)
ground

part of the Earth considered as conductive, the electric potential of which is conventionally taken as zero, being outside the zone of influence of any earthing arrangement

Note 1 to entry: The concept "Earth" means the planet and all its physical matter.

Note 2 to entry: The general mass of the metal structure or hull of the mobile or fixed unit.

[SOURCE: IEC 195-01-01, modified: Synonymous term "main earth" added, Note 2 added]

3.1.54

earth, verb
ground, verb US

to make an electric connection between a conductive part and a local earth

Note 1 to entry: The connection to local earth can be

- intentional, or
- unintentional or accidental

and can be permanent or temporary.

[SOURCE: IEC 195-01-08]

3.1.55

3.1.56

emergency service

services required to allow safe shutdown of the unit and provide safety oriented services for the personnel on the unit during an emergency situation for a defined time

EXAMPLE Emergency shutdown system, emergency lighting, firefighting, alarm and telecommunication systems are examples of emergency services.

3.1.57

essential service

services required to maintain the unit in a defined state of readiness and habitation for a period defined by the user for situations other than normal operation and without recourse to the emergency source of power except than in an emergency situation

3.1.58

PEN conductor

conductor combining the functions of both a protective earthing conductor and a neutral conductor

[SOURCE: IEC 195-02-12]

3.1.59

PEL conductor

conductor combining the functions of both a protective earthing conductor and a line conductor

[SOURCE: IEC 195-02-14]

3.2 Abbreviated terms

CCVT closed cycle vapour turbine

PE protective earth

IE	instrument earth
AVR	automatic voltage regulator
FCL	fault current limiter
IED	intelligent electronic device
CCR	central control room
HVDC VSC	high-voltage direct current voltage source converter
DOL	direct on line
FPSO	floating production storage and offloading unit
FSO	floating storage and offloading unit
HiL	hardware-in-the-loop test
F&G	fire and gas
ESD	emergency Shut Down
EMCS	energy Management and Control System
DP	dynamic Positioning
DPS	dynamic Positioning System
IT	insulated Terra / Isolée Terre
UPS	uninterruptible Power Supply
FCL	fault current limiter

810

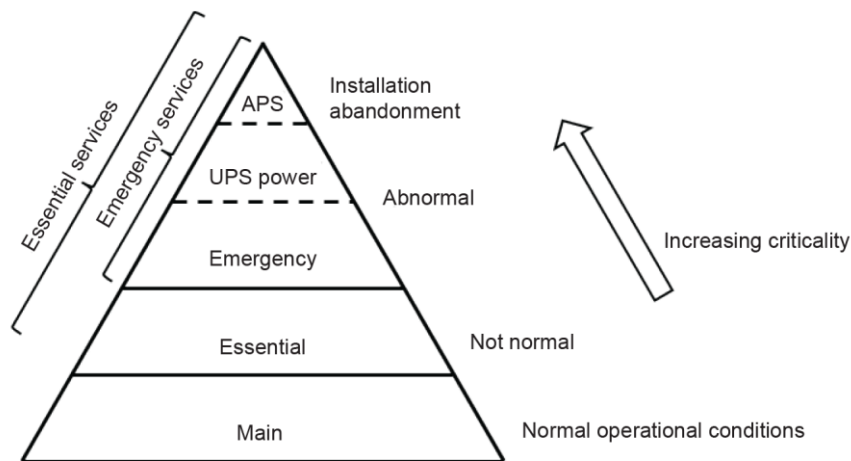
811 **4 Sources of electrical power for manned units**812 **4.1 General**

813 The requirements of Clause 4 apply to manned units. For unmanned units, the requirements of
814 Clause 5 apply.

815 Electrical installations shall be such that

- 816 a) all electrical services necessary for maintaining the unit in normal operational and habitable
817 condition shall be assured without recourse to the emergency source of electrical power,
- 818 b) the electrical system for offshore units shall have a layered structure to provide increasingly
819 resilient sources of electrical power for increasingly important services under progressively
820 onerous conditions of operation, and

- c) as a minimum, all units shall have a main source of power and an emergency source of electrical power, unless the main source of electrical power is designed to also serve as the emergency source of power.



IEC

APS (abandon platform shutdown), or AVS (abandon vessel shutdown).

NOTE 1 APS is not an APS power source feeding consumers, but is mentioned to illustrate that some safety critical equipment can be kept live after initiating APS and isolating of the UPS battery systems by use of own battery. This includes for example maritime navigational aid systems and escape route light fixtures with internal batteries.

NOTE 2 The term "unit" is used instead of "platform" in this document; however the term "APS" is commonly used in the industry to designate the last level of shutdown of a unit.

NOTE 3 Not all units will require all categories of sources of electrical power. The provision of essential power is more typical for large manned units.

Figure 2 – Power system hierarchy in an offshore unit

A typical example of a power system hierarchy in an offshore unit is given in Figure 2.

The failure of a lower priority source of electrical power shall not prevent higher priority sources of electrical power from performing their required function. UPS units shall be able to complete their duty for the full length of their design autonomy period without overheating due to loss of ventilation normally fed by lower criticality sources of electrical power.

Where specific loads require other tolerances for voltages in order to maintain functionality or performance, then specific calculations should be made to confirm values of voltage drop, particularly in cables.

For mobile units, reference shall be made to the IMO MODU Code.

4.2 Main sources of electrical power

4.2.1 Common requirements

Main source of electrical power shall be available by at least two independent power sources. An assignment of N+1 (one single redundancy) main power source arrangements shall be considered.

The minimum requirement related to redundant main sources of electrical power may be fulfilled for example by

- a) two main generators,
- b) one main generator and one essential generator,
- c) two independent external cable supplies from shore or other offshore units, and
- d) one external cable supply (normally main power supply) and one local generator (main or essential).

NOTE Independent renewable sources of power (e.g. wind farms) could be considered in c) and d) provided that the required capacity and continuity of supply is met.

Where transformers, converters or similar equipment constitute a part of the main power system, the system shall be so arranged as to ensure the same continuity of supply as stated in 4.2.

The subdivision of the requested power generation capacity in more than two power sources can improve efficiency for power generation systems operating at part load and with variable loads, and guarantee high system flexibility during unit life. Such design arrangements, for example $3 \times 50\%$ or $4 \times 33\%$, may otherwise relieve developers of unwanted high fault currents.

Adoption of Battery Energy Storage System (BEES) to reduce spinning reserve and environmental emissions associated with part loaded spinning generation could be considered.

Decisions taken at an early stage, due to the long delivery time for equipment such as main gas turbine generator sets, will have a subsequent influence on the fault level for example. So as not to put electrical system design limits at risk with later implications of major nature, the electrical system requirements shall be analysed and specified at the time of selection of such equipment.

4.2.2 Capacity of main and essential power source

The capacity of the main and essential power sources should be such that, in the event of any one power source being unavailable, it shall still be possible, without recourse to the emergency source of electrical power, to supply those services necessary to provide

- a) normal operational conditions (however, it may not be required that full production shall be maintained with one power source being unavailable),
- b) comfortable conditions of habitability, and
- c) asset preservation for a defined standby period of time.

Auxiliary systems supporting main and essential power sources, such as air intakes, fuel system, cooling system, lubrication system, and control system for the generator sets, should be segregated as far as possible to reduce common mode failures.

The functioning of the emergency source of power shall be ensured in the event of a fire or other casualty in the space(s) containing the main and/or essential power system.

4.2.3 Load shedding arrangement

If the electrical power is normally supplied by more than one generator operating in parallel, provisions shall be made by means such as load shedding or by appropriate separation of the switchboard busbar to ensure that, in the event of loss of one of these generating sets, the remaining set(s) are kept in operation without overload to permit station-keeping, propulsion and steering, and to ensure the safety of the unit.

Where the load consists of essential services and non-essential services, consideration shall be given to a load shedding arrangement which will automatically exclude non-essential services when any one generator becomes overloaded and which will function to prevent the overload ability of the generating sets being exceeded.

897 For fixed units, load shedding priority levels shall be affected to loads in order to minimize the
898 impact of load shedding on drilling, production, and off-loading operations.

899 When a dynamic positioning system (DPS) is used for station-keeping of the unit, the line-up of
900 the unit's electrical power generation system shall be in accordance with IMO MSC.1/Circ. 1580
901 and the DP equipment class specified by the appropriate authority.

902 **4.3 Essential source of electrical power**

903 An essential source of power is an optional non-emergency power source. Safety does not
904 depend on the performance of the essential power system as this function is provided by the
905 emergency source(s) of power, should the essential source of power fail.

906 The provision of essential source of power is more likely on

- 907 a) large manned units,
- 908 b) on manned units on which the main source of power is a single imported power cable
909 connection,
- 910 c) on units where the main generating sets are unsuited to operation outside normal production
911 conditions
- 912 d) where the restart power requirements are too large to be supported by the emergency
913 source of power, and
- 914 e) on units which require back-up power in order to secure drilling operations upon loss of main
915 source of power

916 The following requirements to essential source of power is applicable but not limited to:

- 917 1) the capacity of the essential generator shall as a minimum meet the requirements of 4.2.2
918 b) and c), (see also Annex A);
- 919 2) requirements regarding the location of essential power sources shall be identified;
- 920 3) the essential source of electrical power shall not be the same as the emergency source of
921 electrical power;

922 When the main power supply system consists of several main power sources, a main source of
923 electrical power may be used as an essential source of power if all the functional requirements
924 in relation to an essential source of power are met.

925 The essential generator should start automatically upon failure of the supply from the main
926 source of electrical power to the switchboard, to which the essential generator is connected.

927 **4.4 Emergency source of electrical power**

928 **4.4.1** A self-contained emergency source of electrical power shall be provided as required
929 by the appropriate authority. Provided that suitable measures are taken for safeguarding
930 independent emergency operation under all circumstances, the emergency source of electrical
931 power may, in exceptional cases and for periods of short duration, be used to supply
932 non-emergency circuits subject to the agreement of the appropriate authority.

933 The emergency source of electrical power shall be sufficient to supply all those services that
934 are considered mandatory and safety oriented in a case of emergency for at least 18 h or for
935 the time defined by the unit specific safety strategy. Due regard shall be paid to such services
936 as may have to be operated simultaneously.

937 **4.4.2** The emergency power supply system shall comprise a combination of a transitional
938 power source (e.g. UPS with energy storage elements), and a diesel engine driven generator.
939 For fixed offshore units, a power cable from another independent unit may be considered as an
940 alternative to a diesel driven engine, depending on the approval of the appropriate authority.

For units where emergency consumption is limited, UPS with energy storage elements can be used as source for the entire emergency power requirement.

NOTE A diesel engine can have several ratings, for example standby (time at full load not to exceed 5 % of the duty cycle), intermittent (time at full load not to exceed 50 %) and continuous. Further information can be found in ISO 3046-1.

For examples of emergency power load, see Annex B.

In systems where a separate emergency generator is used, the emergency switchboard and the emergency generator should be located in separate rooms close to each other within the same fire zone. Emergency main distribution board for lighting and small power should be located in the emergency switchboard room. There is no such restriction concerning emergency sub-distribution panels.

For units where the main source of electrical power is located in more than one space, the requirements of 4.4.1 may be considered satisfied without an additional emergency source of electrical power, subject to approval of the appropriate authority, provided the conditions in 4.4.2 a) through f) are fulfilled:

- a) there are at least two generator spaces; and
- b) for each generator space there is a wide separation of prime-mover air intakes, prime-mover auxiliaries, and of switchboard interconnection (bus-tie) cables; and
- c) a fire, explosion, flooding or other casualties in any one of the spaces will not affect the power distribution from the others, or to the services required by the appropriate authority; and
- d) if two generator spaces, there are at least two generators in each of the two spaces; or if three or more generator spaces, at least one generator in each space; and
- e) at least two of the generators in two different spaces comply with the requirement as to emergency generators given in 4.4.4 and 4.4.5 and these two generator spaces have their own systems, including power distribution and control systems, completely independent of the systems in the other spaces; and
- f) the emergency switchboard shall be located in a room separate from the fire zone where the generators are located, with independent supplies from the two (or more) generators described in 4.4.2 e). The cable routing of the supplies shall be separated.
- g) As an alternative to an emergency switchboard, the emergency consumers are to be redundant, each consumer with separate supplies from main switchboards in separate fire zones.

In case of using a dedicated emergency switchboard to feed emergency consumers to be used in an emergency, this emergency switchboard is to be fed by both main switchboards.

If consumers to be used in an emergency are redundant, each redundant system shall be fed by different main switchboards.

In both cases, the redundant systems including associated switchboards are to be located in different fire zones.

The requirement in e) will normally require a separate control system for these generators, and with only the minimum protection as allowed for in 4.4.5, when operated as an emergency generator.

The power available, duration of supply and services provided for safety in an emergency shall be as defined in the unit specific safety strategy or as required by the appropriate authority.

4.4.3 The emergency source of electrical power, any associated fuel storage and transforming equipment, the emergency switchboard and related cables shall be separated from

987 any machinery space containing the main source of electrical power, by classified partitions as
988 defined in the IMO MODU Code.

989 The emergency generator, its ventilation and combustion air intakes, emergency switchgear,
990 transformers and further peripherals shall be located above the worst damage waterline, in a
991 place not susceptible to collision by another vessel, with easy access. The location of the
992 openings shall not be susceptible to incoming water (sea water, spill water, etc.).

993 The intake air louvers shall be adequately sheltered and protected against water ingress.

994 The emergency power system shall be arranged to permit total electrical separation from the
995 main power system. During normal service, interconnection from the main switchboard shall
996 supply power to the emergency switchboard provided that automatic interruption of the
997 interconnection at the emergency switchboard is ensured in the event of failure of the main
998 source of electrical power.

999 The electrical, process and utility systems should remain operative for a short period with a
1000 disconnection of power supply to emergency switchboard. This design measure will enable a
1001 test of the automatic starting arrangement for the emergency generator without affecting the
1002 unit's production process or its utility functions. An alternative method to obtain the same
1003 functionality is provision for temporary parallel operation between the main and the emergency
1004 source of power or dedicated load banks should be considered.

1005 For floating fixed units, the emergency power shall be able to function at damaged conditions
1006 as given in the stability study for the unit. If no such information is available, the values given
1007 in IEC 61892-5 may be used as guidance.

1008 Requirements concerning the functioning of the emergency generator on mobile units are given
1009 in IEC 61892-5.

1010 **4.4.4** Where the emergency source of electrical power is a generator, it shall be

- 1011 a) driven by a suitable prime mover with an independent supply of fuel, combustion air, cooling
1012 medium, and with a mechanical overspeed protection (shutoff valve/rig saver),
1013 b) started automatically upon loss of electrical power supply to the emergency switchboard ,
1014 and it shall be automatically connected to the emergency system, and
1015 c) provided with a transitional source of emergency electrical power according to 4.7.

1016 NOTE For the starting arrangements of emergency generators, see 4.5.

1017 **4.4.5** Prime movers for emergency generators shall have as few automatic safety functions
1018 as possible in order to ensure continuous operation. Normal prime mover and generator
1019 protection shall be provided if running unattended for test of the emergency generator or if it is
1020 used as a harbour generator.

1021 **4.4.6** Where the emergency source of electrical power is an accumulator battery, the
1022 following applies:

- 1023 a) the emergency source of electrical power shall carry the emergency electrical load without
1024 recharging whilst maintaining the voltage of the battery throughout the discharge period
1025 within $\pm 15\%$ of its nominal voltage; where the emergency and/or transitional emergency
1026 loads are supplied from a battery via an electronic converter or inverter, the maximum
1027 permitted DC voltage variations are to be taken as those not exceeding acceptable
1028 variations on the load side of the converter or inverter;
1029 b) DC distribution system voltage tolerances below -15% may be considered for deep
1030 discharge tolerant batteries provided that the connected DC loads are rated to perform their
1031 intended function without impairment at these stated wider voltage tolerances;

c) the requirements of IEC 61892-1:2019, Table 3, do not apply to equipment items with integral battery; wider DC voltage tolerances are permissible if the equipment is rated to fulfil their intended function without impairment during the required autonomy period;

d) the emergency source of electrical power shall connect automatically to the emergency switchboard in the event of failure of the main source of electrical power supply; and

e) the emergency source of electrical power shall immediately supply at least those services required for the transitional source of electrical power.

4.4.7 The transitional (uninterruptible) source of emergency electrical power shall consist of an accumulator battery suitably located for use in an emergency. It shall be arranged so as to automatically supply the services required in the event of failure of any of the main, essential or emergency source of electrical power. The battery discharging capacity shall be sufficient for a period of at least 30 minutes or for the period defined in the unit specific emergency and evacuation strategy or by the appropriate authority.

NOTE For further information see Annex B

4.4.8 Discharging of an emergency battery shall give indication/alarm at a manned station.

4.4.9 Trip of supply to emergency lighting shall give an alarm at a manned station.

4.4.10 Provisions shall be made for the testing at regular intervals of the complete emergency power system and shall include the testing of the automatic starting arrangements and any transitional systems. Testing at regular intervals shall also cover load operations and battery discharge operations.

Fast transfer of load from emergency power to main power or the opposite with a transfer time of less than three seconds does not require design for short-circuit of the combined system. However, this is not applicable if testing of the emergency generator is done by parallel operation of the emergency generator and main power system.

4.4.11 All testing, manual operation, starting, transfers of power and stopping of the emergency generator shall be possible to be performed by one operator at one location (e.g. the emergency generator control panel).

4.5 Starting arrangements for emergency generators

4.5.1 Each emergency generator shall be automatically started and be capable of supplying the required services within 45 s. The starting arrangements shall be acceptable to the appropriate authority and with a storage energy capability of at least three consecutive starts. A second source of energy shall be provided for an additional three starts within 30 min.

4.5.2 Where both the main and secondary source of energy arrangements is electrical, the systems shall be independent and include two chargers, and two batteries. When both of the sources of energy are pneumatic, the systems shall include two air receivers.

Consideration should be given to the provision of two starter motors.

Air receiver accumulators for dampers in combustion air intake and room ventilation should be considered as start-up permissive for the emergency generator.

NOTE If the emergency generator supplies fire water pumps, the requirements of NFPA 20 apply.

4.5.3 All starting, charging and energy-storing devices shall be located in the emergency generator room. These devices shall not be used for any purpose other than the operation of the emergency generator set. This does not preclude the supply to the air receivers of the emergency generator set from the main or auxiliary compressed air system through non-return valves fitted in the emergency generator room.

1076 **4.5.4** For a unit which is normally manned, the readiness of the emergency generator to start
1077 shall be indicated in a manned location, for example, the control room.

1078 The integrity of the automatic starting and control systems of the emergency generator shall be
1079 ensured in the event of fire in the manned control location or control room. An emergency stop
1080 for the emergency generator shall be located inside the emergency generator room. In addition,
1081 it shall be possible to manually close the fuel oil shut-off valve from outside the room.

1082 **4.6 Additional requirements for periodically unattended machinery spaces**

1083 **4.6.1** Units intended for operation with periodically unattended machinery spaces shall
1084 comply with 4.6.2 to 4.6.5 inclusive.

1085 NOTE The term "unattended" is used both in the IMO SOLAS Convention, Consolidated Edition 2014, and in the
1086 IMO 2009 MODU Code, 2010 edition. However, neither of those publications contains any definition of the term.

1087 **4.6.2** In the event of failure of the generating set(s) in service, provision shall be made for
1088 the automatic starting and connection to the main switchboard of a standby generating set of
1089 sufficient capacity to supply those services necessary to ensure that the safety of the unit with
1090 regard to station-keeping, propulsion and steering, is at least equivalent to that of a unit having
1091 the machinery space manned.

1092 **4.6.3** The arrangement shall permit automatic re-starting of essential services, which may
1093 be sequentially started if necessary.

1094 **4.6.4** The automatic starting system and characteristics of the standby generating set shall
1095 be such as to permit the standby generator to carry its full load as quickly as is safe and
1096 practicable.

1097 **4.6.5** Arrangements shall be provided to prevent more than one (1) automatic closing of a
1098 given generator circuit-breaker under short-circuit conditions at the generator switchgear.

1099 **4.7 Uninterruptible power system (UPS) source of power**

1100 **4.7.1 General**

1101 The requirements of 4.7 are for UPS, which is part of the emergency source of electrical power
1102 (see 4.4.2 and 4.4.4). The requirement of UPS, being part of an emergency system, fulfils the
1103 requirements for the transitional source of power described in 4.4.2 and 4.4.4. The detailed
1104 requirements for UPS for other purposes have to be set by the project. An example is a UPS
1105 for consumers which can malfunction upon voltage transients, including temporary situations
1106 with reduced supply voltage quality.

1107 UPS for other purposes shall have the same requirements in terms of ventilation, battery
1108 installation, and distribution.

1109 This document refers to IEC 62040-1, IEC 62040-2 and IEC 62040-3 as the UPS equipment
1110 standard.

1111 UPS battery normative guidelines and equipment standards are referred to in IEC 61892-3.

1112 NOTE New battery technologies developed for automotive and shipping industries can be referred to as being fit
1113 for service in UPS applications on offshore units. The high energy density and fast charge-discharge cycles in new
1114 battery technologies can add flexibility in the design planning of emergency, main and essential sources of power,
1115 with energy storage elements distributed in various unit locations. In particular, the energy storage elements can be
1116 assigned integral to distributed load controllers, subject to approval by the applicable authority.

1117 UPS semiconductor converters are described in IEC 62040-3, while rotary UPS equipment is
1118 only referenced.

4.7.2 UPS functionality – Uninterruptible source of power for critical/sensitive loads

The following applies to UPS for critical/sensitive loads:

- a) the UPS source of power may be provided by AC or DC UPS;
- b) the UPS shall be designed with energy storage elements;
- c) minimum autonomy time shall be 30 min unless otherwise required by the applicable authorities; the autonomy time as power source to critical/sensitive loads shall be as required in design or by the applicable authority, or if any alternative autonomy time is defined, it shall be specified and/or approved by the owner of the unit;
- d) a need for periodic maintenance, replacement and repair due to maximum design lifetime of integral UPS components shall be identified and verified by statement of the UPS manufacturer.

The UPS shall be designed so as to automatically supply sufficient power to connected loads in the event of failure or shutdown of all other sources of electrical power, to operate for a period as defined by the safety assessment for the unit.

The following UPS supplied equipment is to be in operation after an emergency shutdown:

- 1) the emergency lighting located at the control stations, along every evacuation route, at muster stations, temporary refuge, embarkation area or means of escape to the sea;
- 2) public address systems and the abandonment alarm system;
- 3) helicopter landing areas and related approach alarm systems;
- 4) external emergency communication systems;
- 5) blow-out preventer, power unit and control systems;
- 6) general alarm systems;

These abandonment loads shall not be automatically disconnected except for end of discharge protection of batteries.

4.7.3 UPS – Design planning issues

Configuration – UPS configuration alternatives are referred to in IEC 62040-3:2021, Annex A.

In normal mode of operation, with fully charged batteries or with UPS by-pass in operation, the UPS shall maintain full selectivity and protection effectiveness within the distribution. In UPS-mode of operations, this should be the aim for as long as possible.

Supply arrangement – In emergency systems which include an emergency generator, the UPS shall be charged from this emergency switchboard. In case of dual redundant UPS, then at least one of the two shall be charged from the emergency switchboard.

For the recharge of energy storage elements, typically batteries, the power source shall have the capacity to both simultaneously recharge the batteries within a specified time and supply power to distributed UPS loads. Recharge of energy storage elements is normally carried out by the main power sources and, only in the event of unavailability of these, by emergency source. Arrangements for charging of batteries from alternative power sources, such as essential power where present, should be considered.

For UPS units providing a power supply to safety and emergency functions, an external bypass that is hardwired and manually operated is to be provided to the UPS, to allow for isolation of the UPS for safety during maintenance and to maintain continuity of load power. Such UPS are to be charged from the emergency system.

Dependability – UPS in configurations that serve to increase reliability, for example by paralleling more UPS units, or by multiple redundant integral UPS components or more

1163 paralleled UPS energy storage elements, shall have all necessary provisions to secure
1164 continued UPS load services after occurrence of a fault in one redundant item.

1165 Location – UPS equipment shall be installed in rooms fit for emergency and critical load
1166 services, with controlled ambient temperatures and clean operating conditions.

1167 Batteries may be installed in battery rooms or together with UPS converters and UPS main
1168 distribution boards. Battery technology that emits explosive gases shall be installed in battery
1169 rooms, according to hazardous area classification.

1170 NOTE Requirements concerning the location of batteries are given in Clause 9 and Table 1 of IEC 61892-6:2019.

1171 These items shall be defined in advance:

- 1172 a) battery protection and isolation devices;
- 1173 b) shutdown control of battery;
- 1174 c) recovery from blackout and dead start conditions;
- 1175 d) exposure to shock, tilting or vibrations;
- 1176 e) load fault clearing capability in UPS energy storage mode (on battery).

1177 Load distribution – UPS installations can be arranged in a centralized or decentralized manner.
1178 UPS main distribution boards and sub-distribution boards will normally be used for centralized
1179 large rated UPS. In both events, a safe fault clearing capacity at load side shall be verified for
1180 all relevant operating modes of the UPS, including both the UPS minimum (operation in battery-
1181 inverter mode) and maximum design capacity (in bypass operation or with a maximum number
1182 of battery-inverter mode units in service) to deliver short-circuit current. The selectivity in a load
1183 distribution will be influenced by the short-circuit current provided by the UPS and the
1184 combination of trip characteristics established in the UPS main and sub-distribution boards.
1185 Special attention is required with respect to inrush current and saturation distortions in
1186 consumer elements.

1187 Monitoring – Comprehensive UPS status monitoring is mandatory as it forms part of a number
1188 of vital and critical load services in emergency and abandonment conditions. Upon failure of
1189 the power supply to safety and emergency functions, an alarm to an operator attended location
1190 shall be initiated unless loss of function will otherwise be unambiguously alarmed. In case of
1191 duplicated or independent power supplies, both supplies shall be monitored. UPS unit
1192 abnormal/fault conditions which could lead to loss of UPS supply shall be alarmed, as a common
1193 alarm or individually, to an operator attended location.

1194 UPS alarms should have a one-minute delay at loss of input power, in order to avoid alarm
1195 flooding before start-up of any standby or emergency generator feeding the input circuit.

1196 The fire and/or blast survivability requirements for compartments containing UPS units
1197 supporting safety and emergency functions shall not be less than the survivability requirements
1198 for the equipment that they serve, or shall otherwise be separated from fire/blast hazard by
1199 fire/blast walls or by safe distance.

1200 Maintenance provisions – UPS maintenance procedures shall be defined for the individual UPS
1201 unit. The procedures shall include reference to fulfilment of service requirements set by the
1202 applicable authority, and logs of any maintenance work undertaken by operators or by external
1203 servicemen representing the UPS supplier or manufacturer.

1204 DC load side UPS equipment may form an alternative to AC load side UPS equipment. The
1205 ability to serve DC UPS voltage within acceptable design tolerances may prove favourable in
1206 terms of simplicity in design and constitute an alternative for defined load services that accept
1207 DC.

1208 UPS availability calculations – When the reliability integrity level of the UPS is requested, it
1209 shall be guided by IEC 62040-3:2021, Annex K.

1210 **4.8 Transmission systems including main power from shore**

1211 **4.8.1** Subclause 4.8 gives additional requirements regarding electrically interconnected
1212 units, including units with power from shore.

1213 **4.8.2** For offshore units which only import/receive power via electrical interconnector(s) and
1214 do not re-export such import power, simplified design and control measures in system operation
1215 will apply. Examples could be production facilities connected to a field centre or to other
1216 offshore and shore side located processing facilities, floating storage units, self-elevated drilling
1217 rigs, unmanned offshore units like remotely controlled wellhead units and satellite units.

1218 In the event of re-export of import power to another unit, additional measures concerning design
1219 and system operation will apply. Long distances may introduce a need to add compensation
1220 equipment and control equipment for the other unit interconnector(s). The design and control
1221 measures shall also cover any sequential influences on the importing interconnector.

1222 For large offshore units where bidirectional power exchange between generating sets on more
1223 facilities shall be possible, a comprehensive analysis of design and control measures shall take
1224 place to define the system requirements, operational limitations that may influence the design
1225 of the cable interconnector, and the primary equipment connected for all relevant modes of
1226 operation, when interconnected and when in autonomous operation, without interconnector.

1227 Any hunting effect between governors and various source controllers in any connected primary
1228 equipment shall be avoided when designing such systems.

1229 For electrically interconnected facilities, it shall be necessary to arrange for an overall power
1230 control central in one unit at a minimum, with a breaker manoeuvring hierarchy that clarifies
1231 operational priorities via the electric interconnector(s) to all interconnected facilities. Fiscal
1232 metering of energy transport and various operational costs running the interconnector(s) shall
1233 be monitored and logged by the various facilities when considered necessary. The
1234 interconnectors may be equipped with distance protection to identify and clear cable faults fast.

1235 NOTE 1 For converter installations offshore where the requirements of this document may not be sufficient,
1236 guidance can be found in IEC 61936-1 and IEC TS 61936-2.

1237 NOTE 2 For system aspects of electrical energy supply, guidance can be found in standards issued by IEC TC 8.
1238 For HV DC transmission systems, guidance can be found in standards issued by IEC TC 115.

1239 **4.8.3** It is recognized that, in power systems run by land based utilities, solid earthed neutral
1240 is regularly used in high-voltage transmission networks, where insulation costs are high. In this
1241 solution, a low-impedance path is provided for the earth-fault current to close and, as result, its
1242 magnitude is comparable with three-phase fault currents. Since the neutral remains at the
1243 potential close to the earth, voltages in unaffected phases remain at levels similar to the pre-
1244 fault ones.

1245 For long distance sea cables, the ability to transfer active power is reduced due to the capacitive
1246 coupling to earth. Countermeasures shall have to be defined to compensate for reactive
1247 currents in the event that the total loading of the cable exceeds its limits of permissible
1248 operation. Influence of reduced cooling in shallow waters, in open air, in risers and J-tubes, and
1249 sun exposed deck areas may effectively de-rate a sea cable's calculated thermal capacity.

1250 The selected transmission voltage will depend on project-specific conditions and may need to
1251 be simulated and verified by design calculations or by use of relevant design experience data.

1252 Transmission interface connection points shall be defined close to the sea cable entry points
1253 on an offshore unit. Safe provisions for installation and connection to the unit's distribution

1254 system shall be identified and aligned with any applicable hazardous zone requirements on the
1255 offshore unit.

1256 Protection schemes shall be defined for the transmission system, for autonomous operation of
1257 individual units with no electric interconnection engaged, and for autonomous units with electric
1258 interconnector engaged.

1259 The location of any compensation equipment in a transmission system shall be optimized for
1260 relevant modes of operation. It will ordinarily be installed either at one or at both ends of a sea
1261 cable, but means that can effectively support cable compensation can also be installed in the
1262 generation or distribution systems that are interconnected.

1263 High-voltage equipment that forms part of a sea cable transmission system shall include safe
1264 means for isolation and earthing of the sea cable and any subsequent compensation equipment,
1265 before any potentially live parts in the transmission system are accessed by operators.

1266 For compensated transmission systems, a neutral earthing resistor (NER) on sea cable side
1267 will not normally be used. For short distance transmission systems with galvanic split and
1268 without compensation, an NER may be installed to monitor and protect against transmission
1269 system earth fault.

1270 Low frequency AC transmission (LFAC) may be evaluated to increase the active power transfer
1271 capacity of metal conductors in sea cables, or alternatively to increase the step-out distance of
1272 such interconnectors. Choice of transmission system earthing concept will not obstruct the use
1273 of reduced frequency.

1274 Type tested equipment established in electrical railways (16 2/3 Hz, 25 Hz) may be considered
1275 for LFAC design components.

1276 For DC transmission systems, the earthing of cable poles and strategies for operation of
1277 semiconductor controlled converters will be subject to proposals by relevant manufacturers
1278 according to the requirements of the appropriate authorities. Examples of applicable technology
1279 are given in Annex C.

1280 **4.9 Alternative sources of power**

1281 Alternative sources of power may be used as either main or essential power source, provided
1282 the requirements of 4.2.2 are met and subject to the approval of the appropriate authority.
1283 Provided the requirements of 4.4 are met, the alternative source may also be used as an
1284 emergency power source, subject to the approval of the appropriate authority.

1285 A renewable source of power can be an alternative source of power. A renewable source of
1286 power may not fulfil the availability requirements for main or essential source of power.
1287 Combined with energy storage of suitable design and capacity, this can be achieved.

1288 Special attention should be given to the capacity of the energy storage facility on units where
1289 thrusters are used for position keeping.

1290 **5 Sources of electrical power for unmanned units**

1291 **5.1 General**

1292 Clause 5 contains specific requirements for power supply and generation at unmanned offshore
1293 units.

1294 Unmanned offshore units at fixed location are in general characterized by the following features:

1295 a) remote controlled without need of human presence for its operability;