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INTERNATIONAL STANDARD

NORME INTERNATIONALE

AMENDMENT 1
AMENDEMENT 1

Power installations exceeding 1 kV a.c. – Part 1: Common rules

Installations électriques en courant alternatif de puissance supérieure à 1 kV – Partie 1: Règles communes

IEC 61936-1:2010-08/AMD1:2014-02(EN-FR)

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FOREWORD

This amendment has been prepared by IEC technical committee 99: System engineering and erection of electrical power installations in systems with nominal voltages above 1 kV a.c. and 1,5 kV d.c., particularly concerning safety aspects.

The text of this amendment is based on the following documents:

FDIS	Report on voting
99/129/FDIS	99/131/RVD

Full information on the voting for the approval of this amendment can be found in the report on voting indicated in the above table.

The committee has decided that the contents of this amendment and the base publication will remain unchanged until the stability date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

Foreword

Insert, in the existing list of differences in some countries, the following new items:

- 7.2.6: 50 mm × 200 mm mesh is not accepted (Australia)
- 7.2.6: Guidance regarding fence construction can be found at ENA Doc 015 (Australia)
- 8.7.1: Fire rating of barriers must be a minimum fire rating of 120 minutes (Australia)
- 8.7.2: The dimensions G_1 and G_2 are to be measured from the inside edge wall of any bund wall rather than the measured point shown in Figure 7a) and 7b) from the transformer where the bund wall is wider than the transformer (Australia)
- 8.8.1.3: Spill containment should extend by 50 % of the height of the transformer (Australia)
- Figure 7a): The dimensions G_1 and G_2 are to be measured from the inside edge wall of any bund wall rather than the measured point shown in Figure 7a) from the transformer where the bund wall is wider than the transformer (Australia)
- Figure 7b): The dimensions G_1 and G_2 are to be measured from the inside edge wall of any bund wall rather than the measured point shown in Figure 7b) from the transformer where the bund wall is wider than the transformer (Australia)
- Clause 10: For requirements regarding earthing refer to AS 2067, Substations and High Voltage Installations (Australia)

1 Scope

Add the following new item e) after d):

e) Electrical installations erected on offshore platforms e.g. offshore wind power farms.

Modify the fifth dashed item in the last list of this clause as follows:

– installations on ships according to IEC 60092 [34] series and offshore units according to IEC 61892 [35] series, which are used in the offshore petroleum industry for drilling, processing and storage purposes.

Modify the first paragraph after the last list of this clause as follows:

This standard does not apply to the design of prefabricated, type-tested switchgear and high voltage/low voltage prefabricated substation, for which separate IEC standards exist.

2 Normative references

Add, to the existing list, the title of the following standards:

IEC/TS 61463, *Bushings – Seismic qualification*

IEC 62271-206, *High-voltage switchgear and controlgear – Part 206: Voltage presence indicating systems for rated voltages above 1 kV and up to and including 52 kV*

IEC 62271-207, *High-voltage switchgear and controlgear – Part 207: Seismic qualification for gas-insulated switchgear assemblies for rated voltages above 52 kV*

IEC/TR 62271-300, *High-voltage switchgear and controlgear – Part 300: Seismic qualification of alternating current circuit-breakers*

IEC 82079-1, *Preparation of instructions for use – Structuring, content and presentation – Part 1: General principles and detailed requirements*

Replace the reference to IEC 62271-1:2007 by the following new reference:

IEC 62271-1:2007, *High-voltage switchgear and controlgear – Part 1: Common specifications* Amendment 1:2011

4.1.2 Agreements between supplier (manufacturer) and user

Add the following four new lines to the existing table:

Subclause	Item
4.3.9	Special conditions and requirements for seismic environment
4.4.3.5	Special conditions and requirements for vibrations
8.7.2.1	Reduction of distances G_1/G_2
10.2.1	Fundamental requirements for design of the earthing system

4.2.4 Short-circuit current

Add the following Note 1 after the first paragraph:

NOTE 1 Where an installation has on-site generation, motors or parallel operation with a network (co-generation), fault levels can increase.

Change the existing Note 1 to Note 2, and the existing Note 2 to Note 3.

4.2.7 Electric and magnetic fields

Modify the existing note as follows:

NOTE National and/or international regulations may specify acceptable levels. Further information is available from International Commission on Non-Ionizing Radiation Protection (ICNIRP) or IEEE.

4.3.1 Equipment and supporting structures

Replace the existing Note 1 by the following normal text:

Consideration shall be given to temporary stresses and loads that may be applied during construction or maintenance procedures. Specific equipment can be affected by cyclic loads and stresses due to thermal expansions (refer to specific equipment standards).

Delete Note 2.

Add, at the end of the second list, the following new item:

– seismic loads.

4.3.9 Vibration

Replace the existing title and text of this subclause with the following:

4.3.9 Seismic loads

Special conditions and requirements shall be agreed between user and supplier. (See also 4.4.3.5 Vibration).

Installations situated in a seismic environment shall be designed to take this into account.

Where load specifications apply to the installation of civil work or equipment to meet seismic conditions, then these specifications shall be observed.

Seismic loads shall be dealt with in accordance with appropriate standards for power installations: e.g. IEC 62271-207 for GIS, IEC/TR 62271-300 for circuit-breakers and IEC/TS 61463 for bushings.

The following measures shall be taken into account:

a) Any individual equipment shall be designed to withstand the dynamic forces resulting from the vertical and horizontal motions of the soil. These effects may be modified by the response of the foundation and/or the supporting frame and/or the floor in which this equipment is installed. The response spectrum of the earthquake shall be considered for the design of the equipment.
b) The layout shall be chosen in order to limit the loads due to interconnections between adjoining devices needing to accommodate large relatively axial, lateral, torsional or other movements to acceptable values. Attention should be paid to other stresses which may develop during an earthquake.

4.4.3.5 Vibration

Replace the existing text of this subclause with the following:

Special conditions and requirements shall be agreed between user and supplier. (See also 4.3.9 Seismic loads).

Vibration caused by wind, electromagnetic stresses, traffic (e. g. temporary road and railway traffic) and industrial processes shall be considered. The withstand capability of equipment against vibrations shall be given by the manufacturer.

The service stresses of equipment, which may be transmitted through a common monolithic foundation or floor (for example opening/reclosing of circuit-breakers) shall be taken into account.

5.4.1 General

Replace the first sentence of the second paragraph with the following:

If parts of an installation can be separated from each other by a disconnector, these parts shall be tested at the rated impulse withstand voltage for the isolating distance (see Tables 1a and 1b as well as Tables 2a and 2b of IEC 62271-1:2007, Amendment 1:2011).

Table 2 – Minimum clearances in air – Voltage range II (U_m > 245 kV)

Replace the existing Table 2 with the following new Table 2:

Table 2 – Minimum clearances in air – Voltage range II (U_m > 245 kV)

Voltage range	Highest voltage for installation	Rated lightning impulse withstand voltage [a]	Rated switching impulse withstand voltage	Minimum phase-to-earth clearance		Rated switching impulse withstand voltage	Minimum phase-to-phase clearance	
	U_m r.m.s.	U_p 1,2/50 µs (peak value)	U_s Phase-to-earth 250/2 500 µs (peak value)	Conductor – structure	Rod – structure	U_s Phase-to-phase 250/2 500 µs (peak value)	Conductor – conductor parallel	Rod – conductor
	kV	kV	kV	mm		kV	mm	
II	300	850/950	750	1 600 1 700 [b]	1 900	1 125	2 300	2 600
		950/1 050	850	1 800 1 900 [b]	2 400	1 275	2 600	3 100
	362	950/1 050	850	1 800 1 900 [b]	2 400	1 275	2 600	3 100
		1 050/1 175	950	2 200	2 900	1 425	3 100	3 600
	420	1 050/1 175	850	1 900 2 200 [b]	2 400	1 360	2 900	3 400
		1 175/1 300	950	2 200 2 400 [b]	2 900	1 425	3 100	3 600
		1 300/1 425	1 050	2 600	3 400	1 575	3 600	4 200
	550	1 175/1 300	950	2 200 2 400 [b]	2 900	1 615	3 700	4 300
		1 300/1 425	1 050	2 600	3 400	1 680	3 900	4 600
		1 425/1 550	1 175	3 100	4 100	1 763	4 200	5 000
	800	1 675/1 800	1 300	3 600	4 800	2 210	6 100	7 400
		1 800/1 950	1 425	4 200	5 600	2 423	7 200	9 000
		1 950/2 100	1 550	4 900	6 400	2 480	7 600	9 400

Voltage range	Highest voltage for installation	Rated lightning impulse withstand voltage [a]	Rated switching impulse withstand voltage	Minimum phase-to-earth clearance		Rated switching impulse withstand voltage	Minimum phase-to-phase clearance	
	U_m r.m.s.	U_p 1,2/50 µs (peak value)	U_s Phase-to-earth 250/2 500 µs (peak value)	Conductor – structure	Rod – structure N	U_s Phase-to-phase 250/2 500 µs (peak value)	Conductor – conductor parallel	Rod – conductor
	kV	kV	kV	mm		kV	mm	
	1 100	1 950/2 100	1 425 [c]	4 200	5 600	-	-	-
		2 100/2 250	1 550	4 900	6 400	2 635	8 400 [d]	10 000 [d]
		2 250/2 400	1 675	5 600 [d]	7 400 [d]	2 764	9 100 [d]	10 900 [d]
		2 400/2 550	1 800	6 300 [d]	8 300 [d]	2 880	9 800 [d]	11 600 [d]
	1 200	2 100/2 250	1 675	5 600 [d]	7 400 [d]	2 848	9 600 [d]	11 400 [d]
		2 250/2 400	1 800	6 300 [d]	8 300 [d]	2 970	10 300 [d]	12 300 [d]
		2 550/2 700	1 950	7 200 [d]	9 500 [d]	3 120	11 200 [d]	13 300 [d]

[a] The rated lightning impulse is applicable phase-to-phase and phase-to-earth.

[b] Minimum clearance required for upper value of rated lightning impulse withstand voltage.

[c] This value is only applicable to the phase-to-earth insulation of single phase equipment not exposed to air.

[d] Tentative values still under consideration.

6.2.1 Switching devices

Modify the fifth paragraph of this subclause as follows:

Where specified by the user, interlocking devices and/or locking facilities shall be installed to provide a safeguard against inappropriate operation.

6.2.9.5 Installation of cables

Add the following new item h) after g):

h) if single-core cables are laid through reinforced ceilings and walls the possibility of heating the steel reinforcing bars shall be considered. If necessary, suitable structural measures to limit the heating shall be determined.

6.2.10 Conductors and accessories

Add the following new paragraph after the first paragraph:

Covered conductors shall be treated as bare conductors.

Add the following paragraph after the note:

Provision shall be made to avoid possible resonant oscillation of tubular busbars caused by wind.

6.2.11 Rotating electrical machines

Replace the second paragraph of this subclause with the following:

The degree of protection of the equipment against the ingress of objects, dust and water shall be chosen in accordance with the climatic and environmental conditions at the site of

installation. Hazardous parts of the machine shall be protected against accidental contact by persons. The degree of protection shall be defined in accordance with IEC 60529.

7.2.1 Protective barrier clearances

Replace the existing text of this subclause with the following:

Within an installation, the following minimum protective clearances shall be maintained between live parts and the internal surface of any protective barrier (see Figure 1):

– for solid walls, without openings, with a minimum height of 1 800 mm, the minimum protective barrier clearance is $B_1 = N$;

– for wire meshes, screens or solid walls with openings, with a minimum height of 1 800 mm and a degree of protection of IPXXB (see IEC 60529), the minimum protective barrier clearance is $B_2 = N + 80$ mm.

NOTE The degree IPXXB ensures protection against access to hazardous parts with fingers.

For non-rigid protective barriers and wire meshes, the clearance values shall be increased to take into account any possible displacement of the protective barrier or mesh.

7.2.6 External fences or walls and access doors

Add the following note after the last paragraph:

NOTE The use of metal mat fences with a mesh size of 50 mm x 200 mm (width x height) is applicable if the design of fencing prevents unauthorized entrance.

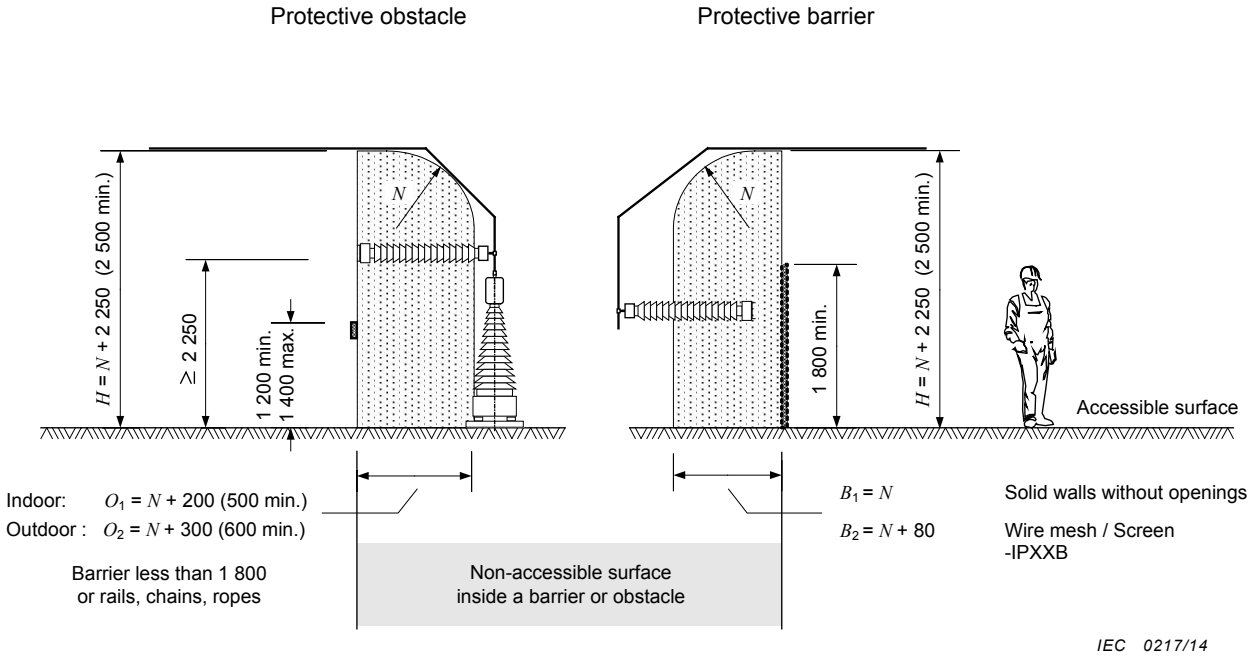
7.4.2.4 Earthing

Modify the first sentence of the second paragraph as follows:

The three enclosures of a single-phase type GIS shall be bonded together with short connections and earthed at least at the end of the enclosure of the outgoing and incoming feeders.

Figure 1 – Protection against direct contact by protective barriers/protective obstacles within closed electrical operating areas

Replace the existing Figure 1 with the following new Figure 1:



Dimensions in millimetres

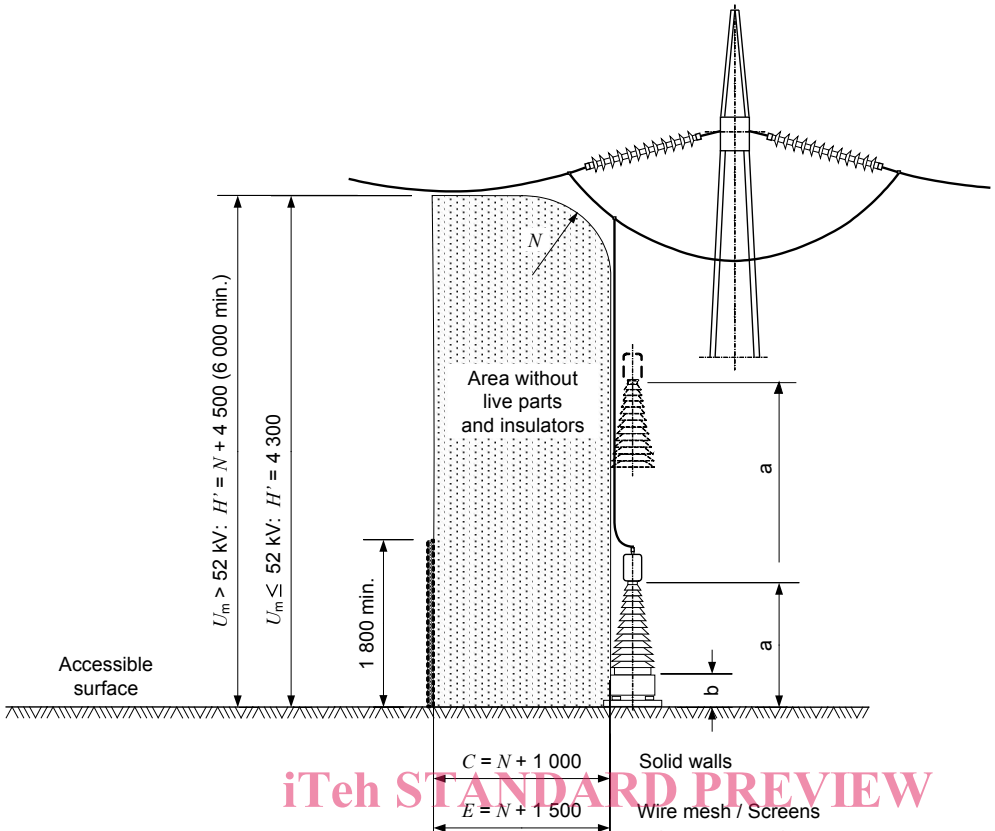
Key

N	Minimum clearance
O	Obstacle clearance
B	Barrier clearance

Figure 1 – Protection against direct contact by protective barriers/protective obstacles within closed electrical operating areas

Figure 2 – Boundary distances and minimum height at the external fence/wall

Replace the existing Figure 2 with the following new Figure 2:



IEC 0218/14

Dimensions in millimetres

Key

N Minimum clearance

H' Minimum clearance of live parts above accessible surface at the external fence

a If this distance to live parts is less than H, protection by barriers or obstacles shall be provided

b If this distance is smaller than 2 250 mm, protection by barriers or obstacles shall be provided

Figure 2 – Boundary distances and minimum height at the external fence/wall

8.4.2 Devices to prevent reclosing of isolating devices

Replace, in the second paragraph of this subclause, the words “an approved tool” *with* “a suitable tool”.

8.4.3 Devices for determining the de-energized state

Replace the third paragraph of this subclause with the following:

Either fixed equipment (see IEC 62271-206) or portable devices (see the IEC 61243 series) can be used to meet this requirement.

8.5 Protection from danger resulting from arc fault

Replace item i) of this subclause with the following:

i) Prevention of re-energization by use of non-resettable devices which detect internal equipment faults, enable pressure relief and provide an external indication.

8.7.1 General

Replace the third dashed item in item a) with the following:

– fire barriers (e.g. fire walls with fire resistance of minimum 60 minutes),

Replace the text in iv) with the following:

iv) non-combustible materials

8.7.2 Transformers, reactors

Replace the first sentence in the last paragraph of this subclause with the following:

The same applies to individual sumps which are connected to the catchment tanks of other transformers; crushed stone layers, fire protection gratings or pipes filled with fluid can, for example, be used for this purpose.

8.7.2.1 Outdoor installations

Replace the existing text of this subclause with the following:

The layout of an outdoor installation shall be such that burning of a transformer with a liquid volume of more than 1 000 l will not cause a fire hazard to other transformers or objects, with the exception of those directly associated with the transformer. For this purpose, adequate clearances, G_1, G_2 shall be necessary. Guide values are given in Table 3. Where transformers with a liquid volume below 1 000 l are installed near walls of combustible material, special fire precautions may be necessary, depending on the nature and the use of the building.

If automatically activated fire extinguishing equipment is installed, the clearances G_1/G_2 can be reduced.

The reduction of distances G_1/G_2 shall be agreed upon between the user and the supplier.

If it is not possible to allow for adequate clearance as indicated in Table 3, fire-resistant separating walls with the following dimensions shall be provided:

a) between transformers (see Figure 6) separating walls. For example EI 60:
   – height: top of the expansion chamber (if any), otherwise the top of the transformer tank;
   – length: width or length of the sump (in the case of a dry-type transformer, the width or length of the transformer, depending upon the direction of the transformer);
b) between transformers and buildings separating walls. For example EI 60; if additional fire separating wall is not provided, fire rating of the building wall should be increased, for example REI 90 (see Figure 7).

NOTE 1 REI represents the bearing system (wall) whereas EI represents the non-load bearing system (wall) where R is the load bearing capacity, E is the fire integrity, I is the thermal insulation and 60/90 refers to fire resistance duration in minutes.

NOTE 2 Definitions of fire resistance are given in EN 13501-2[37].

Table 3 – Guide values for outdoor transformer clearances

Replace the existing Table 3 with the following new Table 3:

Table 3 – Guide values for outdoor transformer clearances

Transformer type	Liquid volume	Clearance G_1 to other transformers or building surface of non-combustible material	Clearance G_2 to building surface of combustible material
	l	m	m
Oil insulated transformers (O)	1 000 <....< 2 000	3	7,5
	2 000 ≤....< 20 000	5	10
	20 000 ≤....< 45 000	10	20
	≥ 45 000	15	30
Less flammable liquid insulated transformers (K) without enhanced protection	1 000 <...< 3 800	1,5	7,5
	≥ 3 800	4,5	15

Less flammable liquid insulated transformers (K) with enhanced protection	Clearance G_1 to building surface or adjacent transformers	
	Horizontal m	Vertical m
	0,9	1,5

Dry-type transformers (A)	Fire behaviour class	Clearance G_1 to building surface or adjacent transformers	
		Horizontal m	Vertical m
	F0	1,5	3,0
	F1	None	None

NOTE 1 Enhanced protection means

– tank rupture strength,

– tank pressure relief,

– low-current fault protection,

– high-current fault protection.

For an example of enhanced protection, see Factory Mutual Global standard 3990 [33], or equivalent.

NOTE 2 Sufficient space should be allowed for periodic cleaning of resin-encapsulated transformer windings, in order to prevent possible electrical faults and fire hazard caused by deposited atmospheric pollution.

NOTE 3 Non-combustible materials may be chosen in accordance to EN 13501-1[36].

Table 4 – Minimum requirements for the installation of indoor transformers

Replace, in Note 1 to Table 4, the words “time in minutes” *with* “fire resistance duration in minutes”.