SLOVENSKI STANDARD
oSIST prEN 50549-1:2017

01-julij-2017

Nadomešča:
SIST EN 50438:2014
SIST EN 50438:2014/IS1:2015
SIST-TS CLC/TS 50549-1:2015

Zahteve za vzporedno vezavo generatorskih postrojev z javnim razdelilnim omrežjem - 1-1. del: Vezava z nizkonapetostnim razdelilnim omrežjem - Generatorski postroji do vključno tipa A

Requirements for generating plants to be connected in parallel with distribution networks - Part 1-1: Connection to a LV distribution network – Generating plants up to and including Type A

Ta slovenski standard je istoveten z: **prEN 50549-1**

ICS:

29.160.20	Generatorji	Generators
29.240.01	Omrežja za prenos in distribucijo električne energije na splošno	Power transmission and distribution networks in general

oSIST prEN 50549-1:2017 **en**

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

DRAFT
prEN 50549-1

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ICS 29.160.20

Will supersede CLC/TS 50549-1:2015, EN 50438:2013, EN 50438:2013/IS1:2015

English Version

Requirements for generating plants to be connected in parallel with distribution networks - Part 1-1: Connection to a LV distribution network - Generating plants up to and including Type A

To be completed

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This draft European Standard is submitted to CENELEC members for enquiry.
Deadline for CENELEC: 2017-08-18.

It has been drawn up by CLC/TC 8X.

If this draft becomes a European Standard, CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

This draft European Standard was established by CENELEC in three official versions (English, French, German).
A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Bulgaria, Croatia, Cyprus, the Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

Recipients of this draft are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

Warning : This document is not a European Standard. It is distributed for review and comments. It is subject to change without notice and shall not be referred to as a European Standard.

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

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European foreword

This document (prEN 50549-1:2017) has been prepared by CLC/TC 8X “System aspects of electrical energy supply”.

This document is currently submitted to the Enquiry.

The following dates are proposed:

• latest date by which the existence of this document has to be announced at national level	(doa)	dor + 6 months
• latest date by which this document has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	dor + 12 months
• latest date by which the national standards conflicting with this document have to be withdrawn	(dow)	dor + 36 months (to be confirmed or modified when voting)

This document will supersede EN 50438:2013 and CLC/TS 50549-1:2015.

This document has been prepared under a mandate given to CENELEC by the European Commission and the European Free Trade Association.

Please note: TC8X/Sec0155/RM - the unconfirmed minutes of the 14th TC8X meeting held in Brussels on 2016-11-23 it specified in decision 6 the requirement to prepare documents for enquiry according to BT155/DG10265/DV. However during the drafting of this document it became apparent that the difference between the planned -1-1 and -1-2 would be so small that it will be more practical for all parties to combine the two documents into one EN 50549-1.

This approach is proposed during the enquiry stage of EN 50549-1. NCs are invited to comment on this approach. If NCs agree, WG03 proposes to publish EN 50549-1 as presented for comment in this document.

This European Standard relates to both European Network Codes and current technical market needs. Its purpose is to give detailed description of functions to be implemented in products.

This European Standard is also intended to serve as a technical reference for the definition of national requirements where European Network Codes requirements allow flexible implementation. The specified requirements are solely technical requirements; economic issues for example. The bearing of cost are not in the scope of this document.

CLC/TC 8X plans future standardization work in order to ensure the compatibility of this European Standard (EN) with the evolution of the legal framework.

1 Scope

This European Standard specifies the technical requirements for the protection functions and the operational capabilities for generating plants, intended to operate in parallel with LV distribution networks.

For practical reasons, this European Standard refers to the relevant distribution system operator where settings have to be defined and/or provided, even when these settings are to be defined and/or provided by another actor e.g. TSO, Member state, regulatory authorities, according to national and European legal framework.

NOTE 1 This includes European network codes and their national implementation, as well as additional national regulations.

NOTE 2 Additional national requirements especially for the connection to the distribution network and the operation of the generating plant may apply.

The requirements of this European Standard apply to all generating plants, generating modules, electrical machinery and electronic equipment, irrespective of the kind of primary energy source and irrespective of the presence of loads in the producer's network that meet all of the following conditions:

- converting any primary energy source into AC electricity;
- connected to a LV distribution network;
- generating modules capacity of Type B or smaller;
- intended to operate in parallel with a distribution network.

If generating modules of different type are combined in one plant, different requirements apply for the different modules based on the type of each module.

NOTE 3 Generating plants connected to a MV distribution network fall into the scope of EN 50549–2.

Unless specified otherwise by the DSO, generating plants connected to a medium voltage distribution network with a maximum apparent power up to 100 kVA can comply with this European Standard as alternative to the requirements of EN 50549-2. A different threshold may be defined by the DSO.

This European Standard defines connection requirements for generating plants to be connected in parallel with distribution networks.

This European Standard recognizes the existence of National Standards, Network Codes, and specific technical requirements of the DSOs and these should be complied with.

Excluded from the scope are:

- the selection and evaluation of the point of connection;
- power system impact assessment;
- connection assessment;
- island operation of generating plants, both intentional and unintentional, where no part of the distribution network is involved;
- four-quadrant rectifier of drives feeding breaking energy back into the distribution network for limited duration with no internal source of primary energy;
- uninterruptible power supply with duration of parallel operation limited to 100 ms;

NOTE 4 Parallel operation due to maintenance of uninterruptible power supply units is not considered.

- requirements for the safety of personnel as they are already adequately covered by existing European Standards.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 60255-127, Measuring relays and protection equipment — Part 127: Functional requirements for over/under voltage protection (IEC 60255-127)

EN 61000-4-30, Electromagnetic compatibility (EMC) — Part 4-30: Testing and measurement techniques — Power quality measurement methods (IEC 61000-4-30)

HD 60364-1, Low-voltage electrical installations — Part 1: Fundamental principles, assessment of general characteristics, definitions (IEC 60364-1)

HD 60364-5-551, Low-voltage electrical installations — Part 5-55: Selection and erection of electrical equipment — Other equipment — Clause 551: Low-voltage generating sets (IEC 60364-5-551)

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1 General

3.1.1
distribution network
electrical network, including closed distribution networks, for the distribution of electrical power from and to third parties connected to it, to and from a transmission or another distribution network, for which a DSO is responsible

3.1.2
closed distribution network
system which distributes electricity within a geographically confined, industrial, commercial or shared services site and does not (without prejudice to a small number of households located within the area served by the system and with employment or similar associations with the owner of the system) supply households customers

Note 1 to entry: This Closed Distribution Network will either have its operations or the production process of the users of the system integrated for specific or technical reasons or distribute electricity primarily to the owner or operator of the Closed Distribution Network or their related undertakings.

3.1.3
distribution system operator - DSO
natural or legal person responsible for the distribution of electrical power to the public and for operating, ensuring the maintenance of and, if necessary, developing the distribution network in a given area

Note 1 to entry: In this document applicable to distribution grids DSO is used for relevant system operator according Article 2 (13) of COMISSION REGULATION 2016/631.

Note 2 to entry: In some countries, the distribution network operator (DNO) fulfils the role of the DSO.

3.1.4
transmission system operator - TSO
natural or legal person responsible for operating, ensuring the maintenance of and, if necessary, developing the transmission system in a given area and, where applicable, its interconnections with other power systems, and for ensuring the long-term ability of the power system to meet reasonable demands for the transmission of electricity

158 **3.1.5**
159 **low voltage (LV) distribution network**
160 electric distribution network with a voltage whose nominal r.m.s. value is Un ≤ 1 kV

161 **3.1.6**
162 **power system stability**
163 capability of a power system to regain a steady state, characterized by the synchronous operation of
164 the generating plants after a disturbance

165 [SOURCE: IEV 603-03-01]

166 **3.1.7**
167 **producer**
168 natural or legal person who already has or is planning to connect an electricity generating plant to a
169 distribution network

170 **3.1.8**
171 **producer's network**
172 electrical installations downstream from the point of connection owned/operated by the producer for
173 internal distribution of electricity

174 **3.1.9**
175 **downstream**
176 direction in which the active power would flow if no generating units, connected to the distribution
177 network, were running

178 **3.1.10**
179 **point of connection - POC**
180 reference point on the electric power system where the user's electrical facility is connected

181 Note 1 to entry: For the purpose of this standard, the electric power system is the distribution network.

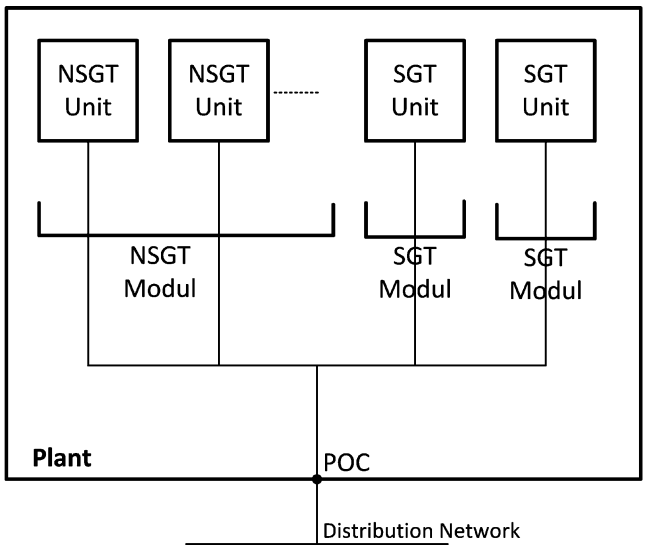
182 [SOURCE: IEV 617-04-01 modified]

183 **3.1.11**
184 **operating in parallel with the distribution network**
185 situation where the generating plant is connected to a distribution network and operating

186 **3.1.12**
187 **temporary operation in parallel with the distribution network**
188 conditions in which the generating plant is connected to a distribution network, during defined short
189 periods, to maintain the continuity of the supply voltage and to facilitate testing

190 ## 3.2 Plant, module and unit

191 **3.2.1**
192 **generating module**
193 either a generating unit of synchronous generating technology or the sum of all generating units of
194 non-synchronous generating technology connected to a common point of connection including all
195 elements needed to feed electric power to the distribution grid



NSGT: non-synchronous generating technology

SGT: synchronous generating technology

Figure 1 — Generating module at a common POC

3.2.2
generating plant
sum of generating modules connected at one point of connection, including auxiliaries and all connection equipment

Note 1 to entry: This definition is intended to be used for verification of compliance to the technical requirements of this standard. It may be different to the legal definition of a plant.

3.2.3
generating unit
smallest set of installations which can generate electrical energy running independently and which can feed this energy into a distribution network

Note 1 to entry: For example, a combined cycle gas turbine (CCGT) or an organic rankine cycle (ORC) after a combustion engine is considered as a single generating unit.

Note 2 to entry: If a generating unit is a combination of technologies leading to different requirements, this has to be settled case by case.

Note 3 to entry: A storage device operating in electricity generation mode and AC connected to the distribution network is considered to be a generating unit.

3.2.4
micro-generating plant
generating plant with generating units having nominal currents in sum not exceeding 16 A per phase

3.2.5
micro-generating unit
generating unit with nominal currents up to and including 16 A per phase

3.2.6
synchronously coupled generating technology
technology where a generating unit is based on a synchronous machine which is directly coupled

3.2.7
non-synchronous generating technology
technology where a generating unit is connected non-synchronously to a distribution grid

Note 1 to entry: Examples are: induction machines and converter based technologies.

3.2.8
cogeneration - combined heat and power (CHP)
combined generation of electricity and heat by an energy conversion system and the concurrent use of the electric and thermal energy from the conversion system

3.3 Power

3.3.1
design active power - P_D
maximum AC active power output at an active factor of 0,9 or the active factor specified by the DSO for a certain generating plant or generating technology

3.3.2
maximum active power - P_{max}
maximum continuous active power which a power-generating plant can produce, less any demand associated solely with facilitating the operation of that power-generating plant and not fed into the network as specified in the connection agreement or as agreed between the DSO and the power-generating facility owner

Note 1 to entry: This maximum power is defined by a measurement with 10 min averaging.

3.3.3
rated current
maximum continuous AC output current which a generating unit or generating plant is designed to achieve under normal operating conditions

[SOURCE: IEV 415-04-03, modified]

3.3.4
maximum apparent power - S_{max}
maximum AC apparent power output that the generating unit or the sum of all the generating units in a generating plant is designed to achieve under normal operating conditions

Note 1 to entry: This maximum power is defined by a measurement with 10 min averaging.

3.3.5
momentary active power - P_M
actual AC active power output at a certain instant

3.3.6
primary energy source
non-electric energy source supplying an electric generating unit

Note 1 to entry: Examples of primary energy sources include natural gas, wind and solar energy. These sources can be utilized, e.g. by gas turbines, wind turbines and photovoltaic cells.

3.3.7
available active power - P_A
maximum AC active power available from the prime mover subject to the availability and magnitude of the primary energy source at the relevant time

Note 1 to entry: The maximum active power considers all constraints regarding e.g. the primary energy source or the availability of a heat sink for CHP.

3.4 Voltage

3.4.1
nominal voltage - U_n
voltage by which a supply network is designated or identified and to which certain operating characteristics are referred

3.4.2
nominal frequency - f_n
frequency used to designate and identify equipment or a power system

Note 1 to entry: For the purpose of this standard, the nominal frequency f_n is 50 Hz.

[SOURCE: IEV 151-16-09, modified]

3.4.3
reference voltage
value specified as the base on which residual voltage, thresholds and other values are expressed in per unit or percentage terms

Note 1 to entry: For the purpose of this standard, the reference voltage is the nominal voltage or the declared voltage of the distribution network.

[SOURCE: EN 50160:2010, 3.18, modified]

3.4.4
voltage change
variation of the r.m.s. value of a voltage between two consecutive levels sustained for definite but unspecified durations

[SOURCE: IEV 161-08-01, modified]

3.4.5
voltage variation
increase or decrease of r.m.s. voltage normally due to load variations in load and/or generation

[SOURCE: EN 50160:2010, 3.34, modified]

3.5 Circuit theory

3.5.1
active factor
for a two-terminal element or a two-terminal circuit under sinusoidal conditions, ratio of the active power to the apparent power

Note 1 to entry: In a three phase system, this is referring to the positive sequence component of the fundamental.

Note 2 to entry: The active factor is equal to the cosine of the displacement angle.

[SOURCE: IEV 131-11-49, modified]

3.5.2
displacement angle - φ
under sinusoidal conditions, phase difference between the voltage applied to a linear two-terminal element or two-terminal circuit and the electric current in the element or circuit

Note 1 to entry: In a three phase system, this is referring to the positive sequence component of the fundamental.

Note 2 to entry: The cosine of the displacement angle is the active factor.

[SOURCE: IEV 131-11-48, modified]

3.5.3
power factor
under periodic conditions, ratio of the absolute value of the active power P to the apparent power S:

$$\lambda = \frac{|P|}{S}$$

Note 1 to entry: Under sinusoidal conditions, the power factor is the absolute value of the active factor.

[SOURCE: IEV 131-11-46]

3.5.4
fundamental components of a three-phase system
3.5.4.1
phasor
representation of a sinusoidal integral quantity by a complex quantity whose argument is equal to the initial phase and whose modulus is equal to the root-mean-square value

Note 1 to entry: For a quantity $a(t) = A\sqrt{2}\cos(\omega t + \Theta_0)$ the phasor is $A \exp j\Theta_0$.

Note 2 to entry: The similar representation with the modulus equal to the amplitude is called “amplitude phasor”.

Note 3 to entry: A phasor can also be represented graphically.

[SOURCE: IEV 131-11-26, modified]

3.5.4.2
positive sequence component of the fundamental
for a three-phase system with phases L1, L2 and L3, the symmetrical sinusoidal three-phase set of voltages or currents having frequency equal to the fundamental frequency and which is defined by the following complex mathematical expression:

$$\underline{X}_1 = \frac{1}{3}\left(\underline{X}_{L1} + \underline{a}\,\underline{X}_{L2} + \underline{a}^2\,\underline{X}_{L3}\right)$$

where

$\underline{a} = e^{j2\pi/3}$ is the 120 degree operator,

X_{L1}, X_{L2} and X_{L3} are the complex expressions of the fundamental frequency phase quantities concerned, that is, current or voltage phasors

Note 1 to entry: In a balanced harmonic-free system, only positive sequence component of the fundamental exists. For example, if phase voltage phasors are symmetrical $\underline{U}_{L1} = Ue^{j\theta}$, $\underline{U}_{L2} = Ue^{j(\theta+4\pi/3)}$ and $\underline{U}_{L3} = Ue^{j(\theta+2\pi/3)}$ then $\underline{U}_1 = (Ue^{j\theta} + e^{j2\pi/3}\,Ue^{j(\theta+4\pi/3)} + e^{j4\pi/3}\,Ue^{j(\theta+2\pi/3)})/3 = (Ue^{j\theta} + Ue^{j\theta} + Ue^{j\theta})/3 = Ue^{j\theta}$

[SOURCE: IEV 448-11-27]

3.5.4.3
negative sequence component of the fundamental
for a three-phase system with phases L1, L2 and L3, the symmetrical sinusoidal three-phase set of voltages or currents having frequency equal to the fundamental frequency and which is defined by the following complex mathematical expression:

$$\underline{X}_2 = \frac{1}{3}\left(\underline{X}_{L1} + \underline{a}^2\,\underline{X}_{L2} + \underline{a}\,\underline{X}_{L3}\right)$$

where

$\underline{a} = e^{j2\pi/3}$ is the 120 degree operator

X_{L1}, X_{L2} and X_{L3} are the complex expressions of the fundamental frequency phase quantities concerned, that is, current or voltage phasors

Note 1 to entry: Negative sequence voltage or current components may be significant only when the voltages or currents, respectively, are unbalanced. For example, if phase voltage phasors are symmetrical $\underline{U}_{L1} = Ue^{j\theta}$, $\underline{U}_{L2} = Ue^{j(\theta+4\pi/3)}$ and $\underline{U}_{L3} = Ue^{j(\theta+2\pi/3)}$ then the negative sequence component $\underline{U}_2 = (Ue^{j\theta} + e^{j4\pi/3}\, Ue^{j(\theta+4\pi/3)} + e^{j2\pi/3}\, Ue^{j(\theta+2\pi/3)})/3 = Ue^{j\theta}\,(1 + e^{j2\pi/3} + e^{j4\pi/3})/3 = 0$.

[SOURCE: IEV 448-11-28]

3.5.4.4
zero sequence component of the fundamental
for a three-phase system with phases L1, L2 and L3, the in-phase sinusoidal voltage or current component having the fundamental frequency and equal amplitude in each of the phases and which is defined by the following complex mathematical expression:

$$\underline{X}_0 = \frac{1}{3}\left(\underline{X}_{L1} + \underline{X}_{L2} + \underline{X}_{L3}\right)$$

where

X_{L1}, X_{L2} and X_{L3} are the complex expressions of the fundamental frequency phase quantities concerned, that is, current or voltage phasors

[SOURCE: IEV 448-11-29]

3.6 Protection

3.6.1
protection system
arrangement of one or more protection equipments, and other devices intended to perform one or more specified protection functions

Note 1 to entry: A protection system includes one or more protection equipments, instrument transformer(s), wiring, tripping circuit(s), auxiliary supply(s) and, where provided, communication system(s). Depending upon the principle(s) of the protection system, it may include one end or all ends of the protected section and, possibly, automatic reclosing equipment.

Note 2 to entry: The circuit-breaker(s) are excluded.

[SOURCE: IEV 448-11-03]

3.6.2
protection relay
measuring relay which detects faults or other abnormal conditions in a power system or of a power equipment

Note 1 to entry: A protection relay is a component part of a protection system.

Note 2 to entry: An interface protection relay is a protection relay acting on the interface switch.

[SOURCE: IEV 447-01-14]

3.6.3
interface protection system
protection system that acts on the interface switch

3.6.4
interface protection relay
combination of different protection relay functions which opens the interface switch of a generating unit and prevents its closure, whichever is appropriate in case of:

– a fault on the distribution network (with reference to POC voltage level);

– an islanding situation;

– the presence of voltage and frequency values outside the corresponding regulation values

3.6.5
basic protection
protection against electric shock under fault-free conditions

[SOURCE: IEV 195-06-01]

3.6.6
basic insulation
insulation of hazardous-live-parts which provides basic protection

Note 1 to entry: This concept does not apply to insulation used exclusively for functional purposes.

[SOURCE: IEV 195-06-06]

3.6.7
disconnection
separation of the active parts of the main circuit of the generating unit or plant from the network with mechanical contacts providing at least the equivalent of basic insulation

Note 1 to entry: Passive components like filters, auxiliary power supply to the generating unit and sense circuits can remain connected.

Note 2 to entry: For the design of basic insulation all voltage sources should be considered.

3.6.8
switch
device for changing the electric connections among its terminals

[SOURCE: IEV 151-12-22]