SLOVENSKI STANDARD
SIST-TS CLC/TS 50549-1:2015

01-april-2015

Zahteve za priklop generatorjev za toke nad 16 A na fazo – 1. del: Priklop na nizkonapetostni distribucijski sistem

Requirements for the connection of generators above 16 A per phase - Part 1: Connection to the LV distribution system

Prescriptions pour le raccordement de générateurs de plus de 16A par phase - Partie 1: Connexion au réseau de distribution BT

Ta slovenski standard je istoveten z: CLC/TS 50549-1:2015

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

SIST-TS CLC/TS 50549-1:2015 en

TECHNICAL SPECIFICATION

SPÉCIFICATION TECHNIQUE

TECHNISCHE SPEZIFIKATION

CLC/TS 50549-1

January 2015

ICS 29.160.20

English Version

Requirements for generating plants to be connected in parallel with distribution networks - Part 1: Connection to a LV distribution network above 16 A

Prescriptions relatives au raccordement de générateurs de plus de 16A par phase - Partie 1: Connexion au réseau de distribution BT

Anforderungen für den Anschluss von Stromerzeugungsanlagen über 16 A je Phase - Teil 1: Anschluss an das Mittelspannungsverteilungsnetz

This Technical Specification was approved by CENELEC on 2014-09-15.

CENELEC members are required to announce the existence of this TS in the same way as for an EN and to make the TS available promptly at national level in an appropriate form. It is permissible to keep conflicting national standards in force.

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, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

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

CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels

Ref. No. CLC/TS 50549-1:2015 E

Contents

Page

Foreword

This document (CLC/TS 50549-1:2015) has been prepared by CLC/TC 8X "System aspects of electrical energy supply".

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC [and/or CEN] shall not be held responsible for identifying any or all such patent rights.

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

This Technical Specification is also intended to serve as a technical reference for the definition of national requirements where European Network Codes requirements allow flexible implementation. The stated requirements are solely technical requirements; economic issues regarding, e.g. 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 Technical Specification with the evolution of the legal framework.

1 Scope

The purpose of this Technical Specification is to provide technical guidance on the requirements for generating plants which can be operated in parallel with a distribution network.

For practical reasons, this Technical Specification refers to the distribution system operator in case settings have to be defined and/or provided, even when these settings are to be defined and/or provided by another actor according to national and European legal framework.

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

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

The requirements of this Technical Specification apply to all generating plants, 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 and rated at more than 16 A per phase;
– intended to operate in parallel with this distribution network under normal network operating conditions.

NOTE 3 Generating plants rated up to and including 16 A per phase are covered by EN 50438.

NOTE 4 Generating plants connected to a MV distribution network fall into the scope of CLC/TS 50549-2.

Unless stated differently 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 Technical Specification as alternative to the requirements of CLC/TS 50549-2. A different threshold may be defined by the DSO.

This Technical Specification defines connection requirements.

This Technical Specification recognizes the existence of National Standards, Network Codes, and specific technical requirements of the DSOs. 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;
– active front ends of drives feeding energy back into the distribution network for short duration;
– 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)*

IEC 60050, *International Electrotechnical Vocabulary*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60050 and the following apply.

3.1
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 131-11-48, modified]

3.2
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]

3.3
basic protection
protection against electric shock under fault-free conditions

[SOURCE: IEV 195-06-01]

3.4
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

3.5
converter connected generating technology
technology where a generating unit is connected to a distribution grid through a converter including doubly fed induction machine based technology (DFIG)

3.6
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

3.7
directly coupled generating technology
technology where a generating unit is connected to a distribution grid without any converter

3.8
disconnection
separation of the active parts of the main circuit of the generating plant or unit 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 lines can remain connected.

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

3.9
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.

3.10
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

3.11
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 some countries, the distribution network operator (DNO) fulfils the role of the DSO.

3.12
downstream
direction in which the active power would flow if no generating units, connected to the distribution network, were running

3.13
droop
ratio of the per-unit change in frequency $(\Delta f)/f_n$ (where f_n is the nominal frequency) to the per-unit change in power $(\Delta P)/\ P_{ref}$ (where P_{ref} is the reference power at the instance when the frequency reaches a frequency threshold):

$s = -\ (\Delta f/f_n)\ /\ (\Delta P/P_{ref})$

[SOURCE: EV 603-04-08]

3.14
fundamental components of a three-phase system

3.14.1
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]

3.14.2
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:

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

where $\underline{a}$ = $e^{j2\pi/3}$ is the 120 degree operator, and $\underline{X}_{L1}$, $\underline{X}_{L2}$ and $\underline{X}_{L3}$ 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]

3.14.3
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:

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

where $\underline{a}$ = $e^{j2\pi/3}$ is the 120° operator, and $\underline{X}_{L1}$, $\underline{X}_{L2}$ and $\underline{X}_{L3}$ 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]

3.14.4
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:

$$\underline{X}_0 = \frac{1}{3}\left(\underline{X}_{\mathrm{L}1} + \underline{X}_{\mathrm{L}2} + \underline{X}_{\mathrm{L}3}\right)$$

where $\underline{X}_{L1}$, $\underline{X}_{L2}$ and $\underline{X}_{L3}$ are the complex expressions of the fundamental frequency phase quantities concerned, that is, current or voltage phasors

[SOURCE: IEV 448-11-29]

3.15
generating plant
sum of generating units 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.

3.16
generating plant controller
intelligence which ensures the fulfillment of performance requirements at the point of connection (POC) towards a generating plant, usually by utilizing external measurement signals from the POC to generate reference to a sub structure e.g. the generating units

3.17
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.

3.18
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

3.19
interface protection system
a protection system that acts on the interface switch

3.20 Interface protection system timing

3.20.1
energizing quantity
energizing quantity by which the protection function is activated when it is applied under specified conditions

Note 1 to entry: See also Figure 1.

[SOURCE: IEV 442-05-58, modified]

3.20.2
start time
duration of the time interval between the instant when the energizing quantity of the measuring relay in reset condition is changed, under specified conditions, and the instant when the start signal asserts

Note 1 to entry: See also Figure 1.

[SOURCE: (EN 60255-151, modified]

3.20.3
time delay setting
intentional delay that might be adjustable by the user

Note 1 to entry: See also Figure 1.

3.20.4
operate time
duration of the time interval between the instant when the energizing quantity of a measuring relay in reset condition is changed, under specified conditions, and the instant when the relay operates

Note 1 to entry: See also Figure 1.

Note 2 to entry: Operate time is start time plus time delay setting.

[SOURCE: IEV 447-05-05, modified]

3.20.5
disconnection time
sum of operate time of the protection system and the opening time of the interface switch

Note 1 to entry: See also Figure 1 where the CB opening time indicates the opening time.

3.20.6
reset time
duration of the time interval between the instant when the energizing quantity of a measuring relay in operate condition is changed, under specified conditions, and the instant when the relay resets

Note 1 to entry: See also Figure 1.

[SOURCE: IEV 447-05-06 modified]

3.20.7
disengaging time
duration of the time interval between the instant a specified change is made in the value of the input energizing quantity which will cause the relay to disengage and instant it disengages

Note 1 to entry: See also Figure 1.

[SOURCE: IEV 447-05-10]

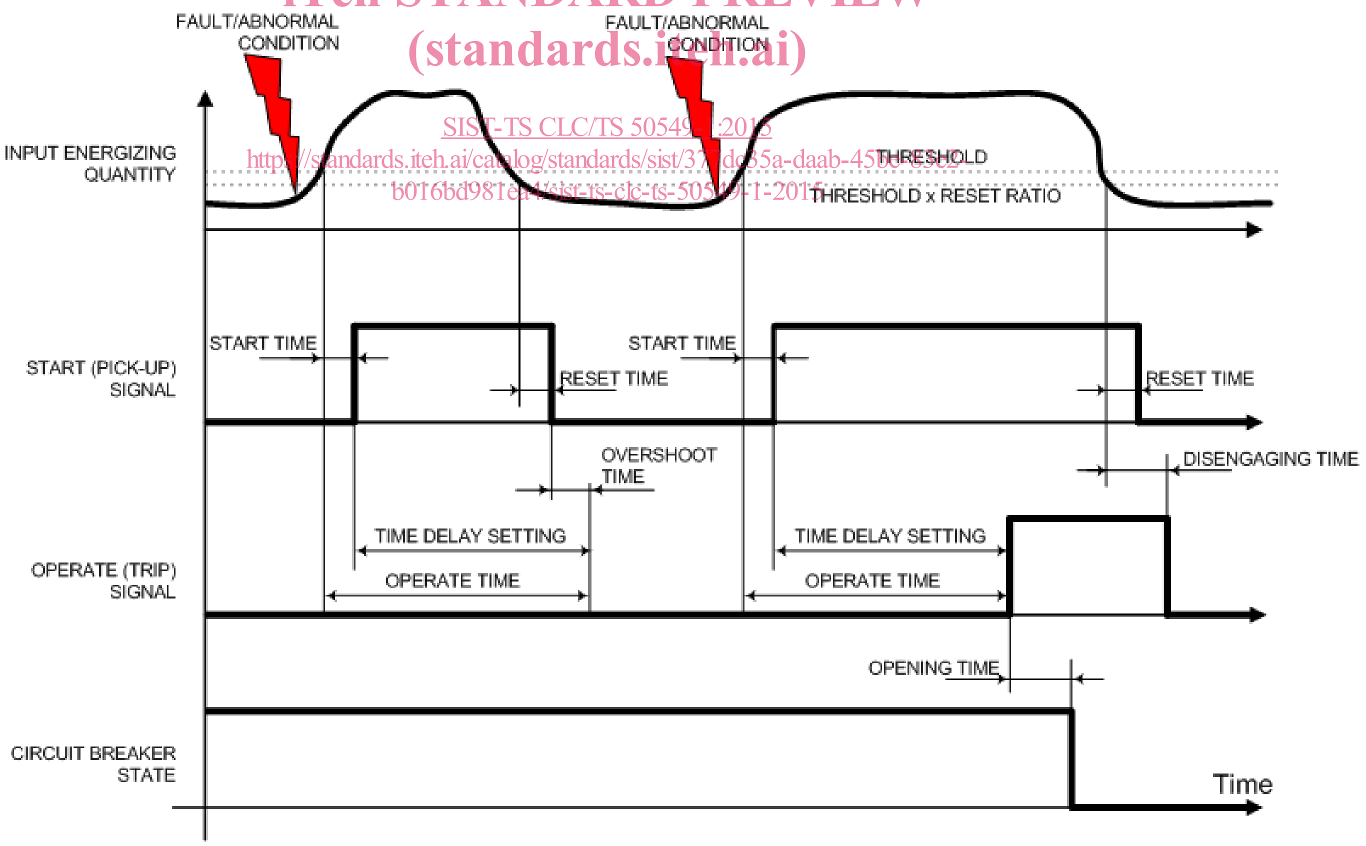

Figure 1 — Main times defining the interface protection performance

3.21
islanding
situation where a section of the distribution network, containing generation, becomes physically disconnected from the rest of distribution network and one or more generating units maintain a supply of electrical energy to the isolated section of the distribution network

3.22
low voltage (LV) distribution network
electric distribution network with a voltage whose nominal r.m.s. value is $U_n \leq 1$ kV

3.23
maximum active power
P_{max}
maximum AC active 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.

3.24
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.

3.25
momentary active power
P_M
the actual AC active power output at a certain instant

3.26
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]

3.27
nominal voltage
U_n
voltage by which a supply network is designated or identified and to which certain operating characteristics are referred

3.28
observation time
time during which all the voltage and the frequency values are observed to be within a specified range prior to a generating plant connection to the distribution network or start to generate electric power

3.29
operation in parallel with the distribution network
situation where the generating plant is connected to a distribution network and operating

3.30
point of connection
POC
reference point on the electric power system where the user’s electrical facility is connected

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

[SOURCE: IEV 617-04-01]

3.31
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]

3.32
power system stability
the capability of a power system to regain a steady state, characterized by the synchronous operation of the generating plants after a disturbance

[SOURCE: IEV 603-03-01]

3.33
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.

3.34
producer
party who already has or is planning to connect an electricity generating plant to a distribution network

3.35
producer's network
electrical installations downstream from the point of connection owned/operated by the producer for internal distribution of electricity

3.36
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]

3.37
protection system
an 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]