

TECHNICAL APPENDIX 1 TO THE GUIDELINES ‘CONNECTING AN ELECTRICITY GENERATION INSTALLATION TO THE DISTRIBUTION NETWORK’ – CONNECTING AN INSTALLATION WITH A NOMINAL RATED CAPACITY OF UP TO 100 kVA

These instructions are a translation of the corresponding instructions in Finnish. In any cases of ambiguity in interpretation, the Finnish-language instructions shall be complied with.

This appendix includes technical information about connecting a generation installation with a nominal rated capacity of **up to 100 kVA** to the distribution network. The purpose of this appendix together with the guidelines ‘Connecting an electricity generation installation to the distribution network’ is to offer information about connecting small-scale electricity generation installations to the network and to facilitate the process of connecting the installations to the network.

This appendix presents requirements needed for inverter connected generation installations. For other types of installations additional requirements may be needed, especially installations with high nominal power.

TABLE OF MODIFICATIONS

Date of modification	Description
12/2011	Original
28.2.2013	Finnish Energy Industries recommends that, in addition to the equipment that fulfil the requirements set in chapter 3, also equipment that fulfil the technical requirements set in German application guide VDE-AR-N-4105, are accepted to be connected to the distribution network.
10.6.2014	In chapter 5 references to standards is added.
27.4.2016	Coverage of appendix is widened from up to 50 kVA to up to 100 kVA. Chapter 3 is updated with new standard SFS-EN 50438 published 5/2015. In chapter 2 references to standard contract terms are updated. In chapter 6, information about general notification sheet is added. A notification about other than inverter connected installations is added in the beginning of appendix.

1. General information about the operation of an electricity generation installation in the electricity distribution network

When connecting a generation installation to the public electricity network and when using it in parallel with the public electricity network, it is of paramount importance that the generation installation is safe and will not cause any disturbances to the network and, for example, damage the electrical equipment of other electricity users. For these reasons, generation installations are subject to certain technical requirements.

A generation installation must not connect to the public electricity network unless the voltage and frequency of the electricity network are within the agreed set limits. The generation installation must not keep on feeding to the electricity network when the network is not fed from elsewhere. When the network voltage returns, the installation may connect to the network automatically or it can be connected back to the network manually if agreed with the system operator.

If one also wants to use a generation installation as reserve power during power cuts, the possibility of a dual connection mode must be installed in the system, with one connection to work in parallel with the network and the other in isolated operation that is completely separated from the network. This requires a separate switch and additional devices. When the electricity network is de-energised, an installation used in isolated operation must not be in connection with the electricity network. This is absolutely essential due to the safety of the fault repair and installation work on the network.

No electricity-generating equipment must cause disturbance to the network or other electrical installations. If a fault is detected in the generation installation, it is the electricity producer's responsibility to disconnect the installation from the network as quickly as possible after detecting the fault. If a generation installation connected to the network causes disturbance elsewhere in the electricity network, the system operator will intervene and, in extreme cases, have the installation removed from the network.

The owner of the electricity generation installation is liable for any damages caused by the electricity generated by its equipment to other electricity users and the system operator if the electricity generated by the equipment does not meet the standards and other requirements.

2. Classification of equipment

Many properties of the generation installation have an impact on its operation in the electricity network. The nominal rated capacity of the generation installation is one significant matter, but other properties are also essential in terms of network use. For example, the start-up current of the installation may vary, depending on the type of equipment, from a start-up current that corresponds with the nominal rated current to one that is 8 times greater than the nominal rated current. These matters are important especially when deciding on the connection point of the generation installation.

The operating mode of the generation installation has an impact on contracts between the electricity producer and the system operator and on the operation and protection features required of the installations. The classification of installations in various uses and the requirements they are subject to are presented in the following table. The columns of the table show the properties that various installations require. Prevention of parallel use means that the installation is mechanically separated from operating in parallel with the distribution network. Synchronisation means that the installation is able to synchronise with the distribution network and remain in that mode. Compatibility describes the electrical compatibility of the installation and the distribution network. Prevention of isolated operation (also called Loss of Mains protection) means protection that prevents the generation installation to feed electricity into a de-energised network. Terms of contract mean the contracts between the owner of the installation and the system operator. The abbreviations refer to the following terms of contract applied to the connection and operation of the installation, recommended by Finnish Energy Industries: Terms of Network Service (VPE2014), Appendix to the Terms and Conditions Concerning Network Services for Electricity Generation (TVPE11), Terms of Connection (LE2014), and Terms of Network Connection for Electricity Generation (TLE2014).

Table 1. Classification of generation installations according to the operating mode and purpose of the installations.

	Class	Prevention of parallel use	Synchronisation	Compatibility	Loss of Mains protection	Terms of contract
Parallel use prevented mechanically	1	X				LE2014 and VPE2014
Electricity transmission to the distribution network prevented	2		X			LE2014 and VPE2014
There is no buyer for the electricity generated	3		X	X	X	LE2014 and TVPE11
Producer sells electricity to a party of the electricity market	4		X	X	X	LE2014 or TLE2014 and TVPE11

3. Protection settings of the generation installation

Generation installations shall be equipped with appropriate protection devices. The purpose of the protection measures is to ensure that the generation installation will not break down as a result of any disturbances in the electricity network. Moreover, the protection measures will ensure that the generation installation will not feed into the network electricity of poor quality, which may damage the equipment of other network users and, at worst, cause serious safety hazards to people and property.

Generation installations of up to 100 kVA must be equipped with protection devices that disconnect the generation installation or isolated generation fed by the generation installation from the public network if the feed to the network is cut off or if the voltage or frequency at the equipment connection point deviates from the normal reported values. The set values of protection are presented in Table 2, in which U_n means the normal nominal rated voltage of the distribution network.

Table 2. The set values for protection devices in the generation installation

Parameter	Operating time	Set value
Overvoltage	0.2 s	$U_n + 10\%$
Undervoltage	0.2 s	$U_n - 15\%$
Overfrequency	0.2 s	51.5 Hz
Underfrequency	0.2 s	47.5 Hz
Loss of Mains	up to 5 s	

Minimum time period for which a micro-generator shall be capable of operating when frequency is within limits 47.5-49 Hz and 51.0-51.5 Hz is 30 minutes. Micro-generator shall operate normally while rate of change of frequency is under 2 Hz/s.

The values of the table are the same as the country-specific values set for Finland in standard SFS-EN 50438. The system operator may deviate from the values case by case.

If the generation installation disconnects from the network due to the functioning of the protection device, it can reconnect to the network only after the network voltage and frequency have returned back to the limits permitted by the set values for protection and have remained within these limits for a certain minimum period. This minimum period is, according to standard SFS-EN 50438 60 seconds.

In addition to the equipment that fulfil the requirements set in this chapter, also equipment that fulfil the technical requirements set in German application guide [VDE-AR-N-4105](#), are accepted to be connected to the distribution network.

4. Quality of electricity

It is the task of the distribution system operators to deliver high-quality electricity to its customers. For this reason, the quality control of electricity is very important also in issues related to small-scale generation of electricity. The quality of electricity must be regarded from the viewpoint of the quality of electricity at the connection point and the quality impacts of the power plant.

A generation plant connected to the electricity network must not impair the quality of electricity nor have a significant impact on the quality of voltage at the point of connection. Generation installations must meet at least the requirements on the quality of electricity set for it in the national (SFS) and international (IEC and CENELEC) standards.

5. Electrical safety

According to the general electrical safety regulations, a generation installation must be equipped with a disconnecting device with a position indicator or a visible clearance between open contacts and to which the system operator has free access. The switch must also have a locking option. The disconnecting device is needed to ensure the safety of electrical work.

Additional information can be found from standards SFS 6000-5-55 (551.7.6), SFS-EN 61140 + A1 (8.3.1) and SFS 6002 (6.2.1 and 6.2.2).

6. Documents concerning the installation to be delivered to the system operator

Before the generation installation is connected to the network, the key documents and information concerning the installation must be delivered to the system operator. The system operator needs at least the basic information about the equipment (generator type, nominal rated capacity, nominal rated current) and information about the inverter used as the connecting device (type data and set values of the inverter). It is worth sending this information to the system operator at a sufficient early stage, preferably before acquiring the generation installation.

Information to be delivered:

- Type, nominal rated capacity, nominal rated current and short-circuit current of the installation
- Type data of the connecting device (inverter)
- The set values and operating times of protection
- Information about the implementation of protection to prevent isolated operation (method and operating time of Loss of mains protection).

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For delivering the necessary information it is possible to use the general notification sheet provided by Finnish Energy (mikrotuotannon yleistietolomake).