

Grid Code Specifications for Demand Connections KJV2018

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1 Introduction

This document contains the Grid Code Specifications for the Demand Connections required by Fingrid Oyj (hereinafter referred to as “Fingrid”), by virtue of the system responsibility imposed on Fingrid, of distribution networks and demand facilities connected to the Finnish transmission grid and of distribution networks and demand facilities offering demand-side management services and connected to the Finnish power system. In addition to these Specifications, connecting parties shall fulfil Fingrid’s General Connection Terms (YLE) valid at the time of connection, the terms specified in the Main Grid Contract and the connection terms set by the relevant network operator.

The Specifications are based on the European Network Code (EU Commission Regulation 2016/1338), to which Fingrid has made national additions and clarifications. The aim of the European network codes is to guarantee equal and non-discriminatory conditions for competition on the internal energy market, to ensure system security and to create harmonised connection terms for grid connections.

Nationally, the purpose of the Grid Code Specifications for Demand Connections is to ensure that

- the connecting party’s electrical equipment withstands the voltage and frequency fluctuations occurring in the power system,
- the connecting party’s electrical equipment does not disconnect from the grid due to frequency and voltage fluctuations,
- while synchronised to the power system, the connecting party’s electrical equipment does not cause any adverse impacts to the other installations connected to the power system, and
- the relevant network operator and Fingrid obtain the data on the connecting party’s electrical equipment, necessary in the planning of the power system and its operation and in the maintaining of system security.

2 Terms and definitions

Distribution network: In terms of the scope of the Specifications, the distribution network is a distribution network connected to the Finnish power system that has a voltage of no less than 110 kV at the connection point.

Connecting party: An operator who owns a distribution network or demand facility which is connected to the Finnish transmission grid or an operator whose distribution network is connected to the Finnish power system, or an operator that offers demand-side management services.

Connection point: Ownership limit as specified in the Connection Agreement.

Connection agreement: An agreement between the connecting party and the relevant network operator, specifying the terms and conditions for connecting the connecting party to the relevant network operator's network.

Reactive power: Imaginary component of the apparent power; unit Mvar.

Normal operating voltage: The voltage at the connection point as specified by the relevant network operator (voltage corresponding to 100% value). Expressed as a per unit value, the normal operating voltage is 1.0 pu.

Apparent power: Product of voltage and current at fundamental frequency; unit MVA.

pu: per unit value. A variable is compared to a predetermined base value.

Active power: Real component of the apparent power; unit MW.

A closed distribution system operates in a restricted area offering industrial, business or community services. A closed distribution system does not supply power to consumer customers.

Finland's power system consists of power plants, the main grid, high-voltage distribution networks, distribution networks and consumers of electricity. The Finnish system is part of the Nordic power system together with the systems of Sweden, Norway and eastern Denmark.

A major disturbance is the system's status in which part of the transmission grid or the entire transmission grid has stopped operating.

The electricity transmission grid is a high-voltage electrical network owned by the transmission system operator (Fingrid Oyj).

Requirements: Grid Code Specifications for Demand Connections KJV2018

Power line connection: A line or substation connected to a transmission line by means of a switching device.

YLE: Fingrid's General Connection Terms.

3 Scope

The Grid Code Specifications for Demand Connections apply to the following electrical equipment connected to Finland's power system:

- demand facilities connected to the transmission grid,
- distribution networks connected to the transmission grid,
- distribution networks, when connection point voltage is at least 110 kV, including closed distribution systems,
- demand facilities used to offer demand-side management services to relevant network operators or the transmission system operator.

The Specifications are applied to new electrical equipment to be connected to the power system, but they shall also apply to existing electrical equipment when their system characteristics are changed. Notification of a change must be given in compliance with the procedure outlined in Section 5.2.

It is the responsibility of the connecting party to fulfil and maintain the KJV2018 Specifications if the electrical equipment's binding procurement agreement was signed after 7 September 2018. Otherwise, the connecting party must fulfil and maintain the specifications that were in force when the electrical equipment's connection agreement was concluded. The Specifications shall be fulfilled at the connection point.

In terms of energy storage systems, these Specifications apply solely to units in pumped-storage hydroelectricity plants; other types of energy storage systems are beyond the scope of the Specifications, for instance battery storage.

When it comes to generating modules located on industrial sites, the network operator of the industrial site, demand facility owner, connecting party and the relevant network operator whose electrical network is connected to the industrial site's electrical network can agree, in collaboration with Fingrid, on the conditions applying to the disconnection of critical loads in the networks in question. The purpose of the agreement is to secure the continuity of the industrial site's production processes in a situation in which disturbances occur in the network in question.

The requirements specified in Chapters 5–10 of this document concern the demand facilities connected to the transmission grid, distribution networks connected to the transmission grid and distribution networks including closed distribution systems. Requirements that apply to demand facilities offering demand-side management services are defined in Sections 7, 9.2, 9.4 and 11.

4 Confidentiality

Confidentiality obligations have been laid down explicitly in European Commission Regulation 2016/1338, Article 11, and these obligations are applied nationally to these Specifications:

Article 11 Confidentiality

obligations

- 1. Any confidential information received, exchanged or transmitted pursuant to this Regulation shall be subject to the conditions of professional secrecy laid down in paragraphs 2, 3 and 4.*
- 2. The obligation of professional secrecy shall apply to any persons, regulatory authorities or entities subject to the provisions of this Regulation.*
- 3. Confidential information received by the persons, regulatory authorities or entities referred to in paragraph 2 in the course of their duties may not be divulged to any other person or authority, without prejudice to cases covered by national law, the other provisions of this Regulation or other relevant Union law.*
- 4. Without prejudice to cases covered by national or Union law, regulatory authorities, entities or persons who receive confidential information pursuant to this Regulation may use it only for the purpose of carrying out their duties under this Regulation.*

5 **Compliance monitoring process of the Specifications, continuous monitoring, and related responsibilities**

This section defines the compliance monitoring process of the Specifications, continuous monitoring of compliance and the operational notification procedure for electrical equipment. Moreover, this section defines the responsibilities, obligations and rights of the connecting party, relevant network operator and Fingrid during the compliance monitoring process and continuous monitoring.

The requirements specified in this section concern the demand facilities connected to the transmission grid, distribution networks connected to the transmission grid and distribution networks including closed distribution systems. The compliance with the Specifications and delivery of data concerning demand facilities offering demand-side management services are defined in Chapter 11.

The details of the responsibilities, obligations and rights for specific requirements are recorded in Chapters 6–11 of this document

5.1 Responsibilities, obligations and rights during the compliance monitoring process and during continuous monitoring

5.1.1 Responsibilities, obligations and rights of the connecting party and the relevant network operator

The connecting party is responsible for the compliance monitoring process and fulfilment of the Specifications as well as for the associated costs. The connecting party is responsible for fulfilling and maintaining operations according to the Specifications throughout the electrical equipment's lifetime.

The connecting party shall notify the relevant network operator of the planned test schedules and procedures to be followed for verifying the electrical equipment's compliance with the Specifications. The relevant network operator may participate in such tests and record the performance of the electrical equipment.

The relevant network operator shall supervise the compliance monitoring process of the Specifications, and take care of the data exchange required by the process with the connecting party and Fingrid. The relevant network operator shall verify the data supplied by the connecting party and assess whether the electrical equipment is compliant with the Specifications, and shall notify the connecting party of the outcome of the assessment.

The relevant network operator shall make publicly available a list of information and documents to be provided as well as the requirements to be fulfilled by the connecting party within the framework of the compliance process.

The relevant network operator shall make public the allocation of responsibilities between the connecting party and the network operator for compliance testing, simulation and monitoring.

The relevant network operator has the right to specify additional requirements if they are needed because of an electricity network located close to the electrical equipment. Potential conflicts between the Specifications and the additional requirements specified by the relevant network operator shall be resolved between Fingrid and the relevant network operator.

The relevant network operator may totally or partially delegate the performance of its compliance monitoring to third parties. In such cases, the relevant network operator shall continue ensuring compliance with the confidentiality obligations (Chapter 4), including entering into confidentiality commitments with the assignee.

If compliance tests or simulations cannot be carried out as agreed between the relevant network operator and the demand facility owner, distribution system operators or closed distribution system operator due to reasons attributable to the relevant network operator, then the relevant network operator shall not unreasonably withhold the operational notification according to the compliance monitoring process.

The connecting party shall maintain the operation of the electrical equipment in accordance with the Specifications also after the accepted execution of the compliance monitoring process of the Specifications. If the connecting party discovers that the operation of the electrical equipment is in conflict with the Specifications, the connecting party shall inform the relevant network operator and Fingrid of this without delay, and take the necessary measures to eliminate the conflict.

The relevant network operator shall inform the connecting party and Fingrid without delay if the relevant network operator discovers at any stage of the compliance monitoring process or during the normal operation of the electrical equipment that the electrical equipment derogates from the Specifications.

5.1.2 Fingrid's responsibilities, obligations and rights

The responsibilities, obligations and rights of the relevant network operator apply to Fingrid when the electrical equipment is connected to Fingrid's grid.

If Fingrid receives information or discovers that the electrical equipment derogates from the Specifications at any stage of the compliance monitoring process or during the normal operation of the electrical equipment, Fingrid may require additional clarifications and measures to correct the derogation. If the shortcomings in the operation of the electrical equipment related to the Specifications influence the operation of the power system, Fingrid, as the transmission system operator, has the right to restrict the operation of the electrical equipment and to impose conditions related to the operation. Fingrid has the right to keep the restrictions imposed in force until the shortcomings detected in the operation of the electrical equipment have been corrected and the capability of the electrical equipment to fulfil the Specifications has been verified.

Fingrid's representative has the right to participate in commissioning testing when the electrical equipment is connected to the electricity network of a third party

5.2 Amendment of electrical equipment technical characteristics

If significant changes are made to electrical equipment which is in operation or to the equipment or systems influencing its technical characteristics, the connecting party shall, before making the changes, inform the relevant network operator of the changes and of their impact on the capability of the electrical equipment to fulfil the Specifications.

Significant changes are the construction of a power line, substation, transformer or demand facility connected to a grid of at least 110 kV and the changing of existing electrical equipment. Moreover, significant changes include changes in technical characteristics, such as the replacement of a substation's relay protection or changes in the characteristics of demand facilities offering demand-side management services.

It is the relevant network operator's responsibility to evaluate and set new requirements for the equipment and systems being changed, in accordance with the Grid Code Specifications for Demand Connections valid at the time.

The relevant network operator must update the existing connection agreement to include information about the equipment to be changed and the Specifications to be applied. If the relevant network operator considers the scope of the change (modernisation or replacement of equipment) to be such that it requires a new connection agreement, the network operator must agree on the terms of a new connection agreement with the connecting party.

If the relevant network operator and the connecting party cannot agree on the connection terms, the matter must be taken to the Finnish Energy Authority. The Energy Authority must decide whether the connection agreement that is in effect should be amended or a new one should be drawn up, as well as the extent to which the Specifications must be complied with.

5.3 Compliance monitoring process of Specifications and operational notification procedure for electrical equipment

The connecting party and the relevant network operator must carry out a compliance monitoring process and operational notification procedure for electrical equipment in stages according to Table 5.1. The procedure presented in Table 5.1 is described in detail in stages in the sub-sections of this section.

Once the connecting party has carried out the measures conforming to the Specifications in each stage in the required scope, the relevant network operator shall verify the data supplied and confirm the execution of the required measures in each stage, as well as deliver the energisation operational notification (EON) and/or operational notification required after each stage to the connecting party. The relevant network operator shall supervise the compliance monitoring process of the Specifications, including the commissioning tests during the compliance monitoring process, and take care of the data exchange required by the process with the connecting party and Fingrid. The relevant network operator shall deliver the data conforming to the Specifications to Fingrid after the confirmation of each stage of the process.

The documentation and delivery of electrical equipment data is specified in Chapter 6. The real-time measurements are specified in Chapter 8. The general requirements are specified in Chapter 9. The compliance monitoring of the Specifications by means of commissioning tests is specified in Chapter 10.

Table 5.1. Compliance monitoring process of the Specifications, operational notification procedure and schedule requirements

Process stage	Condition	Schedule requirement and additional information
Stage 1 (Planning): <ul style="list-style-type: none"> ● Delivery of planning data ● Implementation of real-time measurements ● Energisation planning ● Commissioning inspection ● Statement of compliance 	The connecting party can deliver the Stage 1 data as soon as they are available.	The Stage 1 data must be delivered as early as possible so that the electricity equipment's energisation operational notification and interim operational notification can be processed. The data to be delivered is listed in Table 6.1. A commissioning inspection shall be carried out and the delivery of real-time data shall be verified before the connection can be energised. The relevant network operator must review the delivered data within one month of having received them.
Energisation operational notification (EON) Interim operational notification (ION)	The connecting party has delivered the Stage 1 data, carried out a real-time measurement and carried out a commissioning inspection. The relevant network operator has confirmed the implementation of the required measures.	Upon receiving the EON and the ION, the connecting party shall have the right to energise the network beyond the connection point and use his/her electrical equipment for no more than 6 months.
Stage 2 (Commissioning and compliance): <ul style="list-style-type: none"> ● Changes and updates to stage 1 data ● Implementation of commissioning tests ● Reporting of test results ● Final protection setpoint values ● Statement of compliance 	The relevant network operator has given an EON and ION.	The connecting party must deliver the commissioning testing plan to the relevant network operator no later than 2 months before the planned start of the tests. The compliance testing shall be performed in an accepted manner within 2 months from the date and time on which the use of the electrical equipment has begun. The data to be delivered is listed in Table 6.2.
Stage 3 (Review and approval): <ul style="list-style-type: none"> ● Review of delivered data ● Approval of the process 	The connecting party has delivered the Stage 2 data and carried out the measures, and the relevant network operator has confirmed that the required measures have been implemented.	The relevant network operator must review the delivered data and confirm that the required measures have been carried out. The relevant network operator must deliver a statement on compliance with the Specifications no later than three months after receiving the Stage 2 data.
Final operational notification (FON)	The relevant network operator has confirmed the implementation of the Stage 3 measures.	Upon receiving the FON, the connecting party shall have the right to operate the electrical equipment until further notice.

5.3.1 Stage 1 (Planning), energisation operational notification (EON) and interim operational notification (ION)

In Stage 1, the connecting party shall deliver to the relevant network operator the data listed in Table 6.1 and carry out real-time measurement on the electrical equipment in accordance with the instructions in Chapter 8.

The connecting party shall deliver a statement of compliance as part of the delivery of the Stage 1 data. In the statement of compliance, the connecting party shall indicate each delivered document or file name in the reference column in Table 6.1 and confirm with a signature that the electrical equipment fulfils the set Specifications.

The Stage 1 data must be delivered as early as possible so that the electricity equipment's energisation operational notification and interim operational notification can be processed. Electrical equipment shall always undergo an approved commissioning inspection and a review of the delivered real-time data, before the connecting party can be issued an energisation operational notification (EON) and interim operational notification (ION). The commissioning inspection and review of the real-time data delivery can be carried out just before the connection's commissioning. Once the connecting party has carried out the Stage 1 measures, the relevant network operator shall review the delivered data, confirm the execution of the required measures and deliver an energisation operational notification (EON) and interim operational notification (ION) to the connecting party. The relevant network operator must review the delivered data within one month of having received them.

Upon receiving the EON and the ION, the connecting party shall have the right to energise the network beyond the connection point and use his/her electrical equipment for no more than 6 months.

The period of validity of the ION may be extended on justified grounds for no more than 6 months. An extension of the period of validity must be requested from the relevant network operator and Fingrid, which may, by a unanimous decision, extend the period of validity of the ION. If there is still a further need to derogate from this, a request for such derogation must be requested in accordance with what is laid down in Chapter 7.

5.3.2 Stage 2 (Commissioning and compliance)

In Stage 2, the connecting party carries out the commissioning testing on the electrical equipment and delivers the data listed in Table 6.2 to the relevant network operator. In addition, any possible changes and updates to the Stage 1 data shall be delivered to the relevant network operator during Stage 2.

The connecting party shall deliver a statement of compliance as part of the delivery of the Stage 2 data. In the statement of compliance, the connecting party shall indicate each delivered document or file name in the reference column in Table 6.2 and confirm with a signature that the electrical equipment fulfils the set Specifications.

The condition for the Stage 2 measures is an energisation operational notification (EON) and interim operational notification (ION). All Stage 2 measures must be completed while the ION is valid.

With respect to the planning of commissioning tests, the connecting party must deliver the commissioning testing plan to the relevant network operator no later than 2 months before the planned start of the tests.

The Compliance Testing shall be performed in an accepted manner within 2 months from the date and time on which the use of the electrical equipment has begun.

5.3.3 Stage 3 (Review and approval) final operational notification (FON)

In Stage 3, the relevant network operator reviews all data delivered during the process and confirms that the required measures have been carried out. The relevant network operator must deliver a statement on compliance with the Specifications no later than three months after receiving the Stage 2 data. If there are no comments to be made on the data delivered during the process, the relevant network operator must issue a final operational notification (FON).

The FON is valid until further notice and it entitles the connecting party to use the electrical equipment until further notice.

5.3.4 Limited operational notification (LON)

A limited operational notification procedure enters into effect when significant and unforeseen modifications take place in the electrical equipment and affect its ability to fulfil the Specifications. A connecting party to whom a FON has been granted shall inform the relevant network operator immediately in the following circumstances:

- the electrical equipment is temporarily subject to either significant modification or loss of capability affecting its performance; or
- an equipment failure leading to non-compliance with some relevant Specifications is observed.

The connecting party shall apply for a limited operational notification (LON) from the relevant network operator if the connecting party reasonably expects the above-mentioned circumstances to persist for more than 3 months.

A LON shall be issued by the relevant network operator and shall contain the following information which shall be clearly identifiable:

- the unresolved issues justifying the granting of the LON;
- the responsibilities and timescales for the expected solution; and
- a maximum period of validity which shall not exceed 12 months. The initial period granted may be shorter with the possibility of an extension if evidence is submitted to the satisfaction of the relevant network operator demonstrating that substantial progress has been made towards achieving compliance.

The FON shall be suspended during the period of validity of the LON with regard to the items for which the LON has been issued.

A further extension of the period of validity of the LON may be granted upon a request for a derogation made to the relevant network operator before the expiry of that period, in accordance with the derogation procedure described in Chapter 7.

The relevant network operator shall have the right to refuse to allow the operation of the electrical equipment once the LON is no longer valid. In such cases, the FON shall automatically become invalid.

If the relevant network operator does not grant an extension of the period of validity of the LON when a request for derogation has been made or if it refuses to allow the operation of the electrical equipment once the LON is no longer valid, the connecting party may refer the issue for decision to the Finnish Energy Authority within six months after the notification of the decision of the relevant network operator.

6 Documentation and delivery of electrical equipment data

6.1 Delivery and schedule of electrical equipment data

The connecting party shall supply to the relevant network operator the data on the electrical equipment to be delivered in accordance with the compliance monitoring process for the Specifications as defined in Section 5.3.

- 1) The data specified in Table 6.1 shall be delivered in Stage 1 of the compliance monitoring process.
- 2) The data specified in Table 6.2 shall be delivered in Stage 2 of the compliance monitoring process.

The connecting party shall submit this electrical equipment data to the relevant network operator as electronic documents. The data to be submitted shall be clear and unambiguous in terms of its layout and structure. The relevant network operator shall deliver the data to Fingrid.

The connecting party shall deliver the data on electrical equipment connected to a grid of at least 110 kV, such as substations, power lines, transformers, rotating electrical machines and compensation devices and the electrical network's method of use.

The connecting party shall deliver a statement of compliance as part of the data to be delivered. In the statement of compliance, the connecting party shall indicate each delivered document or file name in the reference column in tables 6.1 and 6.2 and confirm with a signature that the electrical equipment fulfils the set Specifications.

The delivery of data concerning demand facilities offering demand-side management services are defined in Chapter 11.

6.2 Data to be delivered

The data to be delivered on electrical equipment is specified in Tables 6.1 and 6.2.

Table 6.1. Data to be delivered on electrical equipment in Stage 1 of the compliance monitoring process

Stage 1 (Planning)		Reference
1	General data	
1.1	Project name, company name, name of contact person and contact details	
1.2	Connection point, name and abbreviation of connection, relevant network operator and contact details	
1.3	Electrical equipment's power rating	
	Consumption and production capacity [MW]	
	Estimated reactive power [Mvar, cap. and ind.]	
1.4	Location data	
	Location of connection point on a map (municipality, area, connection point, coordinates)	
	Location of branch line on a map (municipality, area, connection point, coordinates)	
2	Technical data	
2.1	Single line diagram	
	The main components of the electrical equipment and the electricity network that connects the components, incl. stand-by supply connections	
	Electric parameters of the components and conductors presented in the single line diagram	
2.2	Documentation and data sheets of transformers	
	Power [MVA], current [A], transformation ratio [primary, secondary], short-circuit impedance [%], short-circuit resistance [%], vector group and earthing details, control range and step of on- or off-load tap-changer [%, %], number of steps of on- or off-load tap-changer and selected step [quantity, step]	
2.3	Branch line technical data	
	Length [km], pylon type, electrical values of phase conductors and lightning conductors [R, X, B]	
2.4	Documentation and data sheets for rotating electrical machines	
	Type, apparent power [MVA], rated capacity [MW], power factor [cos ϕ], current [A], voltage [V], frequency [Hz]	
2.5	Documentation and data sheets for other components impacting reactive power (e.g. compensation batteries and reactors)	
	Where applicable, the required data that is relevant in terms of the Specifications (e.g. power, structure, filter tuning frequency)	
2.6	Short-circuit withstand capability	
	Short-circuit withstand capability of high-voltage electrical equipment	
	The short-circuit current produced by the electrical equipment at the connection point (zero-, positive- and negative-sequence network data)	
3	Planning data	
3.1	Connection's location and cross-sectional drawings	
	Distances to the main grid's power line and its closest pylon	
	The heights of the devices and structures to be built in the transmission line area of Fingrid's power line must be specified using the elevation of the concrete foundation of the closest power line pylon.	
3.2	Area map	
	The map shall show the high-voltage electrical equipment and the following: low-voltage side connections, house-load transformer locations, communication lines, roads and parking lots, other similar structures.	
3.3	Implementation of energy measurements	
	Instrument transformers' technical data, instrument transformers' load calculations, measurement circuit diagrams and measurement control panels' wiring drawings	
3.4	Earthing	
	Substation earthing plan, structure of the earthing system and connections of the earthing wiring.	
3.5	Location coordinates	
	Substation location coordinates, connection point location coordinates, pylon location coordinates	
	The coordinates shall be delivered using the ETRS-TM35FIN projection and as electronic material, e.g. in an Excel table.	
3.6	Branch line data	
	List of pylons and pylon drawings, phase sequence diagram	
	Phase conductors and lightning conductors (material, cross-sectional area, number of sub-conductors)	

Table 6.1. Data to be delivered on electrical equipment in Stage 1 of the compliance monitoring process

4	Relay protection and communication line data	
4.1	Relay protection diagrams and the relays' main setpoint values marked in the diagram	
4.2	Load disconnection and reconnection settings	
4.3	Communication lines and their implementation	
5	Operating voltage and frequency range	
5.1	Data on the electrical equipment's ability to operate at undervoltage and overvoltage	
5.2	Data on the electrical equipment's ability to operate at underfrequency and overfrequency	
6	Power quality	
	Description of the change in the power quality caused by the electrical equipment, and potential reports of factory testing	
7	Real-time measurement data	
	Method of delivery and verification of real-time measurement data	
	Real-time measurement data must be available before the connection can be commissioned. Data delivery can be verified immediately before the connection commissioning.	
8	Schedule of the connection project	
	Connection project's schedule and planned timing of the commissioning	
	Possible options for expansion and known future expansion plans shall also be reported.	
9	Commissioning inspection	
	Commissioning inspection and drawing up of commissioning inspection minutes	
	An approved commissioning inspection shall be carried out on electrical equipment before the connection can be energised. The commissioning inspection can be carried out just before the connection's commissioning.	
	Statement of compliance	
	The connecting party's representative confirms with a signature that the documents referred to in this table's reference details prove that the electrical equipment meets the Specifications set for it. Place, date, signature and printed name:	

Table 6.2. Data to be delivered on electrical equipment in Stage 2 of the compliance monitoring process.

Stage 2 (Commissioning and compliance)		Reference
1	Changes and further specifications	
	Further specifications to the data delivered in Stage 1 of the compliance verification process	
2	Data related to commissioning tests	
2.1	Commissioning plan and schedule	
	The commissioning plan, schedule and a description of the practical arrangements for verifying compliance with the Specifications shall be submitted to the relevant network operator at the latest two months before the tests are started.	
2.2	Measurement arrangements	
	Plan of the execution of measurements for the tests related to the Specifications.	
3	Results of commissioning tests	
3.1	Commissioning report	
3.2	Results of functional commissioning tests	
	a Load disconnection taking place at underfrequency	
	b Disconnection carried out through remote operation of the power line connection	
	c Automatic reconnection of electrical equipment	
	d Synchronisation (if required)	
	e Functioning of control in the damping of power oscillations (if required)	
3.3	Resistance to earth measurement records	
	The resistance to earth measurement records can be delivered within 12 month of the commissioning, if conditions do not permit earlier measurements.	
3.4	Electrical values of transformers, branch lines, underground cables and other possible components (if measured)	
4	Final protection settings	
	Protective relays' main setpoint values and commissioning testing minutes	
	Statement of compliance	
	The connecting party's representative confirms with a signature that the documents referred to in this table's reference details prove that the electrical equipment meets the Specifications set for it. Place, date, signature and printed name:	

7 Derogations

The derogation procedure has been laid down explicitly in European Commission Regulation 2016/1338, Article 50. The described procedure is applied on a national level to these Specifications.

Pursuant to Regulation 2016/1338, Article 50 (4), the relevant network operator and Fingrid must assess any derogations. Fingrid shall assess the request for a derogation based on the following criteria:

- 1) the derogation does not compromise the system security of the power system;
- 2) the derogation does not restrict the transmission capacity of the power system;
- 3) the electrical equipment does not cause disturbance to the other parties connected to the power system;
- 4) the derogation is technically and commercially justified; and
- 5) the derogation may be granted in the future in a similar situation impartially and without discriminating against any future electrical equipment connections.

8 Real-time measurements and data exchange

The connecting party shall provide the relevant network operator with the following measurement data:

- Substations along the power line connected to the main grid and equipped with remote control shall supply the status data on the switching device nearest to the main grid connection point.
- If the electrical network can be connected parallel to the main grid, the grid shall supply the status data on the switching devices through which the parallel connection is formed.
- In grids with a nominal voltage of at least 110 kV, the active power, reactive power and voltage measurements shall be delivered to an extent agreed on separately with the connecting party.

The update interval for real-time data shall be 60 s or more frequently. The measurement data shall be available to Fingrid before the electrical equipment's use begins.

The relevant network operator shall deliver or oblige the connecting party to deliver to Fingrid the real-time measurement data on the 110 kV electrical equipment connected to the electricity network of the relevant network operator.

The detailed requirements for real-time information exchange are outlined in Fingrid's application instruction *Real-time information exchange*.

9 General requirements

9.1 Power system voltages and frequencies

The normal reference voltage (voltage corresponding to the 100% value) at the connection point is case dependent, and the connecting party must always find out what the voltage is from the relevant network operator. The relevant network operator determines the voltage fluctuation range in its electricity network in normal, disturbance and exceptional situations. In a normal situation, the voltage fluctuation range must be at least 0.90–1.05 pu of the normal reference voltage.

The nominal voltage levels in Finland's main grid are 110 kV, 220 kV and 400 kV. Correspondingly, the design of the connection shall be based on the normal grid connection point voltages of 118 kV, 233 kV and 410 kV respectively.

In Fingrid's grid, the voltage fluctuation ranges in normal, disturbance and exceptional situations are as follows: The normal fluctuation range of voltage in a grid with a nominal voltage of 400 kV is 395–420 kV, and in exceptional and disturbance situations the voltage range is 360–420 kV. The normal fluctuation range of voltage in a grid with a nominal voltage of 220 kV is 215–245 kV, and in exceptional and disturbance situations the voltage range is 210–245 kV. The normal fluctuation range of voltage in a grid with a nominal voltage of 110 kV is 105–123 kV, and in exceptional and disturbance situations the voltage range is 100–123 kV.

The Nordic power system's nominal frequency is 50 Hz and the frequency is normally 49.9–50.1 Hz. The frequency of the grid during normal use may vary between 49.0–51.0 Hz and exceptionally even between 47.5–51.5 Hz.

9.2 Operating voltage and frequency range of distribution networks not connected to the transmission grid and of demand facilities offering demand-side management

Distribution networks that have not been connected to the transmission grid and demand facilities that offer demand-side management services shall comply with the voltage and frequency operating range presented in this chapter.

The electrical equipment shall be able to operate continuously and normally in the voltage range defined by the relevant network operator, which must be at least 0.90–1.05 pu of the normal reference voltage. The electrical equipment shall be able to operate for 60 minutes when the connection point's voltage is 1.05–1.10 pu of the normal reference voltage.

The electrical equipment shall be able to operate continuously and normally when the electricity system's frequency is 49.0–51.0 Hz. The electrical equipment must be able to operate for a period of 30 minutes when the electricity system's frequency is 51.0–51.5 or 49.0–47.5.

9.3 Operating voltage and frequency range of distribution networks and demand facilities connected to the transmission grid

Distribution networks and demand facilities connected to the transmission grid shall comply with the operating voltage and frequency range presented in this chapter.

The electrical equipment shall be able to operate continuously and normally when the voltage at the connection point is 0.90–1.05 pu of the normal reference voltage and the frequency is 49.0–51.0 Hz. If the voltage, frequency or both at the connection point differ from these values, the electrical equipment shall remain connected to the network for at least the periods of time specified in Figure 9.1.

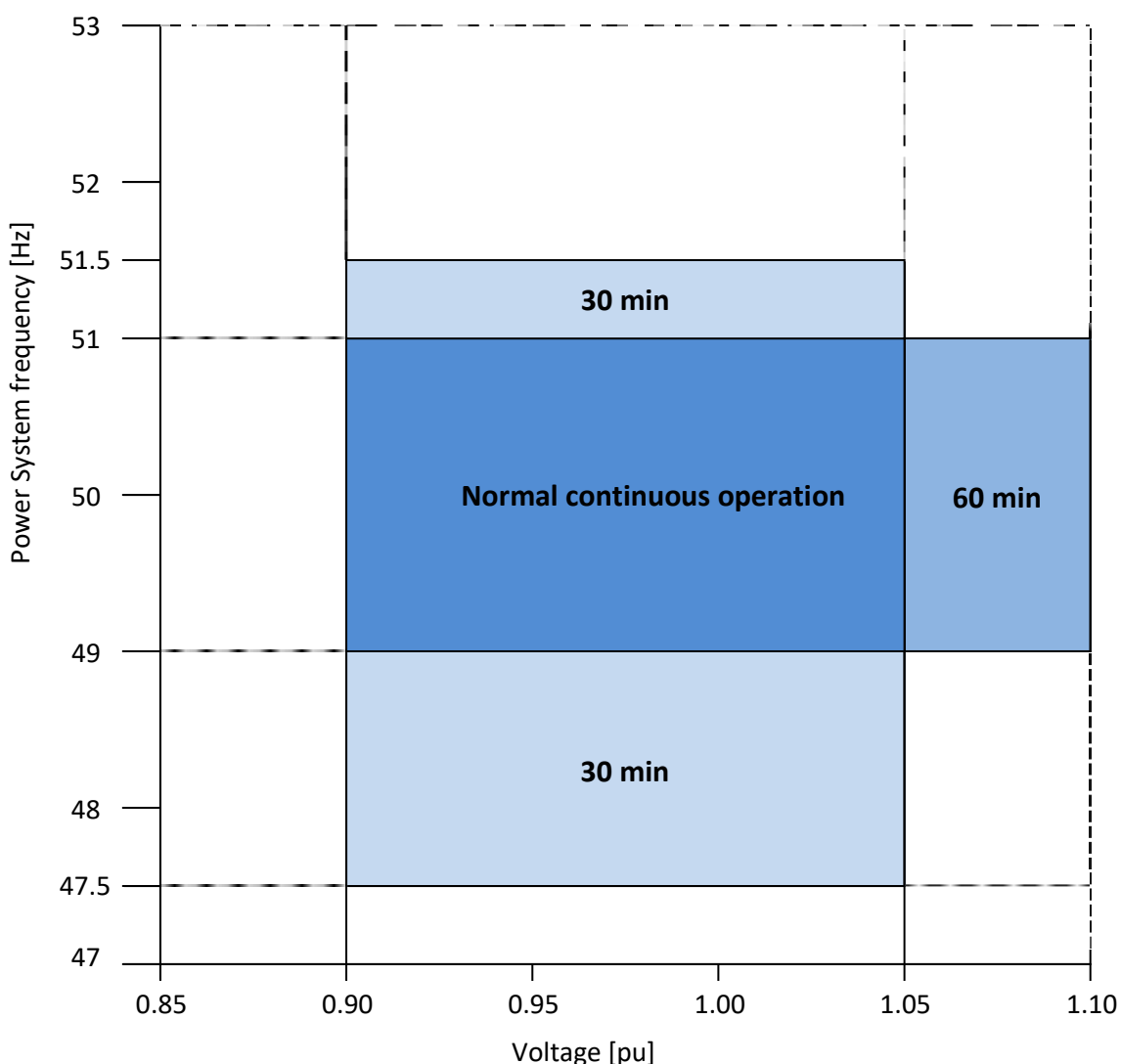


Figure 9.1. The electrical equipment must remain connected to the network at various frequencies and voltages at the connection point set out in the figure. The 1.00 pu voltage base of the continuous operating range in the 400 kV grid is always 400 kV. At other voltage levels, the voltage corresponding to the 1.00 pu value shall be inquired from the relevant network operator.

9.4 Rate of change of frequency withstand capability

The electrical equipment shall be capable of continuing to operate normally when the rate of change of frequency is less than 2.0 Hz/s.

The measurement of the rate of change of frequency shall not react to the sudden changes in the waveform of voltage caused by disturbances in the system.

A protection system that recognises the rate of change of frequency shall not be used in protecting the electrical equipment. The risk of this kind of protection system malfunctioning is high, and unexpected disconnection may occur in the normal operating voltage and frequency range.

9.5 Short-circuit withstand capability

The relevant network operator shall define for the connection point the largest short-circuit current that the connecting party's electrical equipment must be able to withstand. A typical value when connecting to the main grid is 40 kA, however, this value must always be ensured on a case-by-case basis from the relevant network operator.

At the request of the connecting party, the relevant network operator shall deliver the data on the connection point's largest and smallest short-circuit current. The data shall be delivered as a network equivalent (Thevenin's equivalent).

If the connection point's short circuit current changes due to an unexpected event and exceeds the rated value given earlier, the relevant network operator shall immediately inform the connecting party.

For a demand facility or distribution network connected to the transmission grid, the connecting party shall deliver to Fingrid data on the short-circuit current generated by the connecting party's electrical equipment.

A description of the zero-, positive- and negative-sequence network data of the electrical equipment shall be supplied.

If the short circuit current generated by the connecting party's electrical equipment changes due to an unexpected event and exceeds the maximum value given earlier, the connecting party shall immediately inform Fingrid.

9.6 Requirements related to reactive power

Distribution networks and demand facilities connected to the transmission grid shall meet the requirements set for reactive power, which are defined in Fingrid's application instruction *Supply of reactive power and maintenance of reactive power reserves*.

9.7 Protection requirements

The relevant network operator shall specify the schemes and systems necessary for protecting the network, taking into account the characteristics of the electrical equipment.

The protection schemes needed for the electrical equipment and the network as well as the settings relevant to the electrical equipment shall be coordinated and agreed between the relevant network operator and the connecting party.

The connecting party is responsible for specifying the protection settings of the electrical equipment in order to guarantee personal and equipment safety and to prevent equipment damage. The protection settings shall be set in such a way that the electrical equipment remains connected to the grid during disturbances in the power system for as long as this is possible within the scope of the technology and operational safety of the electrical equipment.

The connecting party is responsible for ensuring that the planning of the protection of the electrical equipment takes into account intense short-term changes in the voltages, currents and frequency of the power system caused by disturbances and faults, and the high-speed automatic reconnection and delayed automatic reconnection commonly used in restoring the operation of transmission lines. The settings shall be based on the capability of the equipment to withstand severe fluctuations in system frequency and in the voltage at the connection point. The protection of the electrical equipment must not conflict with the Specifications.

Distribution networks and demand facilities connected to the transmission grid shall meet the requirements set for protection, which are defined in Fingrid's application instruction *Relay protection of main grid and customer connections*.

9.7.1 Earthing of the neutral point of the main transformer

Earthing arrangement of the neutral point at the high-voltage side of the main transformer of the connecting party shall comply with the specifications of the relevant network operator. Normally, Fingrid defines the earthing arrangement of the main transformer's high-voltage side in a 110 kV network.

9.7.2 Requirements related to synchronisation

Distribution networks and demand facilities connected to the transmission grid shall be able to synchronise with the electrical network if it is possible that they operate in island operation or they operate parallel to the transmission grid, in which case the phase angle difference across the synchronising circuit breaker can be more than 30 degrees due to their connection. In these cases, the requirements relating to synchronisation shall be agreed on separately between the connecting party and Fingrid.

9.8 Damping of power oscillations

In the Nordic power system, transmission capacity is limited by the damping of power oscillations. There are inter-area power oscillations in the range of 0.2–1.0 Hz and the main system's dominating oscillation mode is approximately 0.3 Hz.

The use of the electrical equipment shall not amplify power oscillations. Changes in the electrical equipment's load shall be planned in such manner that cyclical power oscillations do not take place in the frequency range of 0.2–1.0 Hz.

Fingrid evaluates the impact of the electrical equipment on the damping of power oscillations. If there is reason to believe that the use of the electrical equipment will weaken the damping of power oscillations, Fingrid will set additional requirements for the connecting party, if necessary.

9.9 Load disconnection and reconnection

The requirements outlined in this section must be complied with in terms of load disconnection and reconnection settings.

9.9.1 Automatic load underfrequency disconnection

The electrical equipment shall be equipped with an underfrequency relay, which automatically disconnects a specific section of the load when the relay's setpoint value is achieved.

The amount of load to be disconnected and the precise relay setpoint value of the relay are defined in connection with the implementation of the Commission Regulation 2017/2196. The owner of the demand facility or distribution network is entitled to select a technical method for achieving the disconnection of the specified load section.

The underfrequency disconnection of loads shall be based on the measurement of the power system frequency and the disconnection shall meet the following requirements:

- the conditions triggering the activation shall be possible to set at 0.05 Hz intervals in the frequency range 47.0–50.0 Hz.
- the disconnection time of the load shall be no more than 150 ms when the frequency's setpoint value is achieved.
- the disconnection shall have a voltage lock-out function, which prevents disconnection at underfrequency when the voltage measured by the relay is within range of 0.30–0.90 pu.
- the protection relay function shall include the ability to report the direction of the flow of active power at the disconnection point.

9.9.2 Remote operation of the power line connection

It shall be possible to disconnect a live power line connection from the main grid as an operational measure using remote control.

9.9.3 Automatic reconnection

Electrical equipment disconnected from the grid due to a disturbance may automatically connect to the electricity system after a disturbance if the following conditions are met:

- the electricity system's frequency is 49.0–51.0 Hz,
- the connection point's voltage is in the normal range,
- the relevant network operator permits the installation of an automatic reconnection system and automatic connection 1–10 minutes after the disturbance,
- connection permission must be separately requested from the relevant network operator following a major disturbance, if separate instructions have not been provided.

9.10 Power quality

With regard to the power quality, the design of the electrical equipment shall take into account the factors and requirements affecting the power quality described in Fingrid's report *Power quality in the 110 kV grid*.

The relevant network operator is obligated to define the power quality requirements based on valid standards and regulations.

The connecting party is obliged to follow the power quality requirements imposed by the relevant network operator and the connecting party shall not exceed the provided emission current restrictions. The connecting party shall be prepared for the power quality specified by the relevant network operator.

The connecting party shall deliver the information and reports requested by the relevant network operator, on the basis of which the relevant network operator can evaluate the impacts of electrical equipment on the power quality before the electrical equipment is connected to the grid.

9.11 Simulation model requirements

Simulations model of the power grid or demand facility do not, normally, need to be delivered as a separate simulation model. The connecting party shall deliver the required data on grid connection and on electrical equipment to be connected to at least 110 kV voltage level, such as substations, power lines, transformers and compensation devices and the electrical network's operational information. This data is included in the required data to be delivered as defined in Chapter 6.

Fingrid can require the connecting party to supply a simulation model based on separate consideration, to the extent outlined in article 21 of Regulation 2016/1388, if the demand facility includes nonlinear or uneven loads (e.g. converters or electric arc furnaces).

10 Commissioning tests

It is the responsibility of the connecting party to verify that the operation of the electrical equipment meets the specified requirements. The connecting party is responsible for the costs related to the compliance process. Compliance with the Specifications shall primarily be verified by means of tests carried out in conjunction with the commissioning of the electrical equipment.

The relevant network operator and/or a representative of Fingrid may participate in the compliance testing either on site or remotely from the network control centre of the relevant network operator. For that purpose, the connecting party shall provide the monitoring equipment necessary to record all relevant test signals and measurements as well as ensure that the necessary representatives of the connecting party are available on site for the entire testing period. Signals specified by the relevant network operator or Fingrid shall be provided if, for selected tests, the network operator or Fingrid wishes to use its own equipment to record performance. The relevant network operator and Fingrid shall decide on their participation at their discretion.

10.1.1 Commissioning test plans and data exchange

The connecting party shall draw up a commissioning plan. The plan shall cover the testing of the operation specified in the Specifications at least in the scope described in this section. The connecting party shall deliver the commissioning plan and a description of the practical arrangements of the tests. The description of the practical arrangements shall cover at least the measurement arrangements, responsible persons, and preliminary schedule. The documents shall be delivered to the relevant network operator no later than 2 months before the planned start of the commissioning testing.

As the transmission system operator, Fingrid has the right to cancel or change the schedule of the commissioning testing if the execution of the tests at the planned time is not possible due to the operation situation of the power system. The relevant network operator has a corresponding right with regard to the operation situation of its own electricity network. The cancellation or schedule change may be caused by factors such as circumstances related to the operation of electrical equipment or the operation situation of the local electricity network and power system. If the timing of the commissioning testing needs to be changed, the connecting party shall agree on a new schedule with the relevant network operator and Fingrid.

10.1.2 Documentation and acceptance of commissioning testing

The connecting party shall deliver the commissioning inspection minutes for the electrical equipment to the connection point operator in Stage 1 of the compliance monitoring process.

It is the responsibility of the connecting party to document the commissioning testing and its results in the commissioning report. The connecting party shall deliver the commissioning report with its attachments as an electronic document to the relevant network operator in Stage 2 of the compliance monitoring process.

The commissioning report shall include:

- 1) Results of functional commissioning tests
 - a) Load underfrequency disconnection (Section 9.9.1)
 - b) Disconnection carried out through remote operation of the power line connection (Section 9.9.2)
 - c) Automatic reconnection of electrical equipment (Section 9.9.3)
 - d) Synchronisation (if required, see Section 9.7.2).
 - e) Damping of power oscillations (if required, see Section 9.8).
- 2) Protective relays' main setpoint values and commissioning testing minutes
- 3) Resistance to earth measurement records
- 4) Electrical measurement protocols of transformers, branch lines, underground cables and other possible components (if measured)

It is the responsibility of the relevant network operator to confirm the fulfilment of the compliance obligation related to the requirements in terms of the commissioning testing based on the following three sectors:

- 1) The preparation, planning and data exchange of the tests have been carried out in accordance with the Specifications.
- 2) The tests have been carried out in accordance with the scope of the Specifications.
- 3) The operation of the electrical equipment verified by the tests is in accordance with the Specifications and with the data provided on the electrical equipment.

10.1.3 Functions to be verified in commissioning testing

The commissioning testing shall verify the following issues:

- 1) Commissioning inspection and drawing up of commissioning inspection minutes

The commissioning inspection and drawing up of commissioning inspection minutes shall be carried out at Stage 1 of the compliance monitoring process.

- 2) Functional commissioning tests

Functional commissioning tests shall be carried out at Stage 2 of the compliance monitoring process.

- a. Load underfrequency disconnection

In the disconnection of loads at underfrequency, it must be verified that all of the electrical equipment equipped with underfrequency relays function in accordance with the Specifications (Section 9.9.1).

- b. Disconnection carried out through remote operation of the power line connection

Disconnection carried out through remote operation of the power line connection must be verified by disconnecting a live power line connection connected to the transmission grid using remote control operational measures.

c. Automatic reconnection of electrical equipment

In the automatic reconnection of the electrical equipment, the reconnection capability and operating time after the disturbance must be verified as per the Specifications (Section 9.9.3).

d. Synchronisation (if required)

Verification of synchronisation shall be agreed on separately on a case-by-case basis.

e. Damping of power oscillations (if required).

Verification of the damping of power oscillations shall be agreed on separately on a case-by-case basis.

3) Resistance to earth measurement

Measurement of resistance to earth shall be carried out using standard-compliant (SFS 6001) methods and test equipment.

4) Functioning of protection

The functioning of the electrical equipment protection in accordance with the Specifications shall be verified through commissioning testing of the protective relays.

11 Requirements of demand facilities offering demand-side management services

A demand facility connected to the Finnish power system or a pooled demand-side resource can offer demand-side management services to the relevant network operator or transmission system operator. Demand-side management services can be offered to the reserve markets maintained by Fingrid according to the following classification:

- Automatic: FCR-N and FCR-D
(frequency controlled reserve - normal operation, - disturbance)
- Remote-controlled: aFRR, mFRR
(automatic frequency restoration reserve, manual frequency restoration reserve)

All demand facilities offering demand-side management services or third-party pooled demand-side resources shall meet the requirements of Sections 9.2 and 9.4. The equipment's ability to meet the requirements is verified, on the part of the requirements in Sections 9.2 and 9.4, using equipment documentation and relay data. The data shall be supplied for equipment that are used to produce a service and for protection systems that disconnect the equipment producing the service in case of abnormal voltage or frequency.

The technical specifications, verification and data exchange for the reserve markets maintained by Fingrid are defined in the approved terms and conditions for reserve providers in accordance with article 18 of Regulation 2017/2195 (EB GL) and an up-to-date version is available on Fingrid's public website.

12 Appendices and references

The documents referred to as appendices to this document are published as appendices to Fingrid's contractual terms and conditions and up-to-date versions are available on Fingrid's public website.

Appendices

Real-time information exchange

Supply of reactive power and maintenance of reactive power reserves

Relay protection instructions for the main grid and customer connections
(110 kV grid power quality)