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**FINGRID OYJ'S
GENERAL CONNECTION TERMS YLE2017**

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1 Introduction

The purpose of this document is to describe Fingrid Oyj's general connection terms (YLE, hereinafter 'the connection terms') between Fingrid Oyj's (hereinafter 'Fingrid') electrical equipment and the electrical equipment owned or controlled by a contracting party connected to Fingrid's grid (hereinafter 'the Connecting Party'). By following the connection terms we ensure the system security of the grid and that the grids to be connected are technically compatible. The terms also define the rights, obligations and responsibilities concerning the connection.

The Connecting Party and Fingrid shall agree on the connection in a separate connection agreement. Before electricity transmission a separate Main Grid Contract is required between the Connecting Party and Fingrid.

The connection terms concern new connections to the main grid and existing connections when additions or essential changes are conducted as referred to in section 2.7. The Connecting Party must agree with parties connected to its grid that their electricity networks and related electrical equipment also meet Fingrid's connection terms as well as other guidelines and requirements related to the implementation of the connection. The instructions, reports and requirements referred to in the connection terms are publicly available together on the Fingrid website.

The connection terms are also applicable to backup supply connections connected to Fingrid's grid, which are only temporarily in use in disturbance or outage situations.

The Connecting Party and Fingrid are responsible for that their electrical equipment meet the requirements of valid laws, decrees, standards and official regulations. If legislation or network codes require technical solutions that deviate from the connection terms, the legislation or network codes must be observed.

2 Grid Connection

2.1 Connection solutions

The grid connection solution and location to the main grid are specified on a case-by-case basis, by taking into account technical alternatives, the overall costs of implementation, the system security of the surrounding main grid, transmission capacity and environmental and land use perspectives. In order to safeguard the reliability and efficiency of the main grid, low-power electrical equipment must be connected to a distribution or high-voltage distribution grid.

The availability and system security are best controlled by making connections to the switchyards. Transmission lines between switchyards transmit and safeguard the necessary power for the switchyards in different operating situations. The Connecting Party's electrical equipment may be connected to Fingrid's 110kV transmission line, if the requirements specified in section 2.3 are met.

2.2 Switchyard connection

Switchyard connection means a connection of the Connecting Party's electrical equipment to Fingrid's 400 kV, 220 kV and 110 kV switchyard circuit breaker bay. The maximum power that can be connected to such a connection is specified switchyard-specifically, taking into account the system security and transmission capacity of the surrounding main grid. The load or generation connections of less than 250 MW shall be connected to a 110 kV or 220 kV switchyard. For technical reasons, the load or generation connections of 250 MW or greater are primarily connected to a 400 kV switchyard.

When connecting to an air-insulated Fingrid switchyard or gas-insulated switchyard by an overhead line, the ownership and management of the lines end at the U-bolts on the terminal support and the top connectors of the connecting jumpers. The U bolts and connectors are owned by Fingrid.

When connecting to an air-insulated Fingrid switchyard by cable, the ownership and management of the lines end at the connectors of Fingrid's lines in the connectors of the Connecting Party's cable terminals. The cable, cable terminals and overvoltage protectors of the cable are owned by the Connecting Party. The wires and their connectors connected to the cable terminal and the cable terminal and overvoltage protector racks and their foundations are owned by Fingrid.

When connecting to a gas-insulated Fingrid switchyard by cable, the ownership and management of the lines at the switchyard end at the Connecting Party's cable section and the cable-side connectors in Fingrid's GIS switchgear output. The connectors on the side of the circuit breaker bay's cable terminal switchgear in question are owned by Fingrid.

The Connecting Party has the right to place its transmission lines in Fingrid's substation area without charge. If the structures in question have to be moved or modified in the substation area, the Connecting Party is responsible for the necessary measures and costs.

2.3 Transmission line connection

A connection to the transmission line means a connection of the Connecting Party's substation or transmission line to Fingrid's 110 kV transmission line. Because of the long geographical transmission distances in Finland, the transmission lines in the main grid are long and the substations are far apart. This is why a connection to Fingrid's 110 kV transmission line is permitted, taking into account the available transmission capacity of the transmission line and the following technical conditions:

- a. The maximum permitted rated current of a transformer without mechanical ventilation (ONAN) is 25 MVA. By equipping the transformer in question with mechanical ventilation (ONAF), the loading of the transformer up to 30 MW is permitted. The transforming capacity to be connected may comprise several different transformer machines.

- b. If the Connecting Party's transformation need is greater than 25 MVA, another transformer of a maximum of 25 MVA can be added to the same connection, provided that this is permitted by system security and the transmission capacity on Fingrid's transmission line. The low-voltage sides of the transformers must not be connected in parallel.
- c. When connecting to a Fingrid transmission line of more than 100 km in length, the connectivity of the transformer size shall be reviewed separately.
- d. It must be possible to disconnect a connecting transmission line from the main grid as a normal operation measure by remote control.
- e. The length of a connecting transmission line can be at most half of the distance of the connection from the closest protective circuit breaker in the main grid. If the connection contains a circuit breaker equipped with protection relays, the length of the connecting transmission line may be equal to the distance of the connection from the nearest protective circuit breaker in the trunk line.
- f. The disconnecting switching devices of a connecting transmission line must be positioned as close as possible to the connection point.
- g. Transmission line connections are not allowed near a substation or on 110 kV circular lines which serve as replacing links in the main transmission grid.
- h. The Connecting Party must ensure that the connection point can be earthed on the main grid transmission line, with the earthing having short-circuit strength. The connection disconnectors must have earthing switches on the main grid transmission line and on the side of the Connecting Party's electrical equipment in order to ensure occupational safety.
- i. The Connecting Party is responsible for the protection of its transformers. Bypass fault or artificial fault disconnectors are not permitted.

In a transmission line connector, ownership ends at the connectors of the connecting jumpers owned by the Connecting Party on Fingrid's transmission line.

When connecting by a cable, the technical implementation of the connection shall be agreed separately by taking into account the technical properties and the location of the cable.

2.4 Connection of electricity consumption

These connection terms are applicable to the consumption connected to Finland's power system.

2.5 Connection of electricity production

A power plant to be connected to the Finnish power system is required to meet Fingrid's valid specifications for the operational performance of power plants (VJV).

The connectivity of power plant units to the power system must be determined well in advance with Fingrid. The connectivity of a power plant depends on the ability of the Nordic power system to withstand rapid power changes. The largest permitted stepwise power change that the Finnish power system can withstand in the connection point of a power plant without compromising system security is 1,300 MW.

In general, power plant shall be connected to Fingrid's switchyard circuit breaker bay. If the transmission capacity so permits, small synchronous generators of less than 5 MW or converter connected power plants of up to 30 MW may be connected to the Fingrid's 110 kV transmission line, as long as their short-circuit current fed to the main grid is no more than 1.2 times the rated current of the power plant.

Fingrid's valid instructions must be observed in voltage control, the production of reactive power and maintaining reactive power reserves.

A power plant in excess of 1 MW connected to a Fingrid transmission line must be equipped with disconnecting relays. A converter connected power plant in excess of 5 MW connected to a transmission line must be equipped with a communications connection to enable high-speed automatic reclosing.

Fingrid is responsible for the synchronisation monitoring relays of its transmission line.

2.6 DC link connection

The connectivity of a high-voltage DC connection to the power system must be determined well in advance with Fingrid.

A high-voltage DC connection to the Finnish power system must meet Fingrid's valid technical requirements set for DC connections.

2.7 Modification of grid

To make additions or essential modifications to Connecting Party's own electrical equipment or to electrical equipment connected directly or indirectly to its grid, the Connecting Party must contact Fingrid well in advance. Fingrid shall examine the effects on the main grid and possible modifications. These types of additions or essential modifications include construction of a new transmission line, a substation, a transformer or power plant of at least 110 kV, or significant modifications to the technical system properties of existing electrical equipment and power plants of at least 110 kV. Essential modifications also include modifications to the operation or to the properties of the Connecting Party's existing electrical equipment of at least 110 kV, and significant structural modifications in Fingrid's grid.

All additions and essential modifications must follow the connection terms (YLE) valid at the moment of introducing the modification and the specifications for operational performance (VJV). The Connecting Party's electrical equipment must meet the requirements set therein. If the Connecting Party and Fingrid fail to reach an agreement on the needed changes taken into consideration of the valid connection terms and specifications for operational performance valid at the moment of introducing the modification, the matter must be passed to the Finnish Energy Authority for resolution.

3 Operational requirements of electrical equipment

3.1 Main principles

The Connecting Party and Fingrid are each responsible for the electrical safety, functioning, condition and operation of the electrical equipment under their control. The Connecting Party and Fingrid maintain and operate their electrical equipment in such a manner that the electricity transmission nor the operation of the power system are not unnecessarily disturbed. In order to ensure the maintenance of the system security, the Connecting Party and Fingrid are obliged to supply each other with operational and maintenance information.

The transmission lines with a rated voltage of 110 ... 400 kV must be equipped with shielding wires. The transmission lines are built and maintained with tree safety in accordance with the Electricity Market Act. The Connecting Party shall ensure the compatibility of the technical implementation of phase wires transposition with Fingrid.

The real-time information exchange is specified in the guidelines for real-time information exchange.

3.2 Planning and supply of information

The Connecting Party must supply the preliminary plans of the connection for Fingrid's review well in advance before starting the implementation, hence the technical compatibility and electrical safety of the connection can be verified. The Connecting Party is responsible for the safe implementation of its electrical equipment according to the terms, for the necessary touch- and dangerous voltage clarifications, and for the actions required.

Fingrid shall submit to the Connecting Party a proposal concerning the location of the connection, information about the short-circuit currents and earth fault currents and information about the basic protection requirements. In transmission line connections, Fingrid also submits requirements concerning the distances of structures from Fingrid's transmission lines and towers. When the Connecting Party is dimensioning its electrical equipment, the Connecting Party must take into account the basic design values and their forecasts given by Fingrid.

The Connecting Party must submit to Fingrid the necessary information about the connection solution, the electrical equipment such as substations, transmission lines, transformers and compensation equipment to be constructed, and on the method of grid operation. With regard to power plants, information must be supplied in accordance with the specifications for the operational performance of power plants (VJV). If necessary, Fingrid may request additional technical information.

During the planning of the connection, the Connecting Party and Fingrid shall agree on the energy metering arrangements. If the metering equipment must be located somewhere other than at a Fingrid substation, the Connecting Party must reserve sufficient space for the metering equipment delivered by Fingrid, the necessary auxiliary power supplies and instrument transformers with wirings and connections for communication purposes.

Before commissioning the transmission line connection, the Connecting Party must deliver to Fingrid the area map of the connection, branch line information, location coordinates, layout and sectional drawings, main circuit diagram, energy metering implementation details, earthing plan, relay protection information and communications information. Information about transmission lines, substations, transformers, power plants and compensation equipment for a switchyard connection in a grid of at least 110 kV must be delivered.

The updated final documents must be delivered to Fingrid no later than two months after the commissioning of the connection. The measurement record of the earthing impedance must be submitted to Fingrid after the measurements, no later than one year after commissioning.

Once the connection has been commissioned, the Connecting Party must supply Fingrid with information about modifications, keeping trees clear of the line and changes in ownership as presented in section 2.7.

3.3 Frequency and voltage variation in the main grid

The standard value for grid frequency in the Nordic power system is 49.9 ... 50.1 Hz. In a disturbance-free operation situation of the grid, the frequency can vary between 49 ... 51 Hz and in exceptional situations between 47.5 ... 51.5 Hz.

The nominal voltage levels in the Finnish main grid are 110 kV, 220 kV and 400 kV.

Correspondingly, the design of the connection must be based on the normal connection point voltages of 118 kV, 233 kV and 410 kV respectively.

The normal voltage range of a grid with a rated voltage of 400 kV is 395 ... 420 kV, and in exceptional and disturbance situations the voltage range is 360 ... 420 kV.

The normal voltage range of a grid with a rated voltage of 220 kV is 215 ... 245 kV, and in exceptional and disturbance situations the voltage range is 210 - 245 kV.

The normal voltage range of a grid with a rated voltage of 110 kV is 105 ... 123 kV, and in exceptional and disturbance situations the voltage range is 100 ... 123 kV.

The Connecting Party's electrical equipment and electrical equipment connected to it directly or indirectly must operate and stay in operation within the presented voltage and frequency ranges so that the equipment meets the requirements set by the power system. The electrical equipment must be protected so that it shall not be damaged even by momentary voltage or frequency changes greater than those mentioned above.

The report of the grid electricity quality describes the general quality of electricity in Finland, fluctuations in voltage and frequency and the quality level that the Connecting Party must be prepared for. If the Connecting Party needs an uninterrupted supply of electricity or better-quality electricity than normal, this must be ensured through Connecting Party's own systems.

3.4 Parallel operation of grids

If the Connecting Party's grid or the Connecting Party's grid together with the grids of other parties constitutes a parallel operational grid with the main grid, the Connecting Party must agree on their parallel operation and potential action and costs arising from it with Fingrid in advance, before starting parallel operation.

3.5 Island operation

The Connecting Party and Fingrid shall agree in advance on the arrangements relating to island operation. The Connecting Party shall be responsible for the implementation costs of island operation.

The Connecting Party may disconnect its electrical equipment from the electricity grid according to terms agreed in advance with Fingrid, or switch itself from the main grid to island operation without advance warning so as to prevent a disturbance or hazard or in the event of faults or disturbance situations in the grid. Island operation refers to a situation where one or more power plants feed a part of a grid which is separated from the main grid. The shift-over to island operation must not disturb the opportunities of other parties to use their connections to the main grid nor interrupt transmission connections in the main grid.

3.6 Grid earthing method

In Finland, the 400 kV and 220 kV grids are effectively earthed; the earth fault factor is 1.4 or less. The 110 kV grid, on the other hand, is only partially earthed and the earth fault factor is 1.8 or less. The earth fault factor means the ratio between the voltage occurring in a sound phase during an earth fault and the normal phase voltage.

The 400 kV or 220 kV neutral point of a transformer included in the Connecting Party's electrical equipment must be earthed by means of a current-limiting earthing coil unless the operation of the power system requires otherwise. The 110 kV neutral point of a transformer is only earthed at selected substations by means of an earthing coil to enable earth fault protection and to maintain a reasonable level of earth fault current. The Connecting Party and Fingrid shall agree on a needs basis on how to earth transformer neutral points, and on the responsibilities and obligations between the Connecting Party and Fingrid. There must also be a separate agreement with Fingrid on bypassing the earthing coil, for example by means of an earthing switch. It is recommended to equip an unearthed neutral point with an overvoltage protector to protect the transformer against overvoltage.

3.7 Protection of electrical equipment

The protection of the Connecting Party's electrical equipment must be compatible with the protection of Fingrid's grid. If needed, Fingrid shall give technical information to coordinate the protection of the connection and the main grid. With regard to protection, the design of electrical equipment must take into account the protection-influencing factors described in the application instructions for Fingrid's relay protection.

The protection of the Connecting Party's electrical equipment and the protection of electrical equipment connected to it directly or indirectly as well as the protection of the main grid must uniformly and selectively operate in order to maintain system security in the grid. The Connecting Party and Fingrid are responsible for the proper operating condition of the protection equipment they own, for the suitability of protection and for specifying the adjustments.

If cable sections are connected to a grid or if the connection is to a resonant earthed 110 kV grid, the protection of the electrical equipment must be agreed separately.

Line protection in the main grid is designed to operate in the case of line faults in the main grid. It is not technically possible to use line protection in the main grid as a protection of a transformer of a transmission line connection or as a protection of a long radial transmission line. If a radial transmission line is connected to a transmission line of the main grid by a circuit breaker equipped with protection, the coordination and settings of the protection must be agreed with Fingrid in advance.

The specifications for the operational performance of power plants possibly concerning the connection must be taken into account when adjusting the protections.

3.8 Grid disturbances and faults

In the design and operation of the Connecting Party's electrical equipment, the Connecting Party must take into account the short-term voltage dips and dead state caused by grid faults as well as the effects of high-speed and delayed automatic reclosing generally used in restoring normal operation. The Connecting Party must take into account the effects of disturbances on the electrical equipment of other parties connected to the main grid through the Connecting Party's grid.

The Connecting Party and Fingrid must agree in advance on the principles concerning the investigation of disturbances. If a fault or disturbance occurs in the grid, Fingrid has the right to disconnect the Connecting Party's electrical equipment from its grid without advance warning, if this is essential because of disturbance investigation or repairs. Fingrid must take immediate action to remove the disturbance from its grid.

If electrical safety or the system security of the main grid so require, Fingrid has the right to request a power plant connected directly or indirectly to the Connecting Party's grid to adjust the active or reactive power, and in extreme cases to disconnect the electrical equipment from the grid.

The Connecting Party and Fingrid must immediately inform each other of faults which have an effect on the other contracting party's grid operation, and must initiate disconnection and safety measures as soon as a disturbance arises.

If faults that disturb the operation of the power system by the Connecting Party or a third party and which cause electricity quality or safety deviations exceeding normally acceptable limits, are detected in electrical equipment connected to the Connecting Party's and Fingrid's grids, the Connecting Party causing the disturbance must immediately correct the faults and shortcomings.

3.9 Transmission outages

If the Connecting Party's or Fingrid's electrical equipment needs to be temporarily disconnected from the grid because of service, repair, modification, inspection or other similar measures, and these have an effect on the other contracting party's operation, the Connecting Party and Fingrid must negotiate about the outage in advance.

If necessary, the Connecting Party is responsible for the replacement arrangements for its connections in cases of service, modification or disturbance to Fingrid's grid resulting in transmission outage. Fingrid is responsible for the replacement arrangements for power transmission in its grid caused by service and modification work or disturbances targeted at the Connecting Party's connections.

The Connecting Party and Fingrid shall plan their arrangements, schedules and measures concerning the outages so that the duration of the outage is not unnecessarily prolonged. Each party is responsible for its own costs.

3.10 Fulfilment of the connection terms

Fingrid has the right to inspect the connection and any subsequent amendments made to it and, if necessary, to request further clarifications. As far as the connection is concerned, the Connecting Party has a reciprocal right to inspect Fingrid's electrical equipment.

If it turns out that the connection does not fulfil the connection terms, the Connecting Party shall submit to Fingrid an account of the impact of the shortcomings on the operation of the connection, plus a plan concerning the measures for the correction of the shortcomings and the correction schedule. After the completion of the modifications, the Connecting Party and Fingrid must jointly verify that the connection fulfils the connection terms. The Connecting Party is responsible for the verification and for the related and possibly resulting measures and costs arising from it. If Fingrid electrical equipment is defective with regard to the connection, Fingrid is responsible for the corrective measures and costs.

If the shortcomings of the connection impact the operation of the power system, Fingrid as the transmission system operator has the right to interrupt or restrict the operation of the connection or impose obligations pertaining to the operation of the connection until the shortcomings have been corrected.

4 Agreements and responsibilities

The connection to the main grid shall be agreed in a connection agreement signed between the Connecting Party and Fingrid. Fingrid's general connection terms constitute an integral part of the connection agreement. The connection agreement determines the ownership and liability limits, usage rights, responsibilities concerning operation and maintenance, and the connection fee.

Fingrid determines the solution, rating and location of connection to the main grid, whereby the changes caused by the connection in the existing main grid are covered by the connection fee. If a Fingrid switchyard or transmission line is built in a new place, the Connecting Party is responsible for modifications to its own electrical equipment.

If the Connecting Party's own needs require additional structures or equipment in the main grid, these are agreed on a case-by-case basis and the Connecting Party carries the resulting costs. Once completed, the disconnectors built in a transmission line of the main grid are the property of Fingrid, and Fingrid is responsible for their operation, maintenance and replacement investments until a need for the device no longer exists. The Connecting Party is responsible for possible auxiliary power and control required by the disconnectors and for the costs of connection to remote operation. The disconnectors on the connecting line are owned by the Connecting Party.

The Connecting Party is also responsible for:

- a) the modification costs in its electrical equipment, caused by an increase in fault currents in the main grid.
- b) costs arising from the transposition of possible phases required for the transmission lines.
- c) measures required in the grids of other parties connected to the its grid directly or indirectly, and its shall reach an agreement with the other parties on the costs arising.

Fingrid constantly monitors the developments both in solutions applied to the grid and in technical issues. Additionally, Fingrid keeps the valid connection terms and its other guidelines, requirements and pricing principles publicly available.