FINGRID

Guidance: Largest permitted stepwise power change in power plant connections in Finland

8 April 2024

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Fingrid Oyj

Street address	Postal address	Telephone	Fax	Business ID 1072894-3, VAT reg.
Läkkisepäntie 21 00620 Helsinki	P.O. Box 530 00101 Helsinki, Finland	+358 (0)30 3955000	+358 (0)30 3955196	firstname.lastname@fingrid.fi **www.fingrid.fi**

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8 April 2024	1.0	First official version

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1 Introduction

Fingrid's General Connection Terms (YLE2021) and Grid Code Specifications for Power Generating Facilities (VJV) impose requirements for power generating facilities connecting to the main grid in Finland. These instructions serve as a detailed application guide for the largest permitted power change in a power generating facility connection, as presented in YLE2021. Fingrid will revise these instructions if necessary.

2 Definitions

Rated capacity (P_{max}) refers to a power generating facility's highest active power generation level measured at the connection point, at which power the facility can operate continuously without a time limit; the rated capacity is specified in the connection agreement or otherwise determined by the relevant network operator and the power generating facility's owner.

In these instructions, **net generation power** refers to the combined rated capacity of the power generating facilities in a generation project.

In these instructions, **generation project** refers to an electricity generation project consisting of one or more power generating facilities.

Power generating facility, in accordance with VJV, refers to a facility built for power generation, capable of supplying electrical power to the connection point.

3 Largest permitted stepwise power change in the connection point of a power plant in Finland

In accordance with the YLE2021 terms, the largest permitted stepwise power change that the Finnish power system can withstand, is 1.3 GW in the connection point of a power plant.

3.1 Consideration of house load

The 1.3 GW limit does not refer to the power generating facility's largest permitted supply to the network. Instead, it refers to the largest permitted stepwise power change. The largest stepwise power change occurs in the event of a fault, in which the power generating facility disconnects from the grid with the rated electricity generation, and the supply of electricity for the power generating facility's house load is taken from the power grid after the fault. Figure 1 illustrates this.

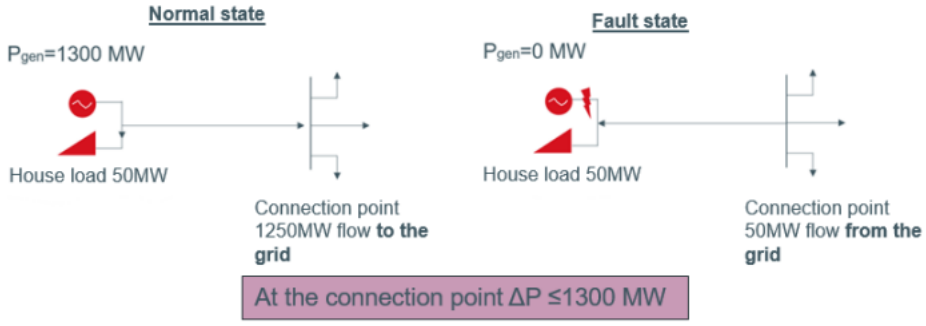

Figure 1. Example of the consideration of house load when calculating the largest stepwise power change for a power generating facility with a rated capacity of 1,250 MW and house load of 50 MW.

3.2 Optimising energy production

When planning the project, the connecting party can optimise the power generating facility's energy production. In practice, this is possible by selecting components that oversize the power generating equipment in relation to the generator and other possible primary components. In such a case, the power generating facility's rated capacity is available for a larger part of the time. In other words, it has higher stability.

Energy production can also be optimised by installing generating capacity in the power generating facility in excess of the rated capacity and using software to limit the active power produced so that it is equal to the rated capacity that can be supplied to the connection point, as agreed upon with the network operator at the connection point. This procedure is not permitted under VJV2018 but is intended to be allowed in the grid code specifications to be updated in 2024 (VJV2024).

4 Segregation of generation projects with a net generation power of more than 1.3 GW

The basic principle in segregating generation projects of more than 1.3 GW is that a power generating facility connecting to the power system of Finland must not cause the power system to have a stepwise power change of more than 1.3 GW at the connection point. Therefore, generation projects that cause a stepwise power change of more than 1.3 GW must be separated so that they are completely independent power generating facilities in terms of their electrical and control technology. Each such power generating facility requires a separate connection.

For generation projects with a net generation capacity of more than 1.3 GW, the connecting party must conduct a reliability study as part of the preliminary design of their project. The study should present the segregation principles used in the design of the power generating facilities and their network connections, including the implementation solutions. The reliability study shall include a probability-based analysis that models the main components (by means such as reliability block diagram or fault trees). Based on this, the average long-term incidence frequency shall be estimated for the incident in which both segregated power generating facilities disconnect from the grid simultaneously.

One condition of the connection is that Fingrid approves the reliability study. The connecting party must conduct a new reliability study if the related conditions change. The connecting party shall be responsible for the timeliness of the reliability study and for the operation of the power generating facility throughout its life cycle.

Table 1 presents examples of details on the segregation of power generating facilities with a net generation power of more than 1.3 GW. Fingrid decides on the allowed implementations on a case-by-case basis when the project's reliability study is approved.

Table 1. Examples of details on the segregation of generation project with a net generation power of more than 1.3 GW.

Case	Allowed?	Justification
The connecting line is a bipole HVDC connection of more than 1,300 MW	Not permitted at the moment	The Nordic transmission system operators are studying the reliability of bipole HVDC connections. There is not yet any practical experience with the reliability of HVDC connections based on metal return circuits with a power of over 1,300 MW.
Power generating facilities having connecting lines on shared towers, if the rated capacity of the power generating facilities totals more than 1,300 MW.	Not permitted	Connecting lines are radial connections, and the loss of the shared tower would directly result in the disconnection from the grid of both or all the power generating facilities. Individual shared towers may be permitted on a case-by-case basis.
Power generating facilities having connecting lines in the same transmission line corridors	Permitted	The lines must be designed so that the collapse of one tower does not cause a disturbance in the other connecting lines.
Power generating facilities having crossing connecting lines (overhead lines), if the rated capacity of the power generating facilities totals more than 1,300 MW.	In principle, this should be avoided, but it may be permitted on a case-by-case basis.	Crossings require Fingrid's approval. The crossing point must be designed with special care and included in the reliability study.
Crossings of a power generating facility's submarine cables (with cables belonging to the same offshore wind farm or other offshore wind farms), if the rated capacity of the power generating facilities totals more than 1,300 MW.	In principle, this should be avoided, but it may be permitted on a case-by-case basis.	Crossings require Fingrid's approval. The crossing point must be designed with special care and included in the reliability study.
Crossings of a power generating facility's submarine cables with Fingrid's submarine cables	In principle, this should be avoided, but it may be permitted on a case-by-case basis.	Crossings require Fingrid's approval. The crossing point must be designed with special care and included in the reliability study.
Shared electrical components (primary or secondary components) at segregated power generating facilities	Not permitted	The loss of a shared component would result in the loss of both power generating facilities. The protection and control systems must also be differentiated.

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Equipment or control systems from the same manufacturer at segregated power generating facilities.	Permitted	Simultaneous failure of different devices or different control systems made by the same manufacturer is considered as exceptional case that is not being prepared at. However, to ensure reliability, the control systems of segregated power generating facilities must use measurements from different current and voltage transformers. In addition, their measurement circuits must be physically isolated from each other.
Segregated power generating facilities sharing an onshore or offshore substation or both	Not permitted	Power generating facilities must not share a substation.
Segregated power generating facilities having nearby onshore or offshore substations or both	In principle, this should be avoided, but it may be permitted on a case-by-case basis.	On a case-by-case basis, it may be permitted to have nearby substations with busbars that can be manually connected together, for example, with a longitudinal switch that is open under normal operating conditions. Such a configuration must be designed with special care to ensure that an individual disturbance cannot lead to the simultaneous loss of both substations. The reliability study must include the substation solution obtained from this design.
Segregated power generating facilities having offshore substations on a shared platform	In principle, this should be avoided, but it may be permitted on a case-by-case basis.	Fingrid must approve the use of a shared platform for more than one offshore substation. If multiple offshore substations are built on the same platform, the configuration must be designed with special care to ensure that an individual disturbance cannot lead to the simultaneous loss of both substations. The reliability study must include the substation solution obtained from this design.
Shared telecommunications connections used to control segregated power generating facilities	In principle, this should be avoided, but it may be permitted on a case-by-case basis.	The telecommunications connections should be segregated if the loss of a shared telecommunications connection could lead to the loss of control or both power generating facilities becoming disconnected from the network.
Segregated power generating facilities having a shared local control centre	Not permitted	The local control centres for specific power generating facilities must be segregated so that one control signal cannot lead to the simultaneous disconnection of both power generating facilities from the network.
Segregated power generating facilities having shared control room activities	Permitted	The entity in charge of operation (the control centre operator) must be the same one for the segregated power generating facilities. The entity in charge of operation must be able to prevent or authorise external control signals in the manner agreed upon with Fingrid.

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