

29 October 2021

## Principles of power system operation

Approved at a meeting of Fingrid’s Board of Directors on 29 October 2021. The Board of Directors approves these principles every two years or whenever necessary. These principles apply to every company in Fingrid Group unless the context warrants otherwise.

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## 1 Operating environment

Finland, Sweden, Norway, and Eastern Denmark form the jointly-operated Nordic synchronous power system. The operating principles of the system are based on European Union legislation and more detailed operation agreements between the power grid organisations in each of the countries. The European requirements, national technical system requirements for connecting parties, and the common planning and operating principles for the Nordic grid lay the foundation for the power system operation of Finland’s main grid. Finland is connected to the grids in Russia and the Baltic countries by HVDC transmission links.

As the European markets have become integrated, Finland’s power system has become strongly connected to the power systems in its neighbouring countries. The European network codes regulate Nordic and national grid operations. The structural change in the power system and the increase in the volume of renewable energy have made it increasingly challenging to manage system security. Stronger connections between countries enable more extensive use of balancing resources and improve system security in the event of disturbances in Finland. However, under certain circumstances, there may be an elevated risk of large-scale disturbances spreading from one system to another.

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## 2 Targets

### System security level

The aim is to maintain the current level of system security in the main grid under all operating conditions, as the current level is adequate from the standpoint of customers and society as a whole. The maximum possible transmission capacity should be made available to the electricity market without jeopardising system security in the main grid.

At the system level, the key principle of operation is N-1 design. In other words, there should be a contingency for the worst individual fault at any time, as well as the ability to restore Finland's subsystem using reserves within 15 minutes, so that it is able to withstand the next dimensioning fault.

A balance between electricity generation and consumption is jointly maintained with the Nordic transmission system operators in accordance with the network codes, methodologies approved by the authorities, and Nordic operation agreements so as to ensure that the quality of the frequency in the Nordic countries is acceptably good.

The frequency, voltages, and power flows in the main grid are maintained according to the national technical system requirements, Nordic agreements, and European network codes and applicable standards.

### Cost-efficient use of resources

In the operation of the Nordic grid balancing resources from various countries are utilised and uniform operating methods are followed. Active cooperation is undertaken with the power grid organisations in Estonia and Russia to ensure system security on cross-border connections. Cost-efficient operation is assured by market-based procuring of the necessary services.

### Safety of the grid

Actions are taken to ensure that the operation of the grid does not pose a hazard to any person or the environment under normal conditions, as well as in the event of a disturbance or accident.

## 3 Operational planning

The operational situation and the associated risks are identified and forecasted. Transmission capacity is calculated taking into account transmission outages and the operational situation. Generation, consumption, and the transmission status are forecasted on the timeline required in the circumstances.

The services provided by the Nordic Regional Security Coordinator (RSC) in Copenhagen are being introduced in phases, and the RSC's activities are under active development.

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#### **4 Control of the power system**

Fingrid uses its own personnel for operational 24/7 control of the main grid. Operating resources and expertise are kept sufficient for managing normal operations, as well as for operating during disturbances.

Operational control makes efficient use of automation and information technology. Real-time data on the main grid, generation, consumption, and neighbouring grids is collected in sufficient quantities to enable effective operation. The other operating organisations are supplied with the data they need.

Local on-site services at substations are outsourced to service providers.

#### **5 Planning and executing transmission outages**

The grid is operated in accordance with the design rules (including the N -1 principle) during planned transmission line and substation outages. In the 110–220 kV grid, local deviations from this rule are possible due to the structure of the grid. Special attention is paid to electrical and occupational safety when transmission outages are planned and implemented. Regular training is provided to ensure that the personnel involved in transmission outages possess a good standard of safety knowledge.

Transmission outages are scheduled so as to minimise the harm to the electricity market and customers connected to the grid. The process of planning an outage takes into account the costs of work during the outage, a calculation of the harm incurred to customers due to a disturbance, the impact on the market, countertrade costs, and losses. Outages are planned on a long-term basis, and outages that affect the market are published well in advance.

#### **6 System reserves**

System reserves ensure a momentary balance between generation and consumption. Fingrid maintains system reserves (Fast Frequency Reserve, Frequency Containment Reserve, and Frequency Restoration Reserves) to handle grid disturbances and ensure power balance. Reserves are purchased at market terms to the extent possible. Reserves in other countries may also be purchased. Fingrid owns reserve power plants, which are started up to restore the frequency, manage transmissions, regulate the voltage, and restore operations following a major disturbance. Efforts are made to fulfil the reserve obligations at all times while minimising the overall cost.

System protection schemes are used to boost the transmission capacity and provide a contingency against faults of greater severity than dimensioning faults (on the N-1 principle). The operation of system protection schemes is based on reliable data transfer and commercial agreements with generation and consumption operators. The under-frequency load shedding system is maintained as a protection against faults of greater severity than dimensioning faults.

No separate reserves are maintained to ensure the adequacy of electricity beyond the reserves required under the Electricity Reserves Act.

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## **7 Disturbance investigation**

An adequate standard of expertise and training, material readiness, and agreements with service providers are maintained to ensure that the Fingrid is constantly prepared to locate and repair ordinary and extraordinary disturbances and faults due to incidents such as major storms. The impacts of faults on system security and the market are taken into consideration when deciding upon the resources required for fault repair. Faults are always located quickly and any danger to environment is eliminated, but repair work can be made at a suitable time dictated by safety and the operational and market situation.

The risk of a major disturbance affecting the entire country is kept as low as possible within the dimensioning rules. Disturbance investigation and fault repair are practised regularly.

The technical compliance of significant power plants and consumption facilities connected to the system is monitored on the basis of disturbance recording and measurements to ensure a good standard of system security under all circumstances in line with the design principles.

## **8 Contingencies for abnormal incidents and crises**

In the event of a severe electricity shortage or a major disturbance that threatens system security, Fingrid may safeguard system security by exercising its rights, as the party responsible for the system, to issue orders to generation and consumption facilities without commercial agreements. Fingrid only exercises its rights as the party responsible for the system if there are no market-based means of addressing the situation.

A sufficient number of national reserves is maintained to ensure that Finland's power system is capable of isolated operation, detached from the rest of the Nordic grid, in the event of disturbances and crises. When Finland's power system is operating in island mode, a reduced system security level is accepted, and it may be necessary to limit consumption or generation.

Continuity planning is undertaken to prepare for operations in the event of disturbances and states of emergency, as referred to in the Emergency Powers Act. A main grid system defence plan is maintained and submitted to the Energy Authority in accordance with the Electricity Market Act. There is active involvement in national contingency planning. In the event of electricity rationing, action is taken in accordance with the instructions issued by the authorities.

## **9 Statistics and reporting**

Relevant information about disturbances is published as quickly as possible. Disturbances, equipment faults, and major operating incidents are analysed and reported retrospectively. Major disturbances are reviewed together with customers. Statistics about disturbances and faults are kept in accordance with international practice. The total economic loss incurred by customers due to disturbances is estimated.