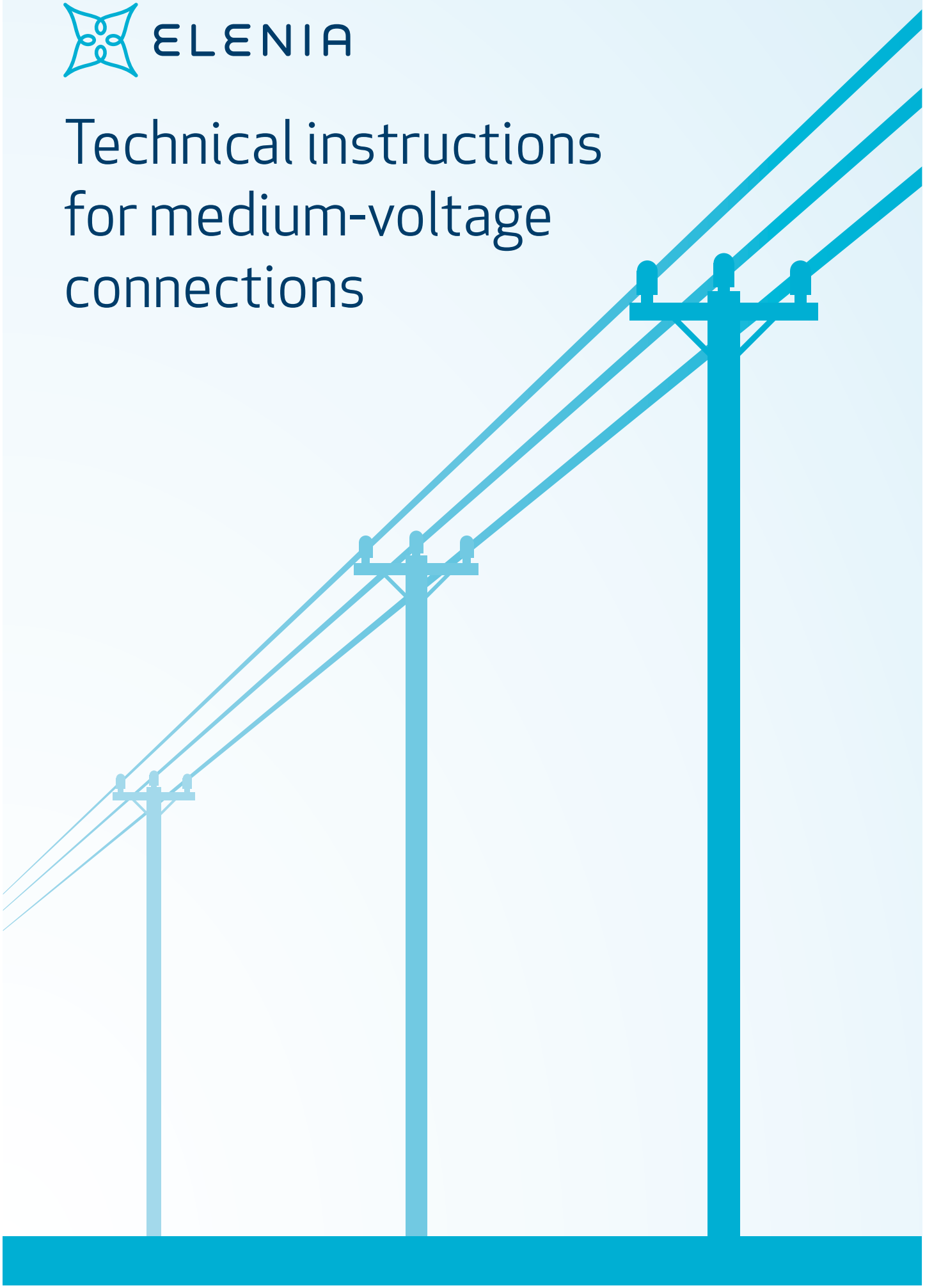
ELENIA

Technical instructions for medium-voltage connections



Contents

1 General information

These instructions summarise the technical requirements and specifications that concern medium-voltage connections. The instructions are applied to new demand and production connections made to Elenia's medium-voltage network, together with the connection contract and the terms and conditions of Finnish Energy. The requirements of the instructions are also applied in case of alterations, expansions or renovations of existing connections, especially the connection switchgear, according to the scope of implementation. Deviations from the instructions must always be agreed in advance in writing.

In addition to these instructions, the current requirements set by the transmission system operator Fingrid for demand facilities, power plants and electricity storage in the documents "Grid Code Specifications for Demand Connections" (KJV), "Grid Code Specifications for Power Generating Facilities" (VJV) and "Grid Code Specifications for Grid Energy Storage Systems" (SJV) are complied with. European network codes must also be taken into account, as regards Elenia's medium-voltage network. The voltage of Elenia's medium-voltage network is typically 20 kV. Possible individual connections planned and implemented at other medium-voltage levels are treated on a case-by-case basis.

Connecting to Elenia's medium-voltage network is subject to the currently valid terms and conditions for the connection of places of electricity use to the under 36 kV distribution network.

Medium-voltage network connections shall be examined on a case-by-case basis to determine the connection method and connection point. The connection point refers to the point where the limits of ownership of the various electricity system operators are located and where the customer's equipment is connected to Elenia's electricity network. A connection's connection point is agreed on a case-by-case basis with the connecting party and recorded in the connection contract.

The connection project can be divided into phases. The connection implementation phase starts after the connection contract is signed. The design and implementation of the connection requires good communication and provision of information between the parties during the project in accordance with chapter 8.

2 Electrotechnical design

The connecting party must plan the implementation of their electrical equipment in accordance with the instructions well in advance in order to avoid changes to their needs and any delays during the ordering and implementation of the connection.

2.1 Location and premises of the customer's transformer substation

- Regardless of the individual layout of the connecting party's electrical equipment, the requirements and specifications for their transformer substation defined in these instructions apply in particular to the space or spaces in which the connecting party's connection switchgear is located.
- The transformer substation must be located in such a way that the length of the connection cables within the property and especially inside the buildings is as short as possible. The goal must be to locate the transformer substation on the incoming side of the connection cables.
- If the transformer substation is implemented as a kiosk-style secondary substation, the goal must be to locate it close to the boundary of the managed land area, i.e. usually the plot.
- In a building transformer substation solution, the substation is placed in a separate building or on a floor on the ground level on the building's outer wall so that the substation's door opens directly outdoors. It is recommended to install a panic latch on the door of the transformer substation room.
- An Elenia representative will mark the outside surface of the transformer substation door with an identification number and name in accordance with Elenia's identification system.
- The path to the transformer substation must be as short and clear as possible and the entrance must be arranged primarily by means such as a key deposit cylinder. Elenia's representative must have access to the transformer substation room at any time.
- There must be adequate lighting for installation, operation and maintenance in the transformer substation room and in the vicinity of the connection bays.
- Space must be reserved on the walls of the transformer substation room for a cabinet containing the remote control, battery and communication equipment. A clear wiring route from the equipment cabinet to the terminal blocks of all the connection bays must be reserved to be implemented later. Within the space reserved for the equipment cabinet there must be a 230 VAC 16 A earthed socket with no residual current device implemented as a separate group connected directly to the property's group switchgear.
  - The space required for remote access equipment is specified in a separate instruction "Remote control specifications for the connection switchgear of customer transformer substations"
- The connecting party's own separating switches or circuit breakers behind the primary protection of the connection switchgear are not connected to Elenia's remote control.
- The signal strength of the GSM network must be sufficient (over -85 dBm) for each connection point in the switchgear room. If the above is not possible, a cable route that is as short and direct as possible must be arranged from the space to a location where the signal strength is reached for the installation of an additional antenna. The required feed through / pipe diameter is 20 mm (e.g. JAP or JM).

2.2 Dimensioning and routing the connection cables

- The cross-section and type of cables used in Elenia's medium-voltage network depend on the technical needs of the site and on the distribution network. Elenia shall determine the design of the connection lines on a case-by-case basis. The cables that are commonly used by Elenia are not fire rated.
- The connecting party is responsible for the planning and so-called pre-implementation of connection line access routes (pipelines, canals, etc.) on land they control and inside their buildings. The route must be implemented in accordance with valid standards and regulations. The cable route to the transformer substation room must be fireproof and, if necessary (if the length of the building is more than 5 m),

separated into fire compartments. The route must be as straight as possible avoiding (sharp) bends in a way that allows a bend radius of no less than 100 cm bend. Cable routes should generally be prepared for the installation of AHXAMK-W 3x300Al +35Cu type cable.

- Piping is the preferred method for implementing the cable route. The inner diameter of the cable protection pipes must be at least 125 mm and the outer surface of the pipes must be mostly yellow. The number of cable protection pipes throughout the entire route must be at least equal to the number of connection bays. In addition, it is recommended to install at least 1 spare pipe on the route. At the boundary of the land area controlled by the connecting party, the ends of the cable protection pipes must be at least 700 mm deep measured from the final ground level. The direction of the pipelines must be confirmed by an Elenia representative well in advance. In order to avoid damage to the pipes, sand or fine soil should be used above and below the piping installation. After the pipes have been installed, they shall be fitted with drawstrings and each end of the pipes shall be plugged with appropriate plugs.
- If there is more than one connection point and cable connections between connection points on the Elenia network side are implemented, the implementation of the routes must be planned and the division of responsibility for implementation must be agreed separately sufficiently well in advance.

2.3 Connection switchgear and primary protection

The connecting party must reserve the required number of connection bays for the connection switchgear as follows:

- Two (2) connection bays must be reserved for the connection switchgear of a demand connection or demand connection with production.
- One (1) connection bay must be reserved in the connection switchgear of a production connection.
- Additional or an otherwise deviating number of connection bays is always agreed in advance in writing.

New and refurbished connection switchgear and their installation must meet at least the following requirements:

- Requirements of up-to-date standards, such as IEC 62271 and its sub-standards
- The switchgear must have been subject to documented short-circuit and arc tests.
- Nominal voltage Un 24 kV, 50 Hz
- Rated current of the connection bay separating switches and railing In630 A
- Short-circuit resistance Ith/ 1 s 16 kA
- Short-circuit resistance Idyn 40 kA
- Surge resistance 125 kV
- Primary protection limiting breaking capacity 16 kA
- Connection bay separating switch breaking capacity 16 kA
- When viewed from the direction of Elenia's network, the connection bays must be located before the primary protection, which must be located before metering.
- The connection points of the cable terminals of the connection bays must be at least 1200 mm above the bottom of the duct level or the floor surface.
- It must be possible to connect an AHXAMK-W 3x300Al +35Cu type cable to each connection bay. Each connection bay must have its own connection point to
  - the earthing conductors of the cable terminals
  - the possible earthing conductors of the connection cable (max Cu35 or Al35)
  - the earthing conductors of the overvoltage protectors, if necessary
- The voltage at each terminal of each phase of the connection cable must be able to be detected from a voltage detector on the cell's front panel or a voltage probe which is in accordance with valid regulations, directly from the terminal without disassembling the switchgear.
- All connection bays shall be equipped with earthing isolators that earth in the direction of the connection lines.
- All connection bays shall be implemented with motorised isolators and with full remote control capability. Controls and status contacts must be wired to the switchgear terminal blocks. A 24VDC voltage is used for the motor controllers. The motor controllers are equipped with sample and hold circuits that allow

the use of pulse controls to control the separating switches.
    - More detailed information about connecting can be found in the separate instruction "Remote control specifications for the connection switchgear of customer transformer substations"
- Connection bay separating switches or their control devices and earthing isolators must be lockable individually using a padlock.
- The separating switches of the connection bays and earthing isolators must be lockable separately so that the earthing isolators can be closed and only the separating switch left open.
- An Elenia representative will label the separating switches of the connection bays in accordance with Elenia's identification system.
- A circuit breaker must always be installed as the primary protection device of the connection switchgear.
    - The circuit breaker ensures fast and safe disconnection in all deviation and fault situations.
    - The circuit breaker allows various protective measures to be flexibly implemented and changed at a later time without significant technical changes to the switchgear.
    - The circuit breaker enables subsequent changes in the way the connection is used, such as connecting production to a demand connection.
    - For more detailed instructions on protection, see section 5

2.4 Other dimensioning factors to be considered

2.4.1 Transformer dimensioning and protection

The use of transformers above 1,600 kVA is generally not recommended. If the connection consists of only one transformer, the primary protection can also serve as protection for the transformer. If there are two or more transformers, separate protection devices must be installed on all of the transformers.

2.4.2 Voltage changes

Rapid voltage changes are mainly related to switching situations. Connecting demand or a power plant either starting or suddenly disconnecting from the network can cause significant and rapid voltage changes.

Connecting demand or power plants to the electrical system may not cause changes of more than 3 % in the voltage at the connection point of the plant. The need to limit the rate of increase of active power demand or production during plant start-up shall be agreed separately with the network operator of the connection point. Disconnecting demand or power plants from the electrical system may not cause changes of more than 4 % in the voltage at the connection point of the plant.

On the other hand, if a substation is connected to customers who are particularly sensitive to rapid voltage changes and disconnection of the demand or production connection is considered likely, more stringent limits for rapid voltage changes may have to be applied.

2.4.3 Flicker

Upon request, the connecting party must provide calculations of the flicker emission caused by their connection. Elenia shall provide the initial data necessary for calculating the flicker emissions. The disturbance indices must be calculated for both the flicker caused by starting and the flicker caused by continuous operation. The full calculations must be submitted to Elenia.

2.4.4 Harmonic current

The harmonics and the total voltage distortion caused by the demand or power plant shall not exceed the limit values specified in the standard SFS-EN 50160.

2.4.5 Compensation of earth fault current

If the earth fault current produced by the connecting party to the connection point is 5 A or more, the connecting party must compensate for at least 5 A of the produced earth fault current.

The earth fault current produced by the underground cable network depends on the type and cross-section of the cables used, but on average the 5 A earth fault current output is achieved with a cable length of about 2 km.

3 Connection implementation

The connecting party must provide sufficient information and documents necessary for the planning and implementation of the connection ahead of time. The minimum requirements for the information and documents to be provided in the different phases are described in section 8.

3.1 Connection method

- A demand connection with or without production is normally connected to Elenia's network with two connection lines so that the connection switchgear is connected to the Elenia trunk network (so-called ring network connection) and the maximum capacity of the connection can be input via either connection cable. On a case-by-case basis, several connection lines and connection points can be implemented, for reasons such as criticality of the connection. In such cases, implementation should be planned in cooperation with Elenia from an early stage.
- Generally, production connections are connected by a single connection line (so-called branch connection).
- A less powerful and less critical demand connection or a demand connection with production can also be connected with a single connection line as a branch, due to reasons such as the structure of the feeding distribution network.
- High-capacity connections, regardless of their type, are usually connected directly to the substation 20 kV line output bay (so-called substation connection). For connections with demand, the connection of a second connection cable (stand-by supply) is determined on a case-by-case basis.
- In the case of a production connection, the connection shall be designed in such a way that the connection capacity can be fed into Elenia's network under normal conditions. The main input direction is determined in cooperation with the customer. In the event of an anomalous switching situation, such as maintenance work or breakdowns in the main grid or Elenia's network, Elenia reserves the right to limit the customer's capacity. Limiting the capacity in deviating switching conditions is separately agreed with the customer.

3.2 Scope of liability for implementation

3.2.1 Connection bays

- The connecting parties are responsible for the acquisition and installation of the connection switchgear/bays as well as for wiring the connection controls and status data to the vicinity of the installation site of the communication and control equipment so that they are ready for installation.
- The connection bays remain the property of the connecting party.
- Maintenance of the connection bays remains the responsibility of the connecting party.
- Responsibility for the use of the connection bays lies solely with Elenia.

3.2.2 Route of connection lines

- Within the land area owned or controlled by the connecting party as well as areas inside buildings, the connecting party is responsible for the preliminary preparation and implementation of routing the pipes and canals required for the connection line, in accordance with the instructions in section 2.
- If piping is not used for implementing the route of the connection lines within land owned or controlled by the customer, but the connection lines are installed directly into cable trenches, the connecting party is responsible for excavating the cable trench up to the border of the area he owns or controls (usually the plot), and Elenia is responsible for filling the cable trench. The connecting party is responsible for any surface structures and finalising work.
- In other respects, the responsibility for the implementation of the route is demarcated by the connection point.

3.2.3 Connection lines

The usual connection point of a demand connection or a demand connection with production is

A. At the terminals of the connection bay cables, in which case Elenia is responsible for implementing the connection lines up to the connection bays.

B. Or at the cable terminal in the 20 kV cable output bay of Elenia's substation, in which case the connecting party is responsible for implementing the connection lines to the proximity of the substation and Elenia is responsible for implementing the connection lines in the substation area in cooperation with the connecting party.

The connection point of a production connection is usually

A. At the cable terminal of the 20 kV cable output bay of Elenia's substation, in which case the connection lines are implemented in the same way as for demand connections

B. Or at Elenia's 20 kV switchgear (e.g. a kiosk-style secondary substation) at the terminal of the connection cable, in which case the connecting party is responsible for implementing the connection line to the proximity of the switchgear, and Elenia is responsible for the feed through and connecting the cables to the switchgear.

3.2.4 Telecommunications and control equipment for remote access

- The connecting party is responsible for providing space and an installation location required by the equipment as well as for implementing the electricity supply in accordance with Elenia's instructions.
- Elenia is responsible for the acquisition, installation, connection and commissioning of the equipment. Elenia is also responsible for the implementation of a possible additional antenna.
- The ownership along with responsibility for the operation and maintenance of the equipment remains with Elenia.

4 Compensation of reactive power and designing control

4.1 Capacity and compensation of reactive power

In the case of a demand connection, compensation of reactive power shall be dimensioned in such a way that no significant amount of reactive power is produced or consumed at the connection point under any circumstances.

A connected power plant must meet the currently valid and applicable grid code specifications (VJV) for the reactive power capacity of power plants. If no reactive power requirements are set in the power plant's grid code specifications, the reactive power capacity shall be measured in such a way that the power plant is able to operate at the connection point with a power factor of 1.0 under all conditions. The power factor requirement also applies to idling, when the power plant does not produce any active power. Therefore, even in an idle condition, the plant must be able to operate in the normal reactive power range.

4.2 Connection point and power plant control

At the connection point, the customer's equipment will be connected to the equipment owned by Elenia. The electrical values and adjustment parameters are always given at the connection point. If the connection point is located at a distance from the actual power plant, but the intermediate network does not significantly affect the reactive power capacity of the power plant, the measurements required by the regulator can be placed at the same point as the power plant itself and the power plant controller. In this case, the adjustment parameters can be given for that point.

4.3 Choice of power plant control method

In this context, “control method” refers to controlling the reactive power produced or consumed by the power plant. Any power plant to be connected must allow selecting either fixed voltage, fixed reactive power or fixed power factor as its control method.

For plants connected directly to a substation with a dedicated output or along the medium-voltage cable, the adjustment method is either fixed power factor or fixed reactive power.

Fixed voltage control can also be used when connecting to a substation or along the cable, but in this case an insensitivity range must be defined for the power plant. While the voltage remains within the insensitivity range, the reactive power of the power plant is not adjusted to adjust voltage at the connection point, but the voltage control is done at the substation.

However, depending on the characteristics of the network at the connection point, the adjustment method may be determined on a case-by-case basis.

In addition to the above, the requirements for power plant control set out in the grid code specifications for power plants must be taken into account when designing power plant control.

5 Protection design

Connecting to Elenia's medium-voltage distribution network is subject to the applicable connection terms and conditions. In addition, the current Fingrid requirements apply to the extent that they concern connecting to the distribution network.

In addition, the power plants must comply with Fingrid's current grid code specifications for production (VJV), including electricity storage (SJV). The requirements of European network codes must also be taken into account.

The Fingrid guidelines "Relay protection of the main grid and customer connections" are applied to connections to Elenia's distribution network. According to the instruction, connecting production to Elenia's electricity network requires that the protection of Elenia's substation be upgraded in order to ensure that the production equipment connected to the medium-voltage network does not maintain voltage in the 110kV network in a situation where the supplying 110kV circuit breaker has been opened for a reason such as a fault in the power network. Elenia also applies the same principles in the case that a substation is connected to the 110kV network owned by Elenia.

Elenia must ensure the safety of the electricity network at all times. A key part of this is to ensure the correct functioning of the protection in order to guarantee personal safety and to avoid adversely affecting the equipment. Correct measures to complement the protection can also prevent the spread of interference in the event of a fault in the electricity network so that they do not cause unnecessary harm to other users of the electricity network.

If there is a need to deviate from the general requirements set out here, the matter must be agreed with Elenia in writing.

5.1 Customer responsibilities in electronic protection

The customer's electrical equipment (power plant, transformer substation or similar) must be equipped with suitable protective devices. The customer is responsible for the appropriate protection of their electrical equipment. The protection of electrical equipment shall be such that it can withstand, without breaking, normal network failures, such as short circuits, earth faults and reconnections these may cause. In addition, the electrical equipment must withstand unexpected interruptions in distribution, for example in the case of a breakdown in the distribution network or in the overhead network, as well as momentary disturbances and changes in the voltages, currents and frequency of the network caused by faults.

The customer is responsible for the design of the protection layouts of their electrical equipment and connections so that the safety of persons and equipment is not compromised, and damage to the equipment is avoided.

The protection settings of the production equipment must be designed so that they do not conflict with the grid code specifications.

The customer is responsible for the settings of the protective equipment under their control and the suitability of the settings for the protection of the electrical equipment in question, as well as for the proper maintenance of the protective equipment.

The design of the operating values of the protective devices is always carried out in cooperation with Elenia's protection designer. The test protocols for essential protection devices, both for the commissioning of the equipment and for subsequent maintenance tests, must be submitted to Elenia in order for Elenia to continue to ensure the selectivity of the protection and to ensure the proper functioning of the protection.

5.2 General principles for protection of medium-voltage connections

A circuit breaker must be installed as the primary protection for both demand and production connections, usually at the connection point. The circuit breaker shall be equipped with both over-current and earth fault protection. At least the earth fault protection must be directed (direction of action towards the network owned by the connecting party). Earth fault protection is not required if there is only one transformer after the primary protection and the length of the medium-voltage power network after the primary protection is less than 30m. Elenia recommends supplementing the protection of the connection point with residual current protection and intermittent earth fault protection.

The customer's protection must be selective with respect to the protection of Elenia's supplying medium-voltage output. The customer is primarily responsible for the selectivity of their own protection. Elenia will provide the customer with the protection settings of the supplying output for ensuring the selectivity.

Elenia recommends using an over-current protection with at least two stages. The second over-current stage should operate without deceleration (total operating time of the protection max. 0.1s), taking into account the customer's network (switching current surge caused by the transformers) and the settings of Elenia's output. Inverse-time protection may be used if its selectivity can be demonstrated by a selectivity test.

In the case of a fault at the low-voltage side, the selectivity should also be considered in relation to the protection provided by Elenia, so that in a possible rail fault, the medium-voltage protection provided by the customer's switchgear works first. Achieving selectivity even in the event of a low-voltage rail fault may in some cases require the use of three separate over-current stages to protect the customer.

If earth fault protection is required under the above conditions, it should be directed. The earth fault protection is set as selective in connection with the settings of Elenia's compensated network. Elenia will provide the customer with the earth fault protection settings of the supplying output for ensuring the selectivity.

The design of the operating values of the zero-voltage protection required for production is always carried out in cooperation with Elenia's protection designer.

5.3 Production connections and demand connections with production

The purpose of the protection requirements is primarily to guarantee the safety of the electricity network, and to ensure that the protection of the electricity network functions as intended. This requires that the production equipment not remain energised in the event that the circuit breakers in the supply network have been opened, for example in the event of a failure of the electricity network. The formation of such an unintended island must be prevented by the protections of power plants (over-frequency, under-frequency, over-current, under-current and island protection) as well as by additional protection of connection points.

The protection settings must be designed so that they do not conflict with the grid code specifications. However, the technical control requirements contained in the grid code specifications are of secondary importance in a situation where there is a risk to personal safety. In such a case, electrical protection and safety take precedence over control of the power plant.

The capacity limits defined in the protection requirements refer to the total combined power output, which may consist of one or more production installations. Here, production installation refers to any unit of electricity production, including electricity storage.

If production is to be connected to an Elenia substation that is connected to another operator's high-voltage distribution network via a transmission line or a primary substation, the protection changes caused by connecting the power plant must be discussed with the operator concerned on a case-by-case basis.

5.3.1 Protection of a production connection

When connecting production to Elenia's medium-voltage network, a circuit breaker must always be installed as the connection's primary protection, usually at the connection point.

The circuit breaker shall be equipped with both over-current and earth fault protection. At least the earth fault protection must be directed (direction of action towards the network owned by the connecting party).

Elenia recommends supplementing the protection of the connection point with residual current protection and intermittent earth fault protection.

Protections of the power plant must prevent the formation of an island. In order to ensure the safety of the electricity network even if the power plant protections do not detect an earth fault on the medium-voltage side, zero-voltage protection must be defined as the power plant's backup protection at the connection point. In addition, the connection point protection must be supplemented with over and undervoltage protection as well as over-frequency and under-frequency protection. LOM protection will also be implemented at the connection point, if possible.

5.3.2 Protection of a demand connection with production

In situations where the gross production capacity of a connection to Elenia's medium-voltage network is equal to or greater than 100kVA, the ratio between the power produced and the power consumed determines the level of protection at the connection point. If the maximum planned or measured power output is greater than the minimum power consumption of the connection, the circuit breaker at the connection point must be equipped with a zero-voltage protection in addition to over-current and earth fault protection. This allows ensuring the safety of the electricity network can in the event that the protections of the power plant do not detect a earth fault on the medium-voltage side.

If the primary protection of the connection point is a fuse-switch disconnector, a circuit breaker must be installed as the primary protection of the connection point. In addition to zero-voltage protection, the circuit breaker shall be equipped with over-current and earth fault protection (at least the earth fault protection must be directed). In addition, the connection point protection shall be supplemented by over and undervoltage protection as well as over-frequency and under-frequency protection. LOM protection will also be implemented at the connection point, if possible.

5.3.3 Production disconnection

Local disconnection relay shall be built for 1–5 MW production. Elenia determines on a case-by-case basis whether local disconnection relays are needed for production capacity of 5 MW or above at the substation supplying Elenia's power plant or if a communications link for disconnection (EVY) is required to be built.

If it is defined that a communications link for disconnection shall be built on the site, the disconnection must be implemented in accordance with Fingrid's instruction "Relay protection of the main grid and customer connections", or the replacement of these instructions. The communications link for disconnection shall be built only in the specified main supply direction. The implementation of the communications link for disconnection may result in measures and costs that the customer should be prepared for.

6 Real-time data exchange

The requirements for real-time data exchange apply to power plants above 0.5 MVA. For power plants with a capacity of 0.5–1 MVA, the need for real-time data exchange is determined by Elenia Ltd on a case-by-case basis, depending on the type of production, the characteristics of the network and whether the energy produced is consumed in full behind the connection point. For power plants with more than 1 MVA, real-time data exchange is always required.

The connecting party provides the necessary information to Elenia and Elenia forwards it to Fingrid. The requirements for real-time data exchange are based on Fingrid's current grid code specifications and, where applicable, Fingrid's current guidelines for real-time data exchange.

Real-time metering and status information must be available in Elenia's operation and control information system when a new power plant or substation is connected to the electricity network.

6.1 Technical implementation of data exchange

The real-time data exchange between Elenia and the customer is carried out between the operation and control information systems. Telecommunications between the operation and control information system is implemented using the FEN network (FIN Elcom Network). The IEC 60870-5-104 protocol is used for real-time data exchange.

If the customer or their control room operator does not already have access to the FEN network, it must be obtained during the project. The customer agrees on joining and using the FEN network directly with its manager, Empower. Up to approximately three months should be allowed for the implementation of the FEN connection.

If the customer does not have a centralised operation and control information system, Elenia can provide the customer with a telecommunications connection to which the customer connects with their RTU device. The IEC 60870-5-104 protocol is used for real-time data exchange also in this case. It is the customer's responsibility to install the telecommunication equipment supplied by Elenia in their own equipment rooms.

The customer and Elenia's contact person will agree on the test time well in advance before the planned commissioning. The customer must provide Elenia's contact person with a test plan and a signal list of the transferred data by e-mail no later than 4 weeks before the testing and commissioning of real-time data exchange.

6.2 Real-time data required from the customer

Elenia requires the following information regarding the maintenance of network security of supply:

- Measurements of active and reactive power by type of production (P, Q)
- Connection-level current and voltage measurements (I, U)
- Switchgear up to circuit breaker, including earthing isolators
- Self-monitoring, awakening and triggering information of connection-level protection
- If the disconnection fuses do not trigger the connection circuit breaker, unambiguous information is required about the production disconnection from the network
- Power plant control mode and information on reactive power control status
- Reactive power control, On/Off
- Mode of reactive power control
- Active power control, On/Off
- Mode of active power control
- Active power limitation, On/Off
- Active power limitation power limit

In addition, other separately requested information as agreed.

Elenia will provide the installation and operating instructions of the manufacturers of telecommunications equipment. The ordering, delivery and installation of the necessary equipment are agreed on a per-project basis with the customer. The equipment must be installed and ready for use before sending the signal list and agreeing on the time of the remote control tests.

The customer must install Elenia's telecommunications equipment and antenna in compliance with the manufacturers' instructions, safety regulations and general care. The antenna must be installed in a way that ensures mobile network signal.

6.3 Requirements for the use of Elenia's telecommunications equipment

When designing their own equipment, the customer must take into account the space reserved for Elenia's telecommunications device and inform Elenia about the required length of the antenna cable. The customer must connect the telecommunications equipment to a certified power supply.

The customer shall reserve space for the equipment in accordance with the manufacturers' instructions. The telecommunication device will be the size of an industry standard router. The minimum space reservation for the device is 300 x 300 x 300 mm. In addition, a cable route to a location with good signal must be reserved for the antenna. The communication device is supplied with a DIN bracket for mounting the device on the DIN rail. The high operating temperature of the router processor must be considered in the design of the installation site and sufficient cooling.

The update interval for real-time data exchange must be no more than 20 seconds. Detailed data communication specifications are agreed on a per-project basis with the customer. The communications shall comply with Elenia's valid information security guidelines.

6.4 Operation in case of maintenance, faults and security incidents

The customer must inform Elenia of any service interruptions. The notification must include the start and end time of the service interruption, as well as the possible effects on Elenia's systems and equipment.

In the event of a prolonged (6h) fault, the customer must notify Elenia by e-mail of the estimated end time of the fault. After recovery from the fault, the customer must inform Elenia of the impact on Elenia's systems and equipment.

7 Energy metering

Elenia installs, maintains and owns the meters used for energy invoicing. Elenia must have unrestricted access to the metering panel, for example by means of a key placed in a key deposit cylinder.

The plan for implementing energy metering (e.g. a main circuit diagram of the equipment, measurement circuit diagram, nominal values of the instrument transformers) must be submitted to Elenia's contact person via email and approved by Elenia no less than one month in advance of the desired start of metering. If necessary, Elenia's contact person will provide the customer with an example circuit diagram for the planning and implementation of metering.

7.1 General requirements for metering

Metering equipment and connections must be carried out in accordance with the standards in force at the time, such as SFS 3381 Measuring equipment and SFS 2529 Energy meter chassis.

For an individual meter that is the responsibility of Elenia, one standard M2 meter grid in accordance with the standard SFS 2529 is required for the energy meter. Metering circuits shall be wired from the grid and their conductors numbered at the instrument transformers in advance. The metering circuits must have interruptible so-called metering terminal blocks. The conductors shall be labelled with the number of the instrument or terminal block. The metering conductors (current and voltage circuits) must have a cross-section of at least 2.5 mm2.

The customer's switchgear must allow for sealing the parts containing unmetered electricity and the wiring of the metering equipment.

An auxiliary voltage of 100-240VAC/DC is recommended to be wired to the energy meter to ensure that the meter can be remotely read even in an exceptional situation if there is no metering voltage. For auxiliary voltage wiring, a 1.5 mm2 conductor must be used. If arranging auxiliary voltage is not possible, the voltage drop of the measuring cable must be verified by calculation and it may not exceed 0.05 %.

7.2 Current and voltage transformers

The customer shall dimension and procure for their switchgear or metering panel the instrument transformers required for metering electrical energy. For medium-voltage measurements, three current transformers and three unipolarly insulated single-phase voltage transformers shall be used in accordance with the standard. It is recommended to place the voltage transformers before the current transformers in the main direction of the energy.

No devices other than the energy meter used for invoicing shall be connected to the same voltage or current metering circuit. The metering voltage circuit is protected by its own 3x10A circuit breaker.

Current transformers must be installed in such a way that their shield values are visible when the equipment is energised or the values can otherwise be reliably verified.

The recommended secondary current for current transformers is 5A. All phases must have their own return current conductors. Current transformers must have an accuracy class of at least 0.2s and the accuracy class required for voltage transformers is 0.2.

Current transformers and conductors shall be dimensioned so that the load of the secondary circuit is 25–100 % of the transformer's nominal current (VA). If necessary, additional resistors shall be used to achieve an adequate load. The load calculation and any necessary additional resistors are acquired and installed by the customer. The load calculation shall be submitted to Elenia on request.

The nominal values of the instrument transformers and any possible primary current range allowed by the current transformers must be documented in e.g. the main circuit diagram and reported to the Elenia contact person via email in no less than one month before the start of metering.

If the electricity consumption increases significantly, the transformation ratio of current transformers must be changed to correspond to the increased primary current. The change and its schedule must be notified to Elenia's contact person in advance.

7.3 Production connections and their metering

Elenia carries out a separate inspection for the metering equipment of production connections to verify the correctness of the measurements after the VJV tests of the power plant and any other inspection and maintenance activities affecting the metering have been completed. Changes to the energy metering circuits must be notified to Elenia before the change is made.

For production connections, the customer must take into account the requirements and implementation of possible metering of internal consumption.

8 Information and documents required from the customer

The connecting party must provide sufficiently comprehensive and accurate information and documents regarding the connection as well in advance as possible, also taking into account Fingrid's grid code specifications. In addition to the grid code specifications, the following information should be provided to Elenia at different stages:

8.1 Connectivity assessment phase

- Customer contact information
- Unambiguous address and/or map of the location of the connection
- Type of connection (demand, production) and intended use
- Connection capacity for both demand and production as well as an estimate of any subsequent changes in capacity
- Preliminary needs regarding security of supply

8.2 Design phase

- As accurate a site plan as possible, demonstrating the location of the connection switchgear and the buildings to be built in the area
- Confirmation on any subsequent changes to capacity and the type of connection
- Planned needs regarding security of supply
- Main circuit diagram of the connection switchgear
- Scope of the connecting party's network and number of transformer substations for which a separate plan/ diagram must be provided on request
- Preliminary route for connection cables
- Protection-related and supplementary documents
  - Protection diagram
  - Planned protection settings and possible security reports
  - Information on the operating principle of island protection (production sites)
  - The information required shall also apply to type A production equipment as defined in the VJV in cases where the production capacity is 100kVA or more.
- Implementation of energy metering
  - Planned metering circuit diagram
  - Nominal values of instrument transformers
  - Load calculations
- Report on flicker, upon request
- Report on the implementation of a possible link for disconnection (production locations of over 5MW)
- Implementation of possible telecommunications in accordance with chapter 6 (at least four weeks before the test):
  - Test plan and contact details of the control room operator*
  - Signal list
- if the customer or the customer's control room operator does not already have access to the FEN network, up to 3 months of processing time must be reserved for related preparations

Plans and signal lists for data exchange must be submitted four weeks before the test. The material must have been submitted for approval and the test schedule agreed two weeks before the test. Signal testing is carried out during normal working hours.

8.3 Implementation phase

- Implementation and connection schedule
- Commissioning inspection record
- Protection-related and supplementary documents
  - Final main circuit diagram
  - Final protection diagram
  - Final protection settings
  - Relay test protocols
- Final metering circuit diagram as well as nominal loads and load calculations for instrument transformers
- Contact details of the operation manager and of the control room or operation personnel responsible for controlling the operation of the connection
- Information on the location of key deposit cylinders, keys and access tags required to access the location.

8.4 Connecting phase and metering

The ordering and implementation of the connection and metering requires that all relevant documents have been submitted to Elenia in accordance with the above sections. The customer must inform Elenia's contact person at least 3 weeks before the commissioning of the connection and metering. Before ordering the metering, the customer must conclude an electricity sales contract for the site.

Before connection, a commissioning inspection report must be drawn up for the equipment, which will be delivered to Elenia and presented upon connection. The network connection relay test must be completed for the part to be commissioned, and the relay test protocols delivered to Elenia.

9 Operation

Operational use and communication related to connecting are carried out in Finnish with Elenia's network control centre. The contact information for Elenia's network control centre for the implementation and management of connections is available from Elenia's contact person.

Upon request, the customer must provide Elenia with the design information regarding the use of the connection equipment in accordance with the applicable connection terms and conditions. For work that causes an interruption in Elenia's network (e.g. connection point separating switch maintenance), the customer must fill in an interruption form on Elenia's website at least 3 weeks before the interruption. Elenia's operations planning is responsible for planning the interruption, and they will contact the customer no later than three (3) working days after the completion of the interruption form. Elenia's contact person can provide the contact information of Elenia's operation planning, if necessary.

It must be possible to contact the customer's equipment's operating personnel or control room 24/7. The customer is responsible for the operation of its own electrical equipment, the safety of operation and managing the connection.

9.1 Access rights and access to connection point equipment

The connection point shall be equipped with a remote-controlled separating switch that allows it to be separated from Elenia's network. The customer must have 24/7 readiness to separate the equipment from Elenia's network at the request of Elenia's network control centre in case of faults, or similar situations. In principle, the customer will handle the separation of the equipment from Elenia's network in all situations at the request of Elenia's network control centre. In addition, in order to ensure a sufficiently rapid separation in emergency and exceptional situations, Elenia must have access to the connection point separating switches which must be lockable in order to guarantee the safety of network operations. If in the event of an emergency or other exceptional situation, Elenia has to separate the customer's equipment for the customer, this must be agreed separately between Elenia's network control centre and the customer's operating personnel. The customer shall familiarise Elenia representatives with the use of the equipment to the extent necessary.

Elenia must have unrestricted access to the customer transformer substation, for example by means of a route key placed in a key deposit cylinder. The key deposit cylinder must be placed in an easy to find location. It is the responsibility of the real estate owner to select a locksmith and set the key deposit cylinder with Elenia's serialisation. If necessary, the locksmith can ask request the correct serialisation number from Elenia's contact person. After the key deposit cylinder has been serialised, a representative of the real estate owner shall arrange a meeting with Elenia's contact person, during which the route key is placed inside the key deposit cylinder. The real estate owner is responsible for ensuring that the key deposit cylinder is securely fixed, such as by anchoring or through-mounting. If there are alarm devices on the access route to the metering panel, Elenia is not responsible for the cost any of the alarms may cause.

Elenia's representatives shall have access to network components Elenia owns on a 24/7 basis for repair and maintenance purposes. A similar requirement also applies to switchgear that Elenia has the right to use. This must be taken into account, in particular, in the case of equipment located inside buildings or fenced areas, in which case keys or access tags necessary for accessing the site must also be added to the site's key deposit cylinder.