ENERGY METERING

1. Standards and guidelines

There are standards and recommendations for harmonising the metering practices of distribution network operators, which are followed with the specifications determined in special guidelines.

- SFS 2529 Energy meter stand
- SFS 2532 Apartment building multi-metering boards
- SFS 2537 Alternating current metering - metering connections
- SFS 3381 Alternating current metering - metering equipment
- SFS 3382 Alternating current metering - control and telemetry equipment
- SFS 4365 Metering boards in single-family houses and board structure
- SFS 5601 Electric energy metering equipment premises
- SFS 5602 Small-house area multi-metering boards Finnish Energy's recommendation Principles of Hourly Metering 2010

1.1 230/400 V connection metering

Direct metering is used when the front fuse is 63 A or less. Otherwise, indirect metering and instrument transformers are used. For indirect metering, a 230 V power socket must be placed near the meter.

1.2 10 and 20 kV connection metering

Metering is carried out with three voltage and current transformers from a metering point with a voltage level of 10 or 20 kV. Low voltage metering can also be performed depending on the transformer, as per a separate distribution product price list.

For medium voltage metering, a 230 V power socket must be placed near or inside the meter housing.

1.2.1 10 and 20 kV connection remote metering

A medium voltage connection is always equipped with primary metering, which is measured from the medium voltage side of the switchgear. It is possible to obtain remote metering for the low voltage side of the connection. Remote reading is supplied by the distribution network operator. Remote reading is carried out with GPRS data line meters.

Primary metering must measure the property board usage (house usage). The primary metering board's main switch must be lockable in the open position by the network company, and the main fuse must be removable or electricity use must be otherwise reliably prevented if the location of use does not have a valid electricity contract. This requirement also enables the prevention of back voltage for service and maintenance work if the location of use has its own small-scale generation of electricity or possible reserve power.

Remote reading is meant to measure residential and commercial properties and other such locations of use. Remote reading is subject to the same technical requirements as 230/400 V metering.

The connection's reactive power compensation must be constructed in such a way that it is placed before remote readings and before the primary metering board.

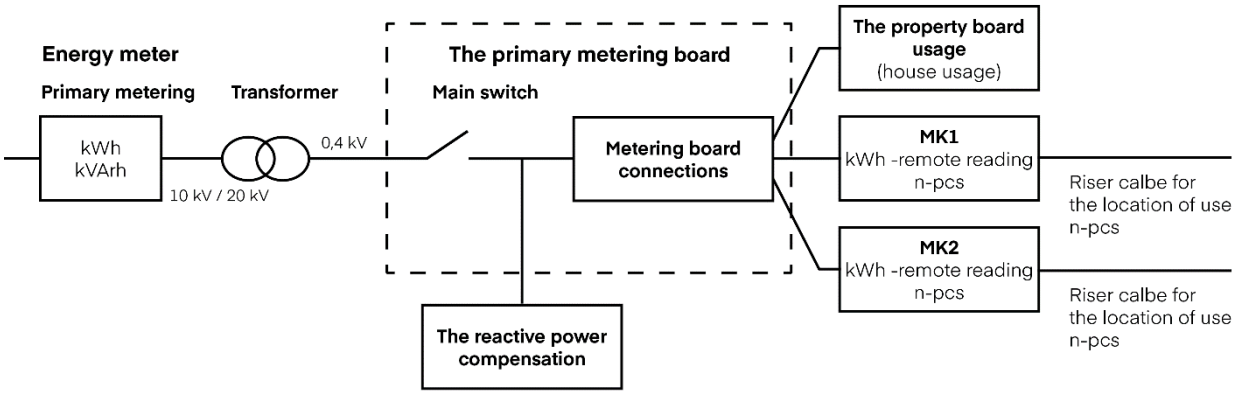

Figure 1. Principle picture of medium voltage remote readings and reactive power compensation. Primary metering measures the electricity consumption of the property board.

1.3 The effect of electricity transmission tendering on metering

Electricity invoicing of all new customers is done on a quarter-hour metering basis. The metering equipment is owned by the distribution network operator. The distribution network operator organises data transmission for metering.

Electricity transmission tendering may affect metering. Possible changes are implemented according to Energy Finland's recommendation Principles of Hourly Metering 2010.

2. Metering equipment rooms and sealing

2.1 Metering stands

Metering stands must be in accordance with the SFS 2529 standard M2 stands.

Metering stands are installed so that the centre of the metering grid is between 80 to 180 cm from the maintenance platform. For power metering, the corresponding height is 100 to 170 cm.

2.2 Metering and distribution board reference numbers

The electrical contractor marks the reference numbers of the metering stand and distribution board in a clearly visible place before installing the meters. The distribution board and metering stand are marked with the same reference number.

The reference number is marked in the top right corner of the metering stand. In a multi-meter board, consecutive numbering is started in the top left corner, row by row.

In terraced houses or semi-detached houses, distribution boards are always marked with a DB code in successive numerical order (DB1, DB2, DB3...). The code must not be changed even if the apartment number changes. Distribution boards should be numbered in the same order as street numbers increase and away from the street on the plot. In apartment buildings, the DB code is the same as the apartment number. Commercial premises are numbered consecutively (CP1, CP2, CP3...).

In parking garages, telecommunications operators' equipment rooms, and other such places, the central connection diagrams must include the name of the apartment or property in addition to the distribution board's number. The name of the apartment or property is determined by the property's owner, and it must be a common noun (e.g.: DB1, Parking garage; DB2, DNA equipment room).

In commercial and office buildings, consecutive numbering is used as the distribution board number by floor (DB1.1, DB1.2, DB1.3...).

The boards' markings must be correct before meters are installed. Newly installed metering equipment and its location of use are electronically exported to the head-end system and invoicing immediately after installation.

If the markings are missing or they are incomplete, boards are not metered and unnecessary visits are invoiced in accordance with the current price list of the distribution network operator.

If the order of the apartments is changed after the meters have been installed, the developer is obliged to notify the distribution network operator immediately. The costs of the change are charged from the developer.

2.3 Enclosure assembly

Meter enclosure assembly should be in accordance with the standard's enclosure requirements. When preparing for power metering, a single enclosure may be used, such as a 2-EK enclosure, in which all M2 metering stands are located under the same cover. Metering can also be located in the main distribution board.

It must be possible to open the power metering enclosure without tools, and the covers must be hinged. It must also include a reading window and the possibility to seal the cover.

A 16 mm² Cu equipment earthing conductor is brought into the meter enclosure and connected to the property's earth circuit connector.

2.4 Sealing

Boards, enclosures, junction boxes, fuse boxes, and so on, which contain unmeasured electricity for the consumer, must have the possibility of reliable sealing of the space.

Examples of such equipment and central components include:

- kWh and kVar meter covers
- control equipment
- instrument transformer enclosures
- meter terminal strip enclosures
- voltage fuse enclosures or single covers
- control fuse
- service main connector enclosure, main fuse enclosure and main switch enclosure.

The space to be sealed must not contain consumer installations such as PE and N busbar connections, and it is recommended that no cables are passed through these spaces to other parts of the board. Unsealing must always be notified before unsealing to OES Oy's metering services.

3. Meters, instrument transformers and tariff control devices

The network operator installs meters on the stands installed by the customer. The metering equipment is owned by the distribution network operator.

In time of day meters, the energy metering device works according to the standard on the cheaper side when the counting device is de-energised.

Register I more expensive time register (7 a.m. to 10 p.m.) Register II cheaper time register (10 p.m. to 7 a.m.)

The control of night loads takes place randomly between 10 p.m. and 11 p.m. In new meterings, customers are offered a customer interface (HAN-port) with an RJ12 connector.

3.1 Instrument transformer low voltage metering (0.4 kV)

The technical values of the current transformers are verified by the network manager's metering services based on the information provided to the network manager. (Main distribution board diagram). The accuracy class must be 0.2 s for current transformers.

Current transformers are selected as follows:

The load must be in the range (0.25…1.0) times the rated load of the current transformer. Normally, 1.5−2.5 VA current transformers are used.

A current transformer with a higher load capacity may be used if it can be shown to remain in the metering range in its class.

The conversion ratio of the current transformers is determined by the apparent power of the measuring object. The nominal value closest to the calculated value is selected as the current transformer. If an increase in power is expected in the near future, a hole current transformer with a higher nominal value is selected as the transformer, and the conversion ratio is changed by increasing the primary turn. The measured current should be in the range (0.2…1.2) times the primary current of the conversion ratio. The secondary current of current transformers is 5 A.

The converted conversion ratio is obtained by dividing the primary current stamped on the transformer's nameplate by the secondary current and by the number of conductors passing through the conductor hole.

The size of site survey current transformers is determined based on the main fuses on the site.

The instrument transformers are installed in such a way that the rating plates can be read when the equipment is energised. The current transformers are installed in the correct direction with regard to the direction of the power supply.

The earthing of instrument transformers is carried out in accordance with the SFS 2537 standard. Instrument transformers are not earthed in low voltage metering.

If a substantial change in the electricity consumption of the electricity user occurs, they must inform the metering services of the network operator so that the current transformers can be sized to match the load.

3.2 Medium voltage metering of instrument transformers (10 and 20 kV)

Three current transformers and three voltage transformers are used in the metering. A disconnector or high voltage fuses must not be used in the primary circuits of voltage transformers. Voltage transformers and electrical terminations must be located before the current transformers with regard to the direction of energy. When selecting instrument transformers, thermal and dynamic short circuit resistance must be ensured from the network company.

The accuracy class must be 0.2 s for current transformers and 0.2 for voltage transformers.

3.3 Measuring cell

When measuring the electricity consumption from the kJ side, the instrument transformers are installed in a separate measuring cell. The secondary current of current transformers is 5 A. The voltage transformers are single-phase, unipolar isolated, and they have a secondary voltage of 57.7 V.

Placing instrument transformers on the floor should be avoided. The structure of the switchgear must be designed so that the instrument transformers can be accessed without removing the circuit-breaker or its components. The instrument transformers are installed so that the junction boxes on the other side are easy to access. Therefore, the junction boxes must be located in the cell on the side of the maintenance corridor. Instrument transformers should be installed in such a way that their rating plates can be seen from the maintenance corridor.

The order of the voltage and current transformers must be as follows:

- main circuit breaker or fuse-switch-disconnector
- the customer's protective current transformers in all three stages
- the network operator's voltage transformers
- the network operator's current transformers
- the customer's other voltage and current transformers.

The contractor installs the attenuator resistor of the voltage transformers in the vicinity of the voltage transformers.

The cell must be clearly labelled (L1, L2, L3) in terms of phase sequence. The direction of the current must be marked on the busbars, unless it is otherwise clearly visible. In the measuring cell, the minimum depth of the free coupling space of the instrument transformers must be 500 mm. When installing the transformers, it must be ensured that the free air gaps are in accordance with the regulations.

3.4 Nominal load

The nominal load of the meters and wiring is about 1.0…4.0 VA/phase on the electric circuit and about 10 VA/phase on the voltage circuit.

Instrument transformers are selected so that the load on the metering equipment is (0.25…1.0) times the nominal load of the instrument transformer. Normally, 7.5–10 VA electric current transformers and 25 VA voltage transformers are used. If the above-mentioned operating load is not reached, the problem must be solved with a representative of OES Oy.

The conversion ratio of the current transformers is determined based on the apparent power of the object to be measured. The nominal value closest to the calculated value is selected as the current transformer. It is recommended that the current transformer has two primary current ranges. If the

apparent power of the electricity user changes, necessary measures must be taken to change the transformers to match the load. The electricity user is responsible for the cost of replacing the transformers.

4. Measuring circuit terminal strips and wiring

4.1 Measuring circuit protection

The metering circuits of indirect metering voltage are protected with a 3x10 A overload protector. In low voltage metering, the contractor installs the overload protectors in the current transformer enclosure or in a separate sealable central part near the transformer.

In medium voltage metering, the contractor or manufacturer installs overload protectors and terminal strips in a sealable enclosure in an easily accessible location, such as in the relay box section of the instrument transformer cell or outside the enclosure. Fuses are not permitted on the primary side of the voltage transformers or on the current measurement circuit.

4.2 Terminal strips

The contractor or manufacturer installs the terminal strips for all indirect metering. Indirect metering must use terminal strips, where the wiring is connected either by screw couplings or by spring-loaded (e.g. Wago 282) connectors. Terminal strips must be breakable and they must be equipped with 4 mm diameter “banana jacks” on both sides of the cut-off point.

The strips must also be connectable in parallel on the side of the instrument transformers.

In indirect metering, current and voltage conductors with a cross-sectional area of 2.5 mm² must be used, unless a larger cross-sectional area is required due to the conductor load, short-circuit resistance or voltage drop. The earthing electrode is 4 mm².

Instrument transformer type is selected in accordance with the requirements of the installation space and, if they are exposed to short-circuit currents and magnetic fields, the conductors of the voltage and current circuits shall be installed in separate metallic shielding pipes or troughs.

The terminal strips are installed in a sealable space in connection with the billing measurement. A working space of at least 50 mm must be reserved on the inlet and outlet side of the terminal strips. The terminal strips must be installed horizontally and numbered from left to right with numbers 1…n in accordance with the wiring diagrams.

Voltage and current circuits are separated with separating plates placed in the terminal strips. The chaining is connected to the inlet side of the terminal strip in such a way that opening the strip cuts off the connection to the meter control.

Electricity user devices are not allowed in the same measuring circuit as billing meters.