Appendix # 2
to the decision of the Board of Directors of IDGC of Centre, JSC
Minutes # 16/14 dated 14.07.2014

THE STANDARD

THE TECHNICAL POLICY ELECTRICITY METERING SYSTEMS WITH REMOTE DATA COLLECTION OF WHOLESALE AND RETAIL ELECTRICITY MARKETS IN THE DISTRIBUTION ELECTRIC GRID COMPLEX OF IDGC OF CENTRE, JSC

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THE CONTENTS

1. Scope of application

1.1. This «Standard. The Technical Policy. Electricity metering systems with remote data collection of wholesale and retail electricity markets in the distribution electric grid complex of IDGC of Centre, JSC» (hereinafter - the Standard) is an internal document of Interregional Distribution Grid Company of Centre, Joint-Stock Company (hereinafter - the Company) and is developed according to Federal laws and Governmental orders of the Russian Federation.

1.2. The purpose of the technical policy in the field of electricity metering systems with remote data collection of wholesale and retail electricity markets consists in maintenance of realisation of the concept of organisation of the commercial metering in the Company for perfection and development of systems of electricity metering of the electric grid complex with use of modern means of electricity metering, metering data collection and transmission, communication channels and software.

1.3. The Standard is intended for application by the executive office and branches of the Company at realisation of works on creation and operation of metering systems.

2. Standard references

The Standard is developed according to requirements of the current legislation of the Russian Federation. In this Standard requirements of the following regulatory documents are considered:

- Federal law «About electric power industry» from March, 26th of 2003 # 35-FZ;

- Federal law «About maintenance of unity of measurements» from June, 26th 2008 N 102-FZ;

- Federal law «About energy conservation and increase of power efficiency and about modification of separate acts of the Russian Federation" from November, 23rd 2009 N 261-FZ;

- The governmental order of the Russian Federation «About the approval of Rules of the wholesale market of electric energy and capacity and about modification of some acts of the Government of the Russian Federation concerning the organisation of functioning of the wholesale market of electric energy and capacity» from December, 27th, 2010 # 1172;

- The governmental order of the Russian Federation «About functioning of the retail markets of the electric energy, full and (or) partial restriction of a mode of consumption of electric energy» from May, 04th, 2012 # 442;

- The governmental order of the Russian Federation «About provision of utilities to

proprietors and users of premises in apartment houses» from May, 06th 2011 #354;

- the international standard IEC 61968-9 «Integration of applications into utility systems. System interfaces for management of distribution. Part 9. Interfaces for meter reading and management»;

- Electrical Installation Regulations edition 7, approved by Order of the Ministry of Energy of Russia from 20.06.2003 # 242.

- User Rules for Operating Electrical Equipment, approved by Order of the Ministry of Energy of Russia from 13.01.2003 # 6.

- Rules on safety at operation of electrical installations approved by Order of the Ministry of Labour of Russia from 24.07.2013 # 328n.

- GOST 7746-2001 «Current transformers. The general specifications»;

- GOST 1983-2001 «Voltage transformers. The general specifications»;

- GOST 31818.11-2012 General technical requirements to electric energy meters;

- GOST 31819.21-2012 Private technical requirements to static meters class 1 and 2;

- GOST 31819.22-2012 Private technical requirements to static meters class 0,2S and 0,5S;

- GOST 31819.23-2012 Private technical requirements to static reactive energy meters;

- IEC 62056-21 «Power consumption measurement. Data exchange for meter reading, control over tariffs and loading. Part 21. Direct data exchange at a site»;

- IEC 61107 «Data exchange at reading of indications of measuring devices and at control of tariffs and loading. Direct local information exchange»;

- GOST R IEC 61038-2001 «Electric energy metering. Tariff rating and load control. Special requirements to switches for timing»;

- SNiP 3.05.06-85 «Electrotechnical devices»;

- SNiP -III-4-80 «Safety precautions in building industry»;

- GOST R 51321.1-2007 «Low-voltage packaged devices for distribution and control. Part 1. Devices tested in full or in part. The general technical requirements and test methods»;

- GOST 14254-96 «Degrees of protection provided with shell structures (IP code)»;

- GOST 2.601-2006 «Uniform system of the design documentation. Operational documents»;

- GOST 12.2.007.0-75 «Occupational safety standards system. Electrotechnical products. The general safety requirements»;

- GOST 12.2.003-91 «Industrial Equipment. The general safety requirements»;

- GOST 12.3.002-75 «Occupational safety standards system. Industrial processes. The general safety requirements»;

- GOST 12.1.019-79 «Occupational Safety Standards. Electrical safety. The general requirements and the nomenclature of kinds of protection;

- GOST 12.1.030 - 81 «Occupational Safety Standards. Electrical safety. Protective grounding, neutral earthing»;

- GOST 12.1.038-82 «Occupational safety standards system. Electrical safety. Maximum permissible values of contact and current voltage»;

- GOST 12.1.004-91 «Occupational safety standards system. Fire safety. The general requirements»;

- RD 34.49.10187 «Instruction on designing of fire-prevention protection of power enterprises»;

- VSN - 01-87 «Fire protection regulations on designing nuclear stations»;

- GOST 12.1.003-83 «Occupational safety standards system. Noise. The general safety requirements»;

- GOST 12.1.023-80 «Occupational safety standards system. Noise. Methods of establishment of noise characteristics of stationary machines»;

- GOST 12.1.006-84 «Occupational safety standards system. Electromagnetic fields of radio frequencies. Admissible levels at workplaces and requirements to the monitoring procedure»;

- GOST 12.1.045-84 «Electrostatic fields. Admissible levels at workplaces and requirements to the monitoring procedure»;

- GOST 12.1.002-84 «Occupational Safety Standards. Electric fields of industrial

frequency. Admissible levels of intensity and requirement to the monitoring procedure at workplaces»;

- GOST 12.2.007.3-75 «Occupational safety standards system. Electrotechnical devices at over 1000 V. Safety requirements»;

- GOST 12.2.007.0-75 «Electrotechnical products. The general safety requirements»;

- GOST R ISO 7498-2-99 «Information technology. Open systems interconnection. Base reference model. Part 2. Architecture of information protection»;

- GOST 12.0.003-74 «Occupational safety standards system. Hazardous and harmful production factors. Classification»;

- GOST 12.1.012-2004 «Occupational safety standards system. Vibrating safety. The general requirements»;

- GOST 25980-83 «Vibration. Protection means. The nomenclature of parameters»;

- IEC 61000-4-3-95 (GOST R 51317.4.3-99) «Electromagnetic compatibility of equipment. Stability to a radio-frequency electromagnetic field. Requirements and test methods».

3. Terms, definitions, abbreviations

In the Standard the following terms and abbreviations are used:

Term/abbreviation	Definition/meaning
Data	Information from measuring instruments, represented in a formalized kind, suitable for transfer, interpretation or processing with participation of a person or automatic means.
Protection of information against unauthorized access	Measures directed on prevention of receipt of protected information by the third party with infringement of the rights or rules of access to the protected information established by legal documents or the proprietor (owner) of the information, performed at technical (hardware) level, including sealing sockets, functional modules, installation of hologrammes, hardware blocking, etc., and (or) at software level, including installation of a password for access.

Measurement	Set of operations on application of an instrument storing a unit of physical size, providing the relation determination (in an obvious or implicit kind) of the measured quantity with its unit and receiving the value of this size.
Information-measuring system (IIK)	Structurally incorporated or territorially localised set of electric energy metering devices, a current transformer and a voltage transformer (if necessary) and their communication lines.
Information and computation complex of an electrical installation (IVKE)	Set of functionally incorporated software, computing and other technical means for collection, diagnostics and information processing under electricity metering regarding measuring zone, and also maintenance of interfaces of access to this information.
Information and computation complex (IVK)	Set of functionally incorporated software, information and technical means, intended for diagnostics of conditions of measuring instruments and objects, collection, processing and storage of the measured data coming from IVKE and IIK, their aggregation, and also maintenance of interfaces of access to this information.
USPD (Controller)	A collection and data transmission device, a component of a system of electricity metering. It represents the last sealed up device in the structural logic scheme of data transmission "metering devices" - "USPD" - "top level system", USPD carries out data collection from metering devices (meters), their processing and storage, transfer of the saved up data to various systems of the top level.
Accuracy class	The generalised characteristic of the given type of measuring instruments, as a rule, reflecting level of their accuracy, expressed by limits of the supposed basic and complementary errors, and also other characteristics influencing the accuracy.
Measurement technique (MI)	Set of particularly described operations, which performance provides reception of measured data with the established indicators of accuracy.

Metrological characteristic of measuring instruments	The characteristic of one of properties of the measuring instrument influencing measured data and its error Notes: 1. For each type of measuring instruments the metrological characteristics are established. The metrological characteristics established by standard documents are named normalised metrological characteristics, and those defined experimentally – the valid metrological characteristics.
Company	The legal entity that performs the activity on transmission of electrical energy - IDGC of Centre, JSC.
Measuring instrument checking	Set of operations which are carried out with a view of acknowledgement of conformity of measuring instruments to established metrological requirements.
Measuring instrument calibration	Set of operations which are carried out with a view of definition of valid values of metrological characteristics of measuring instruments.
Electric substation (SS)	An electrical installation intended for receipt, transformation and distribution of electricity, consisting of transformers or other converters of electric energy, control devices, distribution and auxiliary devices.
Connection	The electric circuit (equipment and buses) for one purpose, name and voltage, connected to buses of a switching centre, a generator, a board, installation and being within an electrical installation limits. Electric circuits of different voltage of one power transformer (irrespective of number of windings), one dual-speed electric motor are considered as one connection. In mesh circuit, one-and-a-half and other ones all switches and buses by means of which this line or transformer are connected to buses of switchgear concern a connection of a line, a transformer.
System of universal time (SOEV)	Functionally incorporated set of software-hardware measuring instruments and time synchronisation in the given system with remote collection and transfer of indications of metering devices in which signals are formed and in succession transformed containing the quantitative information on the measured size of time. SOEV is a measuring instrument of time which carries out the complete function of measurements of time and has standardized metrological characteristics.

Measuring instrument (SI)	hardware intended for measurements of electric energy, having standardized metrological characteristics, reproducing and (or) storing a unit of physical value, the size of which is accepted invariable (within the established error).
An electric energy metering device	A device for definition of quantity of active and (or) the reactive electric energy which has passed through it in the given time interval to a place of electricity consumption.
Type of an electricity metering device	The term used for definition of a concrete design of the metering device, having similar metrological characteristics and constructive similarity of the elements defining these characteristics. The type of the electricity metering device can have some values of rated current and voltage;
Point of measurements	A location and connection point of devices of the commercial metering on an electrical network element, value of measurements of a quantity of power in which is used with a view of commercial metering.
Metering point	A location in the electrical network, defined in coordination with the subject of the retail market of electric power and used for formation of metering indicators with a view of commercial metering
A (voltage) current transformer	A transformer in which under normal conditions of application the secondary current (secondary voltage) is almost proportional to the primary current (primary voltage) and at correct switch-on it is shifted against it with a phase of an angle close to zero.
A device of synchronisation of system time (USSV)	A multipurpose device working in automode which should carry out synchronisation of time from an external reference source of time, maintenance (measurement) of system time and synchronisation of time of the software-hardware entering into the metering system, having with USSV interfaces of hardware and information interaction under the set regulations.
A metering box (board)	An electrotechnical box intended for enclosing of components of a system of electricity metering of industrial consumers, residential consumers, office and residential buildings in electrical AC grids of 380/220 V with 50 Hz frequency.

An electrical installation	Set of machines, devices, lines and accessory equipment (together with constructions and premises in which they are installed), intended for manufacture, transformation, conversion, transmission, distribution of electricity and its transformation to other kind of energy.
A power facility	A grid substation or an entrance switching centre on which the electric power metering will be set up.
ASDTU	An automated system of dispatching and technological management
AMI	An automated information-measuring system of commercial metering of electric power (AMR)
GP	A supplier of last resort
An automated workplace	An automated workplace
Distribution Zone	An area of electrical grids
MES	Transmission electrical grids
SSO	Adjacent grid organisation
CT	Current transformers
VT	Voltage transformers
Secondary Distribution Switchgear, SF6 insulated	Secondary Distribution Switchgear, SF6 insulated
ORE	The wholesale market of electric power
DPC	A data collection and processing centre
PU	A metering device
SUBD	Database management system
SW	Software
ZIP	Spare parts, tools, accessories
hardware	Components of a metering system

4. General provisions

The purpose of this Standard is definition of the basic directions and principles of the organisation of systems of electricity metering at the boundary point of electric grid facilities of the Company and adjacent subjects (consumers, grid organisations) of retail and wholesale markets of electric energy.

The local metering of electric power prevailing now in the retail market with use of both integral, and interval electricity metering devices does not allow to supervise effectively energy passage as a product on all its process cycle, operatively to solve problems of drawing up of balances of electric power and capacity for revealing losses at all grid facilities, to provide operative settlements and payments for the consumed energy and capacity, to optimise and predict power consumption, effectively to operate power consumption modes. Therefore systems of electricity metering are subject to stage-by-stage modernisation and replacement with new means and metering systems based on use of principles of automation of electricity metering.

The variety of means of electric energy metering offered by manufacturers, interfaces of communication and technologies of data transmission demands development of a uniform technical policy on selection and application of means of electricity metering for the purpose of an effective and full solution of problems of the metering in the balanced interests of all subjects and participants of electric power markets. Modernisation of systems of electricity metering should correspond also to recognised modern international norms and rules.

Main principles of the organisation of systems of electricity metering:

- Organisation of settlement systems of electricity metering at the boundary points in the Company’s electrical installations;

- Application of electronic "smart" electricity metering devices;

- Data collection and load control automation.

Systems of electricity metering should provide:

- information support at carrying out of mutual settlements between the Company and other subjects of the wholesale and retail markets regarding measurement of sizes of electric energy and power at the boundary points;

- formation of balances of electric power in the Company’s grids;

- definition of losses of electric power in the Company's grids;

- control over reliability of information on power consumption;

- power monitoring with use of metering devices as primary meters of operative information and data transmission to the Company's ASDTU systems;

- monitoring of parameters of electric power quality with remote signals in case of decrease in values of electric power below a permissible limit;

- remote control over a mode of full and (or) partial restriction of consumption of electric energy;

- possibility of forecasting of power consumption and management of power consumption modes.

Principles of the organisation of metering systems, technical and functional requirements to systems in whole and to their components, defined by this Standard, are subject to the further specification and development as a result of performance of research and design works, realisation of pilot projects for testing new technical solutions and technologies at the Company's facilities.

On the basis of the Standard a set of technical and methodical documents defining rules of application of technical requirements and solutions of the Standard at new construction, expansion, reconstruction and re-equipment (modernisation) of facilities of the Company should be developed.

5. The basic requirements to systems of electricity metering in the electric grid complex of the Company

5.1. The general requirements to a metering system

The system of electricity metering should be created at the boundary point between the Company and other subjects of the retail market of electric energy as a hierarchical, territorially distributed metering system of electric energy, providing an information exchange, management of its components and giving to subjects of the electric power industry, consumers of electric energy (capacity consumers) possibilities of reception of the information on results of the commercial metering of electric energy (capacity) with time binding.

In case of technical (technological) impossibility of installation of a metering system at the boundary point the metering system can be installed in places as much as possible approached to the boundary point.

Installation sites of metering devices depending on type of the consumer and the location of electric grid facilities (electrical installations/power receiving devices of consumers) are defined according to appendix 1 to this Standard.

The measuring system represents a set of metering devices and instrument transformers of current and (or) voltage, interconnected under a set scheme, through which such metering devices are connected (hereinafter - instrument transformers), intended for measurement of volume of electric energy (capacity) in one point of delivery.

The system of electricity metering represents a set of measuring systems connecting and computing components, devices of collection and data transmission, software, intended for measurement, storage, remote collection and transfer of indications of metering devices on one and more points of delivery.

The automated information-measuring system of commercial metering of electric power (AMI) should be created at the boundary point between the Company and other subjects of the wholesale market of electric energy as a hierarchical, territorially distributed system. In case of technical (technological) impossibility of installation of a metering system at the boundary point the metering system can be installed in places as much as possible approached to the boundary point.

At creation of AMI the grid organisation is obliged to provide equipment of points (groups of points) of delivery with metering devices and instrument transformers, and also components connected with collection, processing and transfer of indications of metering devices to a supplier of last resort, according to the requirements established by Rules of the wholesale market for subjects of the wholesale market and concerning organisation of the commercial metering of electric energy in specified points (groups of points) of delivery.

As a part of a system of electricity metering, the following subsystems can be allocated:

- Information-measuring system - IIK;
- Information and computing system of a power facility - IVKE;
- Information and computing system - IVK;
- System of maintenance of universal time.

At creation of a metering system of the retail market, it is allowed for AMI to set collection and transfer of indications of metering devices without application of the level of IVKE according to the design solution.

The Information and computing system of data collection and processing carries out functions of inquiry of metering data and the auxiliary information from IVKE or IIK, their validation, consolidation, storage, analysis and representation, and also the function of remote management of IIK.

IVK of data collection and processing should possess capability of information interaction with IVK of adjacent systems of commercial metering of electric power, set up independently and on platforms of various manufacturers, to provide joint processing and data analysis of electric energy metering, received from the metering systems of the wholesale and retail markets of electric power installed in controllable electrical grids with use of the uniform user program interface. A subsystem of IVK realising data exchange on based on the open international standard IEC 61968-9 should act as a basis of realisation of information interaction.

For newly created IVK it is preferable to:

- use a topological model of the electrical network (on the basis of CIM);

– have a graphic interface for formation of a model of the electrical network and work with the metering data;

– use a uniform system of identification of IIK in metering systems of all kinds.

5.2. The general requirements to organizational levels of a system of electricity metering and equipment structure

The spatially-distributed structure of arrangement of points of electricity metering in territories of the service area of the Company and the centralised data processing of electricity metering in IVK assume realisation of a hierarchical structure of electricity metering data collection. Such structure should provide collection and transmission of electricity metering data from metering devices to data collection and processing centres.

According to the general requirements to a metering system it is expedient to allocate the following organizational levels:

– Level of power facilities. All software-hardware of systems of electricity metering, installed at power facilities of the Company and subjects of the retail market, refer to the given level, including components of measuring channels, collection and information transfer devices, and also at its presence - a local centre of data collection and processing of electricity metering. At serviced power facilities at the given level also there can be organizational subdivisions providing operation of systems of electricity metering of a power facility.

– District level. It includes organizational subdivisions of electricity metering of the level of areas of distribution electrical grids (hereinafter - Distribution Zone). At the given level the organisation of an automated workplace for access to the data of electric energy metering and capacity from all power facilities for formation of balances on Distribution Zones is provided.

– Regional level. It includes organizational subdivisions of electricity metering of branches of IDGC of Centre, JSC (hereinafter the Branch) and the hardware-software complex of IVK maintained by them uniting the data of electric energy metering from all district levels within one subject of the Russian Federation. By means of the organisation of an information exchange between servers of enterprises of MES (Transmission Grid Companies) and the Company’s Branches reception of the summary information for formation of balances of electric power and capacity at the level of the subject of the

Russian Federation is provided. At the given level by means of conclusion of agreements on an information exchange questions of reception of the information from the adjacent grid organisations, generation and large customers should be settled. Organizational subdivisions of electricity metering with attraction of subdivisions of information technology and communications at the given level provide collection, storage and processing of the summary information.

– Top level. It includes organizational subdivisions of electricity metering, using automated workplaces for access to the data of the metering from all IVK within the service area of the Company. At the given level the single balance on territories in the service area of the Company is formed with the organisation of a centre of collection of corporate data. The organisation of a metering system and communication channels should allow users of the Company to have access to any level of the system.

5.3. The general requirements to IIK

All metering devices of electric energy, measuring instruments entering into IIK should be included in the list of the measuring instruments brought in the Federal information fund on maintenance of unity of measurements and admitted to application in the Russian Federation, correspond to the requirements established by this Standard, and have working certificates for calibration testing and set seals of the person having accreditation on the right of checking measuring instruments. Besides the design of elements of IIK should provide installation of seals of the Company.

In case of installation by an adjacent subject of the retail market (under his initiative and at his expense) of metering devices in the Company's electrical installations, the given metering devices are transferred by the subject to the Company with compensation of economically well-founded expenses incurred by the given person on designing, acquisition, installation and commissioning of the measuring instruments. The further service and operation is carried out by the Company or a person authorised by it.

At installation/replacement of metering devices at residential consumers remote collection and data transmission from metering devices by the Company should be set up with application of the following solutions depending on local conditions:

- At new construction - the account organisation at the boundary point with installation of entrance wires and lead-in and switching devices with which protection against unauthorized access to measuring instruments and not isolated current carrying parts of an electrical installation, located before measuring instruments, is provided.

- At modernisation of metering systems - removal of measuring instruments outside premises (private households) at the boundary point, including with application of remote-mount points of electricity metering or metering devices of electric energy equipped with a remote (outboard) for data display.

- At replacement of metering devices of electric energy inside premises - application of components of a system of electricity metering, providing measurement, access to measuring instruments by the Company or an authorised person, and also possibility of remote reading of metering devices of electric energy and load control of consumers.

In case of excess of the requirements established by this Standard to metering devices for residential customers established by standard legal acts, the Company has no right to demand from residential customers payment of installed metering devices in the size exceeding cost of metering devices, minimally satisfying such established by standard legal acts, requirements to metering devices in points of connection of power receiving devices of residential customers to the electrical grid. Collection of a payment for installed metering devices over the specified size is allowed only under condition of the consent of the residential customer.

The design of secondary circuits should allow to make sealing of terminals of secondary circuits of current and voltage, sealing switches in circuits of primary and secondary voltage of voltage transformers being on with impossibility of switching-off (including automatic) without destruction of seals and visual control marks. Connection of metering devices of transformer connection should be made with special terminals providing safe shorting of circuits of current and safe switching-off of voltage circuits at replacement and service of metering devices. Testing jigs should provide for their possibility of sealing not to allow access to secondary measuring circuits.

Installation of electricity metering devices and wiring to them should be performed according to the operational code for electrical installations requirements (the 7th edition).

The scheme of an information-measuring system of measuring instruments of electric energy some possibility of replacement of a metering device and connection of a reference meter should be provided without interrupting transmission of electrical energy through the grid elements in which the given information-measuring system is installed.

Use of intermediate current transformers for connection of a commercial meter (SI) is forbidden.

Accuracy classes and characteristics of measuring instruments should correspond to the requirements specified in table # 5.3.1

Table # 5.3.1

Object of measurements	Accuracy classes, not lower, for:		
	A metering device	Current	Voltage

	active energy metering	reactive energy metering	transformer	transformer
Objects of the network enterprises				
Power lines 220 kV and above	0,2S	0,5 (1,0)	0,2S	0,2
Power lines and lead-ins 35 - 110 kV	0,5S 0,2S*	1,0	0,5S 0,2S*	0,5 0,2*
Power lines and lead-ins 6 - 10 kV with the connected capacity 5 MW and more	0,5S	1,0	0,5S	0,5
Outgoing circuits and input 0,4 kV	0,5	1,0	0,5	-
Objects of consumers of electric energy				
Consumers with capacity 100 MW and more	0,2S*	0,5 (1,0)	0,2S*	0,2*
Consumers with capacity ≥of 670 kW (up to 100 MW)	0,5S	1,0	0,5S*	0,5
Consumers with capacity <670 kW at connection:				
– to grids 110 kV and above	0,5S	1,0	0,5S*	0,5
– to grids 6 – 35 kV	0,5S*	1,0	0,5S*	0,5
– to grids 0,4 (0,2) kV	1,0*	2,0	0,5	-
* - at new construction or modernisation.				

Note: the table presents minimum permissible requirements to accuracy classes of components of IIK, for increase of accuracy of measurements application of components of IIK with an accuracy class above the given values is allowed. For the purpose of observance of necessary sensitivity of IIK at work of a CT with small loadings (in a case when on conditions of electrodynamic and heat endurance a CT with overrated transformation ratio is used), it is allowed to use components of IIK, at which metrological characteristics are rated, for values of primary current from 1 % of rated value (with alphabetic identifier "S").

The operational documentation on components of IIK shall be executed in Russian.

Secondary circuits of current and voltage intended for electric energy metering, should have counter marks.

At connection of metering devices, application of skrutok and the ration in secondary circuits is not allowed.

5.4. Requirements to current transformers and to their secondary circuits

Current instrument transformers should be applied in grids of 6 kV and above as well as in grids of 0,4 kV when the measured current exceeds 60A, and connected capacity – more than 35 kW.

At construction of new and reconstruction of existing facilities it is necessary to apply the scheme of measurement with three CTs.

Measuring circuits for connection of metering devices are necessary to connect to a separate winding of the current transformer (the accuracy class is defined by table 5.3.1).

Schemes with built in current transformers whose design does not provide for carrying out of periodic metrological checks, it is allowed to apply only before reconstruction of electrical installations. At construction of new and reconstruction of existing facilities it is allowed to use built in current transformers, only if their design provides for carrying out of periodic metrological checks for the purpose of commercial metering of electric power.

On a condition of mechanical durability copper conductors with their section not less than 2,5 sq. mm should be applied. Application of aluminium conductors at new construction and reconstruction **is forbidden**. Total power of loadings of secondary circuits of measuring CTs should not exceed capacity of nominal secondary loadings of these transformers specified in the certificate of a CT.

Applied measuring CTs as for their technical requirements should correspond to GOST 7746-2001 «Current transformers. The general specifications».

A metering device can be connected to a measuring CT with the rated current smaller than the secondary rated current of the measuring CT at observance of the following conditions:

- the value of the maximum secondary current in an metering point should not exceed rated maximum current of the metering device, and duration of influence of the maximum secondary current – permissible duration of influence for the given type of the metering device;

- at minimum modes the current in a secondary winding of a CT should provide an accuracy class of secondary windings of the CT according to requirements of GOST 7746-2001 tab. 8.

At underloading additional loading resistors should be installed in secondary circuits of a CT.

Values of permissible accuracy classes of current transformers for each type of connections are presented in Table 5.3.1.

At new construction or reconstruction it is forbidden to connect any other measuring instruments, and also relay protection and automation to a secondary winding of a measuring CT to which a series circuit of a commercial metering device is connected. For existing metering systems, in the absence of secondary windings for connection of metering devices, it is allowed for joint connection of metering devices with measuring instruments at observance of load demand on secondary windings of the current transformer and protection of secondary circuits against unauthorized access.

Applied starting from 01.01.2015 electromagnetic current transformers should have weak residual saturation of flux density for what their iron circuits should be made from amorphous magnetically soft or nanocrystal alloys. In the presence of the corresponding feasibility report it is necessary to apply transformers on the basis of polarising optics (optical transformers), thus it is necessary to aspire to combination in a single current and voltage measurement unit (optical units).

For connection of electricity metering devices it is allowed to install additional current transformers on transmission lines of 110 kV and above at absence of secondary windings at the current transformer for connection of electricity metering devices, for maintenance of work of the electricity metering device in a demanded accuracy class, on loading conditions on secondary windings of the current transformer.

Terminal clips should provide safe shorting of secondary circuits of current transformers, switching-off of current circuits of the electricity metering device and volt circuits in each phase of the electricity metering device at its replacement or check, and also connection of a reference electric power meter without disconnection of wires and cables. The design of terminal clips of measuring circuits should provide for their protection against unauthorized access, including with use of measuring terminal boxes.

At new construction for the purpose of electric power metering it is necessary to provide application of separate current transformers with accuracy classes according to table 5.3.1. Use of built in current transformers is allowed on voltage above 110 kV and primary currents from above 300 A.

In order to avoid increase in inductive reactance of cores of cables it is necessary to perform interconnection wiring of secondary circuits of current transformers rings and bunch stranding so that the sum of currents of these circuits of each cable was equal to zero in any modes.

The calibration interval of current transformers should be at least 6 years.

With a view of application of modern solutions it is expedient to prioritize applied current transformers according to the following principles:

– installation of optical units (in the presence of a feasibility report), providing possibility of reception of digital measurements at the minimum volume of the occupied space at substations;

– installation of electromagnetic transformers as a stand-alone device;

– installation of electromagnetic current transformers built in fault interrupter switches (in the absence of available space in premises of a substation).

5.5. Requirements to voltage transformers and to their secondary circuits

Three-phase voltage transformers (VT) or single-phase transformers, installed in each of three phases, should be applied to power up volt circuits of measurement components of metering devices. It is allowed to use schemes with built in voltage transformers only before reconstruction of electrical installations. At construction of new and reconstruction of existing facilities it is forbidden to use built in voltage transformers for commercial metering of electric power. An exception is a VT, built in switchgear and control gear with gas-insulated insulation, hereinafter - Secondary Distribution Switchgear, SF6 insulated. At application of Secondary Distribution Switchgear, SF6 insulated, built in VTs should have possibility of carrying out of periodic metrological calibration.

Applied measuring VTs as for their technical characteristics should correspond to GOST 1983-2001 «Voltage transformers. The general specifications».

At new construction antiresonant transformers having measuring windings, proof to the resonance phenomenon, should be applied.

Values of permissible accuracy classes of voltage transformers for each type of connections are presented in Table 5.3.1.

Values of relative losses of voltage in lines of connection of metering devices to voltage transformers should be no more than 0,25 % of nominal secondary voltage for voltage transformers of accuracy classes of 0,2 and 0,5 and no more 0,5 % for voltage transformers of accuracy class 1,0. Section of connector wire in secondary volt circuits of a VT for billing and technical metering should be at least 1,5 sq. mm for copper. Application of aluminium conductors at new construction and reconstruction **is forbidden**.

In order to avoid increase in inductive reactance of cores of cables it is necessary to make interconnection wiring of secondary circuits of voltage transformers so that the sum of currents of these circuits of each cable was equal to zero in any modes.

The design of terminal clips of voltage transformers should provide their protection against unauthorized access.

Measuring VTs of all voltage classes should be protected from high voltage by corresponding fuses or protection switches. Thus the design of drives of the protection switches on the high voltage side of measuring VTs of billing metering should provide possibility of their sealing. The voltage transformers used only for metering and protected with fuses, should have control of integrity of the fuses.

At presence at a metering facility of several busbars and connection of each measuring VT to a corresponding separate busbar there should be a device for switching of circuits of metering devices of each connection to a measuring VT of a corresponding busbar provided.

At underload in secondary circuits VT additional loading resistors should be installed.

The calibration interval of voltage transformers should be at least 6 years.

5.6. Requirements to electricity metering devices

5.6.1 The general requirements to electricity metering devices

Universal requirements

Multipurpose "smart" measuring instruments are allowed to be installed for commercial metering, the term of state checking of which has not expired. Technical parameters and metrological characteristics of metering devices should correspond to requirements of GOST R 52320-2005 Part 11 «Meters of electric energy», GOST R 52323-2005 Part 22 «Static active energy meters of accuracy classes 0,2S and 0,5S», GOST R 52322-2005 Part 21 «Static active energy meters of accuracy classes 1 and 2» (for reactive energy - GOST R 52425−2005 «Static reactive energy meters»), IEC62056-21.

Since January, 1st, 2014 according to Orders of Rosstandart from November 22, 2012 №1035-st, №1036-st, №1037, №1038-st, №1039-st interstate standards (GOST) on the general and private requirements to electricity metering devices are introduced. Effect of the standards covers only newly developed metering devices or on modernised ones including after January 1, 2014.

The list of introduced and cancelled standards is given in table 2.6.1.1.

Table 2.6.1.1.

Item #	**Standards introduced**	**Standards cancelled**	**Object of standardization**
	GOST 31818.11-2012	GOST R 52320-2005	The general technical requirements to electric energy meters.
	GOST 31819.21-2012	GOST R 52322-2005	Private technical requirements to static meters class 1 and 2.
	GOST 31819.22-2012	GOST R 52323-2005	Private technical requirements to static meters class 0,2S and 0,5S.
	GOST 31819.23-2012	GOST R 52425-2005	Private technical requirements to static reactive energy meters.

For display of indications and supervision over the functioning indicator, the electric energy metering device should be equipped with a built in display and-or with remote (portable) display.

Devices of electric energy metering should provide measurement of consumed electric energy within limits of rated errors during all service life of the metering device. A non-volatile memory unit should provide storage of programmed parameters of the metering device and preservation of metering data at power interruption.

The information on the display of the electric energy metering device should be displayed in Russian and include the current meter reading, the current tariff, indication of an operable state of the metering device, indication of cases of intervention in work and emergency events. Display of units of measure is allowed to be made in the international system of SI units. Indication backlighting should be provided. The detailed differentiated requirements to metering devices are given in table 5.6.1.2.

The electric energy metering device should function normally not later than in 5 seconds after feeding with rated voltage to clips of the metering device. Protection of metering data and parameters of electric energy metering devices from unauthorized access (an electronic seal of the case and terminal cover of the electric energy metering device, a password, hardware blocking, a hologramme) should be provided. In the electric energy metering device control over correctness of connection of measuring circuits should be provided. Protection against unauthorized access should be executed at the technical (hardware) and software level.

As protection against influence of magnet fields (of various nature) on elements of the electric energy metering device should be provided. Magnet field influence should be recorded in the "log of events":

- date and time of the beginning of an event;

- date and time of the end of an event.

The functioning indicator should be visible from the display side of the metering device.

The electric energy metering device should have:

1) a built in calendar;
2) an optical port, with a data communications protocol corresponding to IEC 61107,
3) for maintenance of remote transfer of all registration and service data, one of the following interfaces of communications to be in place: GPRS, CAN, PLC, RF, RS-485 or Ethernet. The given interface should not coincide with the interface under item 2);

4) three-phase metering devices of semi-indirect or indirect connection (except for residential customers) should have an additional physical and/or logic interface providing their connection to a network of data collection and transfer to ASDTU;
5) a multitariff menu (tariff zones should be programmable);
6) a built in clock (accuracy of the built in clock rate should correspond to requirements of GOST R IEC 61038-2001 in the temperature range from minus 40 to +60°C and have capability of automatic adjustment).
7) the functioning temperature range according to the declared technical characteristics within from -40 to $+60^0$C.
8) the calibration interval, both for single-phase and three-phase metering devices should make be at least 10 years.
9) average operating time of metering devices until failure at least 100 000 hours.
10) term of operation of a battery built in the electric energy metering device at least 10 years.
11) term of operation at least 20 years.

The speed of transmission of data of metering devices should be defined by standard specifications of applied interfaces of communication.

Devices of electric energy metering should provide electric power measurement by an accruing result and calculation of average capacity for hourly time intervals.

Each installed billing metering device should have on the screws, fixing the case to the metering device, a seal with a brand of a state verification officer, and on the tightening cover - the Company's seal.

Metering devices making measurements in two directions of electric energy flow are applied to performance of measurements in metering points with a reversive mode of operation of a distribution circuit (hereinafter – reversive metering devices).

Table 5.6.1.2

The differentiated requirements

Parameter	**Single-phase metering device**	**Three-phase metering device of direct connection**	**Three-phase metering device of semi-indirect connection**	**Three-phase metering device of indirect connection**
Operating voltages	230V	3x230/400V	3x230/400V Universal connection	3x57,7/100V Universal connection
Operating currents	At In=5A Imax ≥60A; At In=10A Imax ≥100A	At I_n=5A I_{max} ≥60A; At I_n=10A I_{max} ≥100A	At I_n=1A I_{max} ≥2A; At I_n=5A I_{max} ≥7,5A	At I_n=1A I_{max} ≥2A; At I_n=5A I_{max} ≥7,5A
Backup power supply, from any voltage in a voltage range	-	option, 12-230V	option, 12-230V	12-230V
Load control mode	a built in relay	a built in relay	control signal	control signal
Isolated discrete input	-	-	2 isolated with 24V internal power supply	2 isolated with 24V internal power supply
Isolated discrete output	-	-	2	2
Power consumption - shunt circuits - series circuits - built in communication modules	- no more than 2,0 W (10 VA) - no more than 0,3 VA - no more than 3 W	- no more than 6 W (30 VA) - no more than 0,9 VA - no more than 3 W	- no more than 6 W (30 VA) - no more than 0,9 VA - no more than 3 W	- no more than 6 W (30 VA) - no more than 0,9 VA - no more than 3 W

Parameter	**Single-phase metering device**	**Three-phase metering device of direct connection**	**Three-phase metering device of semi-indirect connection**	**Three-phase metering device of indirect connection**
Measurement of quality of electric energy (informative parameter)	steady-state voltage deviation; frequency deviation.	steady-state voltage deviation; frequency deviation.	steady-state voltage deviation; frequency deviation..	steady-state voltage deviation; frequency deviation. duration of voltage dip; depth of voltage dip; duration of surge voltage
Measured and calculated parameters in real time mode	- phase voltage; - phase current; - active power; - reactive power; - apparent power; - power factor; - current in the neutral lead; - current unbalance in phase and zero wires; - power frequency	- voltage on each phase; - current on each phase; - active power, total and on each phase; - reactive power, total and on each phase; - apparent power, total and on each phase; - power factor total and on each phase; - power frequency	- voltage on each phase; - current on each phase; - active power, total and on each phase; - reactive power, total and on each phase; - apparent power, total and on each phase; - power factor total and on each phase; - power frequency	- voltage on each phase; - current on each phase; - active power, total and on each phase; - reactive power, total and on each phase; - apparent power, total and on each phase; - power factor total

Parameter	**Single-phase metering device**	**Three-phase metering device of direct connection**	**Three-phase metering device of semi-indirect connection**	**Three-phase metering device of indirect connection**
				and on each phase; - power frequency
Galvanically isolated interfaces of communication	-	-	One	Two
Internal power supply of circuits of the interface	- for use as part of a system of remote data collection			

5.6.2 Requirements to functions of electricity metering devices

Installed metering devices of electric energy should provide possibility of data storage of the commercial metering and formation of a load curve with programmable integration time from 1 till 60 minutes for active power.

The metering device, in cases of occurrence of emergency situations (unauthorized intervention), should have possibility to represent itself as the initiator of communication with the level of IVKE or IVK.

Devices of electric energy metering participating in billing in the wholesale market of electric energy should correspond to requirements of the Wholesale Electricity Market and provide storage of a load curve according to the Rules of the wholesale market for subjects of the wholesale market and concerning the organisation of the commercial metering of electric energy in the specified points (groups of points) of delivery.

Devices of electric energy metering participating in billing in the retail market of electric energy should provide storage of:

– a load curve with a 60 minute interval in depth at least for 123 days;

– data on active and reactive electric energy with an accruing result for the last month, including in the direct and return directions, programmed parameters - at least for 3 years;

– daily values in depth at least for 120 days.

Devices of electric energy metering without possibility of measurement of the basic values of the electric energy quality were allowed to be installed until 31.12.2014. The number of supported tariffs by the metering device (differentiated by day zones) should be at least 4.

Devices of electric energy metering should provide logging «events» with the correct time stamp (not fewer than 100 log entries). The metering device should provide self-diagnostic function.

Function of remote restriction/switching-off of loading by means of an external command signal should be provided.

The log of events of metering devices should record:

– date and time of a terminal cover opening;

– date and time of opening of the case of a metering device;

– date of last reprogramming;

– current flow changes in phase conductors;

– date and time of magnetic influence above permitted standard;

– change of current values of time and date at time synchronisation;

– change of a value of parameters of quality of electric energy;

– loss of voltage in the presence of current in measuring circuits;

– emergencies.

5.6.3 Requirements to connection of electricity metering devices

At organisation and performance of work for installation and adjustment of electrotechnical devices the requirements of SNiP 3.05.06-85, SNiP-III-4-80, state standards, specifications, «Rules for technical maintenance of electrical installations of consumers» (chapters 1.2; 1.3; 1.4; 2.4), «Operational Code for Electrical Installations» (chapters 1.7; 1.5; 2.1 and 3.4) should be observed.

Assembly and installation works (including concerning measuring and information circuits) are made only with the disconnected power supply. At the kinds of works specified above the safety measures excluding unauthorized connection of power supply to the product should be provided.

It is necessary to perform connection of metering devices, used for formation of balance of electric energy and power, taking into account their operation in the following modes:

- "receiving" - the flow of power (energy) directed to buses of that voltage class, to a VT of which volt circuits of a meter are connected;

- "returning" - the flow of power (energy) directed from buses of that voltage class, to a VT of which volt circuits of a meter are connected.

Accuracy classes of metering devices, CTs, VTs being a part of measuring systems considering quantity of electric energy at "receiving" and "returning" should be identical.

Connection of a metering device at the "returning" mode can be made by reversing current on I1 windings of the current transformer in relation to the direction of current on input current terminals of the meter.

5.7. Requirements to cases (boxes) of electric energy metering

Metering cases should correspond to the obligatory requirements established by GOST R 51321.1, to provide degree of protection against penetration of water and foreign objects in accordance with GOST 14254-96 of at least IP 54.

The following kinds of contact clips (hereinafter clips) for connection of external conductors should be provided in cases:

- clips for connection of zero working N conductors of power and group circuits;

- clips for connection of zero protective PE conductors or PEN conductors of power and group grids.

The case design should allow taking visual reading of a metering device without opening it, viewing all indications and other parameters displayed on the metering device as well as impact the automatic switch located after the metering device. Doors should open at an angle providing convenient access to devices, clips at installation and the case servicing.

5.8. Requirements to an electric energy metering system with remote data collection

The metering system of electric energy with remote collection and transfer of readings of metering devices should provide:

- performance in the points of delivery of measurements of hourly increments of active and reactive electric energy characterising volumes of supply (transmission) of electric energy;

- remote collection with the set periodicity of the measurement data and their storage in a database within 3,5 years with periodic backing up on external data carriers;

- remote collection of indications from all controlled IIK of electric energy at the single moment of time, including under a command of the operator;

- control over completeness and volume of the collected information from all controlled IIK;

- diagnostics of functioning of hardware and software;

- configuration and adjustment of parameters of performance of measurements and other actions, including in a remote mode;

- keeping up of a universal timing system, development of current time with accuracy of no more than ±5 seconds a day;

- automatic granting of measured data to adjacent subjects of the retail market, and also subjects of operational and supervisory management (in the presence of corresponding conditions in contracts or agreements);

- measurement of values of quality of electric energy;

- calculation of all necessary indicators of power consumption, possibility of change in process of work of structure and quantity of considered parameters, and mechanisms of their calculation as well.

5.8.1 Requirements to IVKE

IVKE (controller) should perform the following functions:

1. Intermediate collection, transfer and-or storage of electricity metering data;

2. Granting of digital interfaces of access to metering devices;

3. Data transmission to IVK under own initiative and initiative of IVK with use of constantly accessible communication channels;

4. Automatic changeover between the basic and reserve communication channels.

Formats and data communications protocols of IVKE should be open, universal and allow to use them as a part of hardware-software complexes of various developers. At data transmission their protection against unauthorized access should be provided.

Applied IVKE should maintain interfaces of communications with metering devices.

IVKE should have data transmission possibility in various hardware-software complexes for their further processing and storage, including simultaneous transfer.

Newly installed after 01.01.2015 IVKE should provide automatic search of metering devices and connection while polling, and at organisation of the IVKE level at a 6 (10) kV transformer substation also have additional a physical and/ or logic interface providing their connection in a network of data collection and transfer to ASDTU.

Protection of IVKE against unauthorized access should be carried out both at the hardware level (sealing of sockets, functional modules, etc.), and at the software level (access to data and possibility of change of parameters of adjustment of IVKE should be provided only at password entering).

Local parameter setting up of IVKE should be carried out only at removal of a mechanical seal and password entering, thus in the «Log of events» this event should be automatically fixed with date and time stamps.

Remote parameter setting up of IVKE should be carried out only via a protected communication channel at obligatory entering of the password, thus in the «Log of events» this event should be automatically fixed with date and time stamps.

IVKE should have a self-diagnostic test with result fixing in the «Log of events» and external indication.

IVKE should have a monitoring system of deadlock with a subsequent restart. IVKE should have industrial execution and be intended for continuous functioning in premises with the raised hazard, with installation possibility in the limited spaces (in boxes, compartments, panels, etc.) and also provide for convenience of maintenance service.

IVKE should provide automatic correction (synchronisation) of time of served metering devices of electric energy.

Supply voltage of IVKE from the AC/DC mains should be 220V with tolerance limits within ± 20%. Power consumption of IVKE, with a full set of electronic modules, should not exceed 100 W. Cooling of IVKE should be carried out with natural convection. IVKE should provide working capacity in a temperature range according to operating conditions.

IVKE should be executed in a single case. Design of IVKE should allow to place it both on standard panels, and in specialised boxes.

IVKE should provide safe operation, both in public networks, and in private communication networks, including with use of a protected VPN channel with encryption coding.

5.8.2 Requirements to IVK

5.8.2.1 The general requirements to IVK

The Information and computing system of data collection and processing (IVK) should make automatic, under set regulations, data collection of electricity metering, power consumption parameters, parameters of quality of electric energy and information on incidents in communication channels from all IVKE or electricity metering devices (in the absence of IVKE), and also transfer of control commands to smart electricity metering devices.

The software of an information and computing system complex should have the russified interface of the user (including auxiliary and service functions).

IVK of data collection and processing should provide possibility of information interaction with IVK adjacent and-or subordinate systems of commercial metering of electric power on the basis of the open international standard IEC 61968-9, installed independently and on platforms of various manufacturers. IVK should possess capabilities of information interaction with automated systems of adjacent subjects to the Company.

For unification of software platforms and decrease in expenses for operation and support, it is desirable for IVK of the retail market to provide in full realisation of requirements to hardware-software complex of IVK to AMI systems of the wholesale market of electric power. In this case, a uniform software platform of IVK should provide functionality on consolidation and management of resources of data storage of all types, necessary both at the retail and wholesale markets of electric power.

5.8.2.2 Requirements to functions of IVK

The Information and computing system of data collection and processing should provide for:

- Information exchange with adjacent subjects of the retail market of electric power on the basis of open international standard IEC 61968-9;

- Correction of clock rate of elements of a system (DB server, microprocessor-based metering devices and other devices) by means of a module of the reference time receiving the information on exact time from authentic sources (network time, GPS, GLONASS);

- Formation of balances of electric power at substations;

- Accumulation of registration values of physical sizes in a database of the centre of data collection and processing (DPC) at least for last 3,5 years with possibility of subsequent not limited on storage life long-term archiving.

- Possibility of group management of metering devices for drawing up of balances, consolidation and aggregation of information, drawing up of reports and other analytical purposes in the absence of restrictions on quantity of channels of direct measurements included in a group and possibility of encapsulation of groups without restrictions on enclosure level;

- On demand of the operator displaying information on a measurement point (group of points) for visual control of parameters of measured values on the screen of the monitor of an automated workplace;

- Information transfer to remote customers with use of standard channel-forming equipments in public networks, such as the Internet;

- Automatic logging of significant events registered by metering devices/controller on facts of their occurrence;

- Control over completeness and reliability of information collected from all controlled IIK;

- Group configuration/parameter setting up (management) of metering devices and IVKE of various manufacturers with grouping on any attribute of an object;

- Formation of various kinds of reports: for a day, a month, any way chosen period, on one channel or a group of channels. Reports should represent the information in a tabular and (or) graphic form and allow to make also analytical data processing on the chosen measuring channels (statistics) with subsequent printing out;

- Provision of protection against unauthorized access to IVK at the hardware and software levels;

- Diagnosis testing of working capacity of equipment and communication lines;

- Granting of control access to measured data on demand;

- A system of software security, constructed on the basis of accounts of users and roles defining a list of actions which the user can perform in the system, and the system administrator should have capability, if necessary, to create/change/remove a role, to expand and narrow the list of roles of the user;

- Possibility of use of domain users registered in Active Directory for authorisation in a system of accounts;

- Possibility of restriction of access of users to knots of hierarchy of metering facilities;

- Possibility of contextual search of IIK under number of a metering device, the name of a customer, a supply centre and other features;

- Possibility of maintaining registers of metering points, characteristics of customers (Surname, given name, patronymic, the address, number of the connection contract, personal account number), storage of history of contracts, replacements of metering devices and instrument transformers, maintaining registers of documents (certificates of check of a metering device, information on calibration of a metering device, contracts of connection of customers etc.);

- Possibility of storage of typical load (consumption) curves, replacement of missing data on current consumption;

- Automatic formation and sending by means of e-mail of measured data in developed patterns to adjacent systems.

- Reception of hourly values of active and reactive power on demand;

- Formation of reports containing the information about total (for a day, a month) values of consumed active and reactive energy by tariff zones with fixing of date and time of reading of metering devices;

- Formation of a file of the information on registered by metering devices electrical grid parameters;

- Data acquisition about phasing change: a failure date and time;

- Creation of vectograms of connections of metering devices;

- Reception of date/time of initialization of a metering device, date/time of last dump, number of dumps;

- Reception of a signal of unauthorized intervention;

- Reception of system parameters of a metering device.

- Possibility of expansion of normative-reference information by creation of new attributes of objects and directories, using built in means, without attraction of a developer,

and the number of attributes and directories should not be limited at the software level, the user should have possibility of definition of connections between directories;

- Possibility of creation of hierarchies of metering facilities, at performance of the following conditions:

- hierarchies are created by users having the corresponding rights, with application of means of the software exclusively built in the main interface, without attraction of developers;
- the quantity of hierarchies is not limited;
- the quantity of levels of each hierarchy is defined by the user;
- hierarchies can be created on the basis of attributes of objects and directories, including, created by the user.

- The following functions of creation of reports and notification:

- manual and automatic (under the schedule) creation and sending of reports, by e-mail;
- sending by electronic mail/SMS notifications at approach of certain events (absence in the system of data on current consumption, deviation of parameters of consumption over the set limits, approach of events connected with emergency and unplanned situations, registered by the metering device);
- mechanisms of visual and sound notification of users built in the main interface.

- Possibility of export of data in formats MS Excel, Adobe Acrobat, XML, HTML, CSV;

- Possibility of work with the majority of known DB types, at least, with Microsoft SQL Server and ORACLE, the software supplier should have a confirmed experience of realisation of projects with use of specified DB types;

- Backing up of a database either at the software level, or with built in means of a used DB with capability of maintenance, at the further development of the system, of automatic changeover between servers (in "hot" mode);

- In a system there should be possibility provided for increasing of hardware without removal from uninterruptible service of components of the system at change of quantity of metering points as part of the system.

5.8.3 Requirements to communication channels

At remote metering data collection data transmission should be carried out via communication channels providing data collection and exchange with standard interfaces and data communications protocols of "inquiry-response" type in automatic and in automated (on demand) modes.

The communication channels intended for information transfer should provide steady connections between devices of metering systems.

Technical realisation of communication channels and used data communications protocols should provide data transmission of the billing metering from the bottom level to top with the maximum time delay not exceeding 50% from an interval of data collection in automode.

At definition of types of communication channels in each specific case it is necessary to start with a territorial arrangement of metering subjects and objects and the maximum use of own telecommunication communications. Ranging of communication channels on their usage priority ranking at new construction and reconstruction of metering systems are presented in table 5.8.3.

Table 5.8.3

Object of metering	Communication channels							
	IIK-IVKE (IVK)					IVKE-IVK		
	RS-485	PLC	Ethernet	RF*	GPRS	GPRS	Ethernet	RS-485
SS 35 kV and above	2	-	1	3	4	3	1	2
TS 6,10 kV	2	3	1	4	5	1	-	-
Apartment house	2	3	1	4	5	2	1	-
Private household	-	1	-	2	3	2	1	-

* the concept «RF» includes the channels realised in not licensed range of radio frequencies, including with protocols ZigBee, BlueTooth and so forth.

Necessity of the reserve communication channel and the choice of one of channels as the core should be made at a development cycle of the project of remote data collection of electricity metering, proceeding from a cycle of polling and volume of transferred data. Thus it is necessary to provide reservation of communication channels between IVK and IIK if the source of time synchronisation is at the IVK level.

Detailed requirements to communication facilities and communication channels should be established in specifications and technical requirements on projects of the organisation of remote metering data collection.

5.8.4 Requirements to modes of remote data collection of electricity metering

It is necessary to make remote collection and transfer of readings of metering devices to one and more points of delivery according to the set regulations of polling (with time stamps and regulated events), and also by separate single inquiries to the metering device and Controller with instructions of concrete type of the required data.

Possibility of the general access (to all metering devices) and individual (to the allocated meter) should be provided.

In the absence of communication channels it is allowed to use devices of local collection (a control panel, a portable computer, etc.) with the subsequent loading of the collected data to the top level IVK DB for data collection.

At the IVK level some possibility of automatic remote metering data transmission should be provided to all interested parties participating in commercial and (or) technological turnover of electric power on metering subjects (objects). At formation of metering databases some possibility of use of replacing information according to the set regulations of polling should be provided.

5.8.5 Requirements to used interfaces and data communications protocols

Data collection and transmission devices should have possibility of information gathering from metering devices, transfer to a higher level, networking with other devices via digital interface RS-485, RS-232, etc., and also possibility to access some Ethernet network and a programmable IP-address.

For connection of devices with digital interfaces cables intended for industrial networks, constructed according to the standard EIARS-485, RS-422 should be used. It is forbidden to apply cables with an unshielded twisted pair. Cables should be laid with use of interface splitters. At the cable line laying outside premises, it should be protected with a lightning protection device on two sides. It is not allowed to lay cables of digital interfaces and power cables together. Metering devices and IVK should have open standard data communications protocols on all digital interfaces, corresponding to the standard IEC 62056 (DLMS/COSEM). They should be full and consistent, allowing experts to realise these protocols, with the text description in Russian.

Protocols of the same type of the metering device, but different in versions and (or) year of manufacture, should be compatible, i.e. later version of the protocol (and software supporting it) should be operable with metering devices of earlier manufacture years.

Formats and data communications protocols of all subsystems of AMI and systems of electricity metering should be open, universal and allow to use them as a part of hardware-software complexes of various developers.

Top level IVK of AMI and metering systems should transfer the metering data to adjacent subjects of the retail market in the unified data communications protocol. Transport level of data exchange is to organise on the basis of using SOAP WEB – services.

Data exchange of IVK with subordinated/adjacent AMI and metering systems of the retail market should be organised on the basis of the protocol corresponding to the standard IEC 61968-9.

Requirements to realisation of the data communications protocol on the basis of IEC 61968-9

The protocol realisation should provide bidirectional data exchange:

- data transmission of measurements and events from a subordinate to the operating system at the initiative of a source and reading on demand;
- end-to-end load control;
- end-to-end management of tariff plans;
- end-to-end management of configurations of metering devices and IVKE;
- synchronisation of normative-reference information;
- data transmission of events in volume accessible in the subordinated system.

Interaction of systems should be organised on the basis of web services.

Requirements to realisation of PLC protocol

- modulation type - OFDM;
- operating frequency band: 35,9 … 90,6 KHz;

Requirements to the organisation of web services

- use of SOAP protocol of version 1.2 as a transport protocol;

- use of HTTP, HTTPS, direct TCP, as communication medium.

5.8.6 Requirements to the software

The software of the applied equipment should be sufficient for realisation of all functions, and also have means for the organisation of all demanded processes of data processing, SW should represent set of the software providing together with hardware solution of all realised tasks.

SW should have a modular structure: each function should be realised by means of one or several modules, and changes brought in any of modules, should not limit performance of their functions by other modules.

In the software of top level integration of functions of billing and technical metering, aggregation of IIK data of commercial and technical metering should be provided.

The software complex of top level should carry out functions of metering data collection, accumulation, storage, processing, display, documenting and distribution of this data, synchronisation of clock rate of metering devices.

The storage period of IVK data should be at least 3,5 years.

Uniform qualifiers of objects of a database should be used, allowing to fix replacement of metering devices in metering points, to set modes of their polling, to provide correctness of data and parameters read out from metering devices and placed in the base, and also continuity and completeness of the data in the base.

The software should have the russified user interface (including auxiliary and service functions).

Diagnostic messages, messages on cases of unauthorized intervention, and also the reports of information, which are given out in the course of work of programs, should be unified.

The applied software of top level of the system generally should provide the solution of the following set of tasks:

- commercial tasks - maintenance of settlememts for supplied/consumed energy between subjects of the energy market (in the long term) for a settlement period;
- tasks of operative control of energy and power on metering points and objects;

- balancing tasks – maintenance of calculation of operative balances of energy and power for each metering object and subject;
- tasks of general losses - definition of actual balancing losses of electric energy and power for metering objects and subjects;
- tasks of technical losses calculation - maintenance of calculation of actual losses of electric power in power transformers and lines;
- restriction and regulation tasks - maintenance of restriction of consumption of energy and power and active load management of consumers-regulators;
- engineering control tasks - maintenance of control over the technical condition of components of a system of electricity metering;
- forecasting tasks – tasks of short-term, intermediate term and long-term forecasting of power generation/consumption for each metering subject.

Possibility of solving commercial tasks with the periodicity corresponding to a size of the billing period, established by a standard legal act or a contract, and also a working tariff system with taking into account of multiple tariffs by periods of days and nights should be provided.

Licence agreements on software use should be termless.

5.8.7 The organisation of information exchange with retailers and consumers

Consumers and (or) their representatives (including retailers) have the right of access to metering devices for readings in the presence of representatives of the Company or in an order and in cases established by contracts of services rendering for transmission of electric power. The admission of persons is carried out according to the Occupational Safety Rules at Electric Installations Operation. Between subjects of the electric power retail market an agreement can be entered into on the information metering devices data exchange procedure, which should comprise a collection and information transfer scheme, a format and terms and conditions of the information exchange, and also persons responsible for operation of metering devices.

6. The order of control over realisation of commercial metering of electric power

Primary acceptance of measuring instruments and schemes of their connection to billing, periodic or off-schedule, including under the demand of consumers, maintenance service should be accompanied by instrument check from the Company. Any tool intervention in work of a billing instrument involves removal and replacement before installed indicating seals, which is without fail is recorded by the Company's personnel.

In the presence of not executed ordering instructions to the consumer about necessity of bringing electricity metering to requirements of normative and technical certificates, or at detection of signs of such necessity during acceptance, and also at revealing of threat of occurrence or signs of non-metered power consumption, measuring instruments to billing are not admitted. A corresponding mark is made about it in the instrument check certificate.

The personnel of branches of the Company carries out control over the condition of billing metering devices, which are both on the Company's balance, and on the balance of consumers. Along with it control over the presence of seals of the state verification of measuring instruments, and also sealing of metering circuits and metering devices with indicating seals is carried out. Responsibility for timely metrological calibration of metering devices of electric energy is assigned to proprietors of metering devices of electric energy. Representatives of retailers should be invited for participation in joint checks of the technical condition and metrological characteristics of billing measuring instruments of electric energy.

Each electricity metering device should have an inscription specifying the name of connection on which the electric power metering is made. It is allowed to make the inscription on a panel near to the metering device if it is possible unambiguously to define the inscription belonging to each electricity metering device.

7. Metrological assurance

Metrological assurance of the condition and application of measuring instruments, observance of obligatory requirements in the state regulation sphere is carried out by federal executive authorities and metrological services of legal bodies.

Metrological assurance of electricity metering should be carried out:

- at a design stage - allocation in projects of metrological sections with calculations and estimations of limiting errors of elements and IIK as a whole;

- at a stage of manufacturing of electricity metering devices - carrying out of the

state acceptance and state control tests;

- while in service – periodic checking of measuring instruments of the billing metering of electric power and calibration of measuring instruments of the technical metering of electric power.

Elements of IIK are subject to obligatory metrological control.

Elements of IIK (a CT, a VT, electricity metering devices) should be confirmed as types of measuring instruments, entered into the Federal information fund on assurance of unity of measurements. Elements of IIK of the commercial metering should have seals of a verification officer and-or working certificates on calibration.

Each installed IIK for the billing metering should have a certificate-report signed from the grid company and the consumer. In case of replacement of measuring instruments, which are a part of measuring systems, the corresponding information is entered into in the certificate-report of IIK.

Calculation of losses at discrepancy of a point of measurements and delivery points is carried out according to the current legislation of the Russian Federation.

8. Requirements to operation

Operating conditions of the equipment of metering systems should correspond to the requirements specified in the operational documentation on hardware. The warranty period of normal operation of metering devices of electric energy, communication and data collection and transmission equipment - entering into a metering system should be at least 60 months. Term of operation of electricity metering devices should be at least 24 years.

The scope, structure and mode of operation of personnel should be defined depending on the structure of hardware and software, and also problems being solved.

The personnel should provide correctness of functioning of all hardware and perform all work to service and immediate restoration of working capacity of the equipment.

Operation and restoration of working capacity of equipment of IIK and automated data collection should be made by replacement of modules from compound components out of spare parts.

During designing, installation and commissioning of hardware for metering systems training and certification of service staff should be provided.

8.1. Requirements to the operational documentation

The operational documentation on IIK should correspond to GOST 2.601-2006 and contain the following information:

- the list of measuring instruments as a part of an information-measuring system with indication of their nominal parameters and accuracy classes;

- connection diagramme of an electricity metering device, a CT and a VT;

- a certificate-report;

- certificates on equipment of IIK;

- one-line diagramme of connection to the external electrical grid, co-ordinated with the proprietor or other lawful owner of grid facilities to whom the applicant or third parties are technologically connected, whose interests he represents, with indication of names and voltage levels of buses of external substations, supposed groups of points of delivery, places of connection of commercial metering devices, instrument voltage transformers and boundary points certified by representatives of adjacent owners of electrical grids;

- data on maximum load and installed transformer capacity;

- initial data, technique and results of calculation of limits of total relative error of measuring instruments.

8.2. Requirements to safety

Components of a system of electricity metering under requirements of human protection from electric shock should belong to class 1 and be executed according to GOST 12.2.007-0-75.

Hardware at installation, adjustment, service and repair should correspond to the general safety requirements in accordance with GOST 12.2.003 and GOST 12.3.002, and also:

- regarding electrical safety - GOST 12.1.019, GOST 12.1.030, GOST 12.1.038, GOST 12.2.007.0-75;

- regarding fire safety - GOST 12.1.004, RD 34.49.10187, VSN - 01-87,

- regarding noise created at work - GOST 12.1.003, GOST 12.1.023,

- regarding electromagnetic fields of radio frequencies created at work - GOST 12.1.006, electrostatic fields - GOST 12.1.045, industrial frequency electric fields - GOST 12.1.002;

CTs and VTs in operation should correspond to safety requirements in accordance with GOST 12.2.007.3-75 and GOST 12.2.007.0-75. One of lead terminals of secondary windings of a CT and VT should be earthed.

Regarding data exchange protection between open systems, hardware is executed according to GOST R ISO 7498-2-99.

In served premises of hardware and at automated workplaces of the personnel dangerous and harmful production factors should be limited in accordance with GOST 12.0.003, including:

- levels of electromagnetic, electrostatic and electric fields accordingly - GOST 12.1.006, GOST 12.1.045, GOST 12.1.002;

- levels of acoustic noise - GOST 12.1.006;

- vibration levels - GOST 12.1.012, GOST 25980.

8.3. Requirements to electromagnetic compatibility

All hardware should be compatible with the norms on noise stability, established by IEC 61000-4-3:1995 for maintenance of normal functioning in electromagnetic environment.

8.4. Requirements to pilot operation.

At pilot operation the conformity of installed equipment and software to these technical requirements is checked, and also performance by components of a metering system of the properties and functions declared by the manufacturer. Successful polling is reception of the information from 95% of metering devices (daily polling, monthly polling). Incident is understood as an event breaking normal functioning of a system, and not allowing successfully to realise one or several of the declared functions.

Criteria of successful completion of pilot operation:

automatic daily collection of values saved up for a day and from the beginning of a month of energy totally and separately under all tariffs - no more than 0,5% of cases of unsuccessful polling;

automatic monthly collection of values of active power averaged for a passed 30 minute interval - no more than 0,5% of cases of unsuccessful polling;

automatic collection of records of logs of events of metering devices - no more than 0,5% of cases of unsuccessful polling for a day;

remote (from a workplace of the operator) management (restriction, switching-off) of consumption loading on each connection equipped with metering devices, entering into the automated system - no more than 0,5% of cases of unsuccessful actions (without taking into account the condition of communication channels);

remote (from a workplace of the operator) setting up parameters of metering devices and their groups - no more than 0,5% of cases of unsuccessful actions (without taking into account the condition of communication channels);

stable operation of elements of the automated system – as much as possible permissible number of faults and failures of elements of the automated system – no more than 0,5% from total modules entering into its structure (servers, metering devices, communication equipment) during a pilot operation;

the quantity of metering devices, data from which were not received by remote polling within a reporting month (excepting cases of failure of a metering device), Controller, a server, % from the total number of metering devices - no more than 0,1%;

average time of elimination of the cause of incident (failure) from the moment of incident occurrence (no more than 4 hours);

the quantity of incidents which have caused unauthorized, or made with infringement of the established order, restriction and (or) load shedding, except for incorrect actions of the personnel of the Customer – no more than 2% in the first month of a pilot operation.

8.5. Acceptance procedures of work and kinds of tests

Before putting equipment of IIK, IVKE, IVK and SOEV in constant operation the following kinds of tests should be performed:

preliminary;

pilot operation;

acceptance.

Preliminary tests should be performed for definition of degree of working capacity and the decision of acceptance possibility to a pilot operation.

The pilot operation should be performed for the purpose of revealing of features of functioning of a system and definition of necessity of completion or correction of separate realised design solutions.

The system acceptance tests should be performed for the purpose of definition of its conformity to requirements of the technical project for its creation and finding out of possibility of putting it in constant operation.

Stage-by-stage carrying out of acceptance tests is allowed.

9. Realisation of a technical policy

The list of measures on realisation of the Technical policy:

Carrying out of comparative tests and the analysis of operation of electricity metering devices (three-phase and single-phase electronic metering devices with digital interfaces, elements of automation of metering systems corresponding to them and software). At the analysis of the specified devices first of all it is necessary to investigate accuracy questions in all loading range, reliability, electromagnetic compatibility, information and telecommunication characteristics (standard, open and high-speed interfaces and protocols).

- On the basis of the Standard about the technical policy to develop technical solutions on the organisation of metering systems and to carry out according to these projects modernisation of working metering systems (their fragments) or creation of new metering systems.

- On the basis of a complex of typical technical solutions for corporate computer networks (communication channels) to develop projects on creation/modernization of computer networks and, in case of need, to execute according to these projects modernisation of working networks (their fragments, including communication channels) or creation new for data collection and transmission at all levels of a metering system with remote data collection in automode.

- It is not allowed to use equipment, technologies, materials and systems which did not pass when due hereunder certification on conformity to requirements of the Standard, not having experience of realisation in the Company or having negative responses.

- To perform pilot installation of metering systems corresponding to the Standard about the technical policy, and also new and improved samples only by results of trial testing of the equipment for at least 6 months at a pilot site in the following scope:

– for grids 0,4 (0,2) kV - from 1 000 metering points to 5 000 metering points;

– for grids 10 kV - from 20 to 70 metering points;

– for grids 35 kV and above - from 5 to 15 metering points.

- Introduction of practice of constant perfection of management of realisation of the technical policy in the area of electricity metering systems with remote data collection; an objective estimation of results of realisation of the technical policy.

- Introduction of practice of technical and economic justification of application of new systems and devices of automation for electric energy metering;

- On the basis of the Standard about the technical policy to update an order of planning and performance of work on creation (modernisation) of systems of electricity metering, including performance of programs of perspective development of systems of electricity metering in the distribution electric grid complex at the electric power retail market.

10. Management of the technical policy

10.1. The basic policy management methods

Timely actualisation of the technical policy and programs of development of metering systems of the Company should be provided for management of the technical policy, coordination of work to develop and implement new equipment and technologies aimed to increase efficiency of functioning of systems of electricity metering, decrease in costs of its operation and work reliability improvement in the Company in the conditions of constant development of technologies, the state policy of stimulation of innovative activity and development of electric power markets.

The Company constantly conducts monitoring of development of technologies, allocates prospects and priorities, and sets tasks for suppliers of solutions proceeding from requirements of the Company.

The Company carries out:

- organizational-methodical management of development of new equipment and technologies for setting up electricity metering;

- development of offers on perfection of structure of works, allocation of priority directions and tasks;

- examination of offers on development and implementation of new equipment and technologies;

- analysis of performance of works on development of new equipment and technologies and preparation of corresponding conclusions and offers;

- preparation of offers on perspective researches and development, pilot projects and new normative and technical documents in the field of electric power metering.

The Company on the basis of new technologies, engineering solutions, taking into account financial possibilities, should make decisions on their implementation, reflected in the technical policy and concrete guideline documents.

10.2. The program of scientific and experimental works

The basic directions of the program of scientific and experimental works consist in the following:

- development of methodical recommendations on technical and economic justification to application of new systems and automation devices in grids;

- development of new principles and technical solutions for metering systems for the purpose of maintenance of timely and full data collection about electric energy consumption, increase of accuracy of the metering, improvement in reliability of metering systems;

- development of new principles of operative revealing of centres of losses;

- carrying out of technical and organizational actions for decrease in losses of electric energy in the Company's grids;

- perfection of information support and communication hardware;

- development of perspective solutions on perfection of service of metering systems.

10.3. Perfection of designing of systems of electricity metering

Perfection of design and research activity is based on the following principles:

- ensurance of safety in projects at work performance at grid facilities of the Company;

- application in projects of progressive technical solutions, electric equipment, designs and materials;

- improvement of quality of designing and reduction of terms of performance of the design documentation owing to automation of design works (creation of an automated design engineering system of metering systems), use of quality management system of design production according to requirements of the international standard ISO 9001-2001;

- organisation of examination of design production;
- maximum use of typical design solutions at work performance.

10.4. Indicators of progressiveness of technical solutions and technologies for perspective development of systems of electricity metering

Functional and technological indicators of progressiveness of systems of electricity metering consist in the following:

- automation of the process of remote data collection, calculation of balances and electric power losses;
- compactness of the equipment and modularity execution with high-scale of operational compatibility;
- absence of necessity of constant staff to be at metering facilities;
- application of methods and diagnostic tools of the equipment without its switching off;
- metering error of active electric power no more than 0,5%.

The following refers to economic indicators:

- automation of electricity metering;
- minimisation of expenses for service;
- decrease in losses of electric power with increase of metering accuracy;
- decrease in quantity of the duplicating equipment at facilities.

APPENDIX # 1
to STO BP 7/02-02/2014

TYPICAL INSTALLATION SITES OF METERING DEVICES OF ELECTRIC ENERGY

The target of creation/modernization of the metering is the organisation of the settlement electricity metering at the boundary point of balance participation (POD) in distribution circuits of the Company and consumer equipment (adjacent grid organisation). In case of absence of technical possibility and (or) economic feasibility of installation of measuring instruments on the border of balance participation of subjects of the retail market it is allowed to have a temporary (before moving the metering point on POD) variant of the organisation/modernization of systems in other points of a distribution circuit, under condition of their least remoteness from border of balance participation. In this case the billing meter should have the function of pre-calculation of technological losses of electricity according to conditions of the running contract. In case of absence of possibility of metering of technological losses directly by an electric energy meter, the amount of technological losses is defined according to actual regulatory legal acts (Main provisions of electricity retail markets functioning and/or by the technique of performance of measurements of electric energy certified in accordance with the established procedure). The procedure of calculation of technological losses from a point of delivery to a point of measurements should be defined in the contract on rendering services for electrical energy transmission and the power supply contract (purchase and sale of electric energy) and provide for a change of amount of losses at a deviation of actual consumption from contractual values.

At creation/modernization of the technical electricity metering in the Company's networks first of all it is necessary to provide balancing of distribution circuits 10 - 0,4 kV, balancing of sections of distribution circuit 35 kV (and above) with a considerable quantity of the connected consumers with services for electricity transmission (substations of 35 kV and above of adjacent subjects of the market), balancing of structural divisions of the Company and definition of volumes of electricity flow between voltage levels by means of installation of the interval electricity metering on a secondary voltage level.

At creation/modernization of systems of the electricity metering the requirements of Federal law dated from November, 23rd, 2009 «About energy conservation and about increase of energy efficiency and about modification of separate acts of the Russian Federation» #261–FZ should be fulfilled.

1 For substations 35, 110 kV

For convenience of operation of meters it is recommended to install test cable sealing boxes on one panel with meters. At configuration of installation locations of metering devices it is necessary to consider ensuring convenience of installation and operation.

If POD is on the customer substation side (SS), then high-voltage metering points are applied to set up metering.

2 Transformer Substations 6-10/0,4kV

For protection of meters and switching equipment against mechanical impacts and unauthorised access it is recommended to install them in boxes. The boxes are mounted taking into account the convenience to access, install and operate meters. Depending on installation environmental conditions, boxes are equipped with means for maintenance of the temperatures necessary for normal operation of the equipment.

If POD is on the customer HV transformer substation side (TS), then high-voltage metering points are applied to set up metering.

3 Metering on overhead lines 110, 35, 10-6 kV

For protection of meters and switching equipment against mechanical impacts and unauthorised access it is recommended to install them in boxes. The boxes are mounted taking into account the convenience to access, install and operate meters. Depending on installation environmental conditions, boxes are equipped with means for maintenance of the temperatures necessary for normal operation of the equipment.

Billing measuring instruments of electric energy between subjects of the electric energy retail market should be installed on POD (Fig. 1 variants 1,3).

If POD is at Customer SS, TS, Switchgear (SWG) (Fig. 1 variant 3) the electricity metering will be set up with the use of portable (including high-voltage) commercial metering points.

In case of absence of technical possibility and (or) economic feasibility of installation of measuring devices on POD, it is allowed to have a temporary installation in other points of a network, under condition of their least remoteness from border of balance participation (Fig. 1 variants 2,4,5,6).

Checking metering devices of electric energy should be installed at SS, Distribution Substation if the billing metering device is located on POD, passing on the customer side (Fig. 1 variant 7).

4 Bypass and bus-tie (sectionalizing) switches

On bypass and bus-tie (sectionalizing) switches used as bypass switches, for connections, having commercial metering, settlement measuring instruments of electric energy (Fig. 2) should be installed. In other cases the measuring instruments installed on bypass and bus-tie (sectionalizing) switches, are used for technical metering (Fig. 3).

5 Incoming line sections in multiroom houses and office buildings

For protection of meters and switching equipment against mechanical impacts and unauthorised access it is recommended to install them in boxes. The boxes are mounted taking into account the convenience to access, install and operate meters. Depending on installation environmental conditions, boxes are equipped with means for maintenance of the temperatures necessary for normal operation of the equipment.

For apartment houses it is necessary to equip without fail incoming line sections (ILS) with electricity metering (including with use of portable commercial metering points) (Fig. 4), thus the installed meter should have capability of the automated collection of metering data. If intrahouse networks of an apartment house are on balance of the grid company, entrance bushings in the apartment house are equipped with technical metering devices (Fig. 5, Variant 2), the settlement metering will be set up in points of delivery of electricity to consumers (Fig. 4, Variant 1). If intrahouse networks of an apartment house are on balance of proprietors of individual premises the settlement metering will be set up on incoming line sections in a multiroom apartment house, and also in points of delivery of electricity in each individual premise taking into account metering requirements and features of their setup defined according to Federal law dated from November, 23rd, 2009 «About energy conservation and about increase of energy efficiency and about modification of separate acts of the Russian Federation» #261–FZ (Fig. 4).

At presence in an inhabited apartment house of uninhabited premises the separate metering of the consumed electricity for such premises is provided.

The installed metering should have capability of the setup of the automated collection of metering data.

6 ILS of private home ownerships and legal entities 0,4 (0,2) kV

For citizens - consumers of electric energy living in private home ownerships, metering devices are installed on POD, on incoming line section in the house, including with application of portable metering points.

For legal persons - consumers of electric energy metering devices are installed on POD, including with application of portable metering points or metering devices of electric energy equipped with the remote (portable) display for information viewing.

7 Technical metering

At facilities of the Company the technical metering of active and reactive energy it is necessary to set up at SS 35, 110 kV on entrance bushings of medium and low voltage of power transformers, on each outgoing circuit of 6 kV and above voltage, which is on the Company's balance. Besides, depending on network topology, for the purpose of balancing of sections of distribution circuits it is necessary to set up the metering on the Company's feeders (Transformer Substation, Distribution Transformer Substation, Distribution Substation etc.).

7.1 Utility (auxiliary) transformers

On utility transformer (UT) devices of electricity metering are installed, corresponding to the requirements specified for the commercial metering of electric energy.

The metering should be set up on HV utility transformer side (Fig. 6, variant 1). In case of absence of technical possibility and (or) economic feasibility of installation of measuring devices on HV utility transformer side, it is allowed to install them on LV utility transformer side (Fig. 6 variant 2) with application of the function of pre-calculation of technical losses of electric energy.

7.2 Entrance bushings of transformers

Measuring instruments of electric energy, installed on entrance bushings of transformers, can be temporarily used as metering ones, in a case:

- absence of meters on POD, passing on the line section "Company-Consumer", for example, Variants 1, 2 Fig. 7;

- if the Company's substation feeds one connected consumer, for example, Variants 1, 2 Fig. 8;
- if the line 6-10 kV feeding the Company's TS is on balance of an outside organisation (Fig. 7, Variant 1).

Measuring instruments of electric energy, installed on entrance bushings of transformers of SS of regional distribution grid companies, can be used as technical metering devices, in a case when on POD, passing through entrance bushings of a line, settlement meters are installed (Fig. 9).

7.3 Noncommercial feeders

Measuring devices of electricity are installed at noncommercial feeders for the setup of technical metering. The meter installation location is defined taking into account metering technical capabilities and (or) economic feasibility.

7.4 Flows between SAC and within borders of the Company

With a view of performance of the requirements shown to AMI in the wholesale market of electric power it is necessary, at the boundary points in which points (group of points) of delivery are located, with whose use a supplier of last resort buys electric energy in the wholesale market, serving consumers, whose power installations are connected to electric grid facilities of the Company, to provide equipment of such points (groups of points) of delivery with metering devices and instrument transformers, and also the components connected with collection, processing and transfer of readings of metering devices to the supplier of last resort, according to the requirements established by the Rules of the wholesale market for subjects of the wholesale market and concerning organisation of the commercial metering of electric energy in specified points (groups of points) of delivery.

For provision of full observability of the data about electricity flows within borders of the Company (between Distribution Zones) it is necessary to set up collection, processing and storage of technical data on increments of electric energy flows used for control over commercial information reliability, update of a settlement model and for solving other industrial tasks.

Electricity measuring devices for the set up of metering are installed on any side of a line through which the flow goes. The meter installation location is defined taking into account metering technical capabilities and (or) economic feasibility.

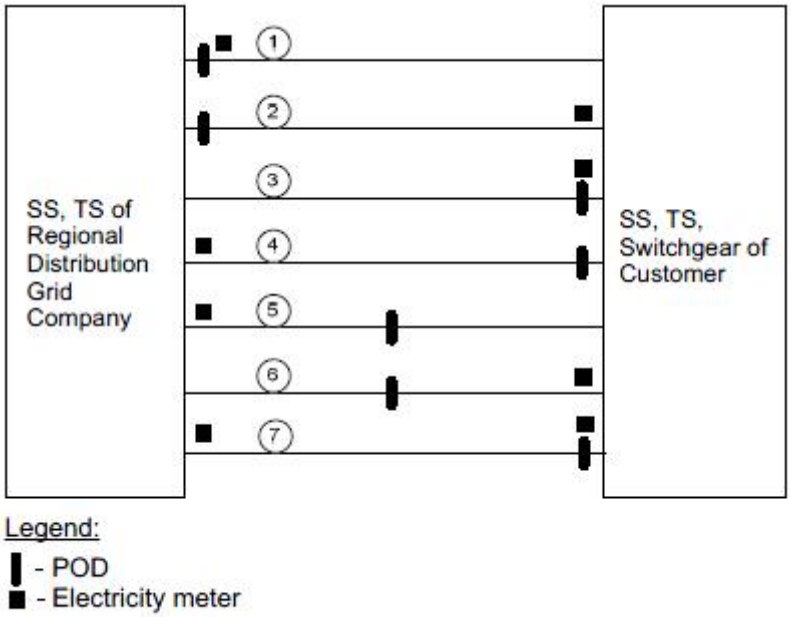
SS, TS of Regional Distribution Grid Company
SS, TS, Switchgear of Customer
1
2
3
4
5
6
7
Legend:
- POD
- Electricity meter

Fig. 1

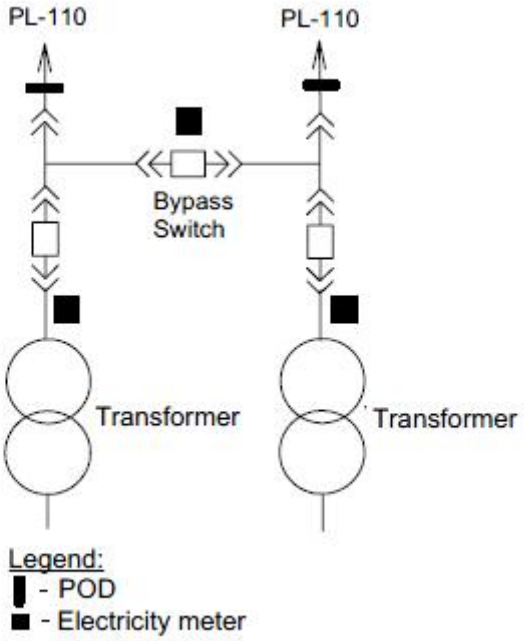
PL-110
PL-110
Bypass Switch
Transformer
Transformer
Legend:
- POD
- Electricity meter

Fig. 2.

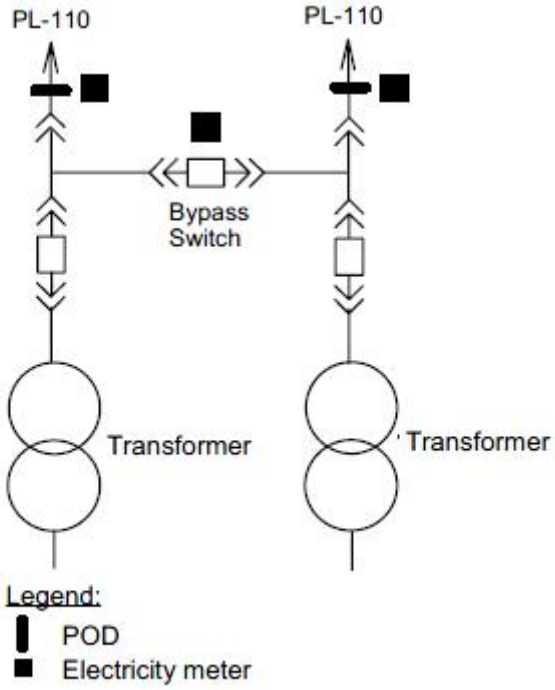
PL-110
PL-110
Bypass
Switch
Transformer
Transformer
Legend:
POD
Electricity meter

Fig. 3.

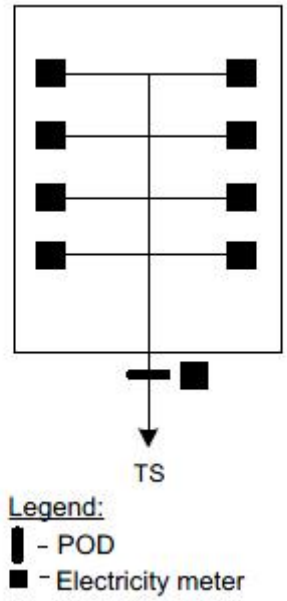
TS
Legend:
- POD
- Electricity meter

Fig. 4

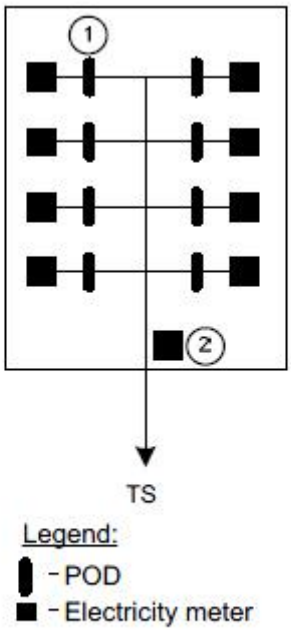
1
2
TS
Legend:
- POD
- Electricity meter

Fig. 5

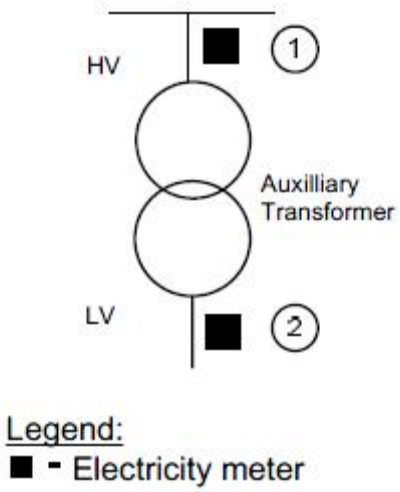
HV
1
Auxilliary
Transformer
LV
2
Legend:
- Electricity meter

Fig. 6.

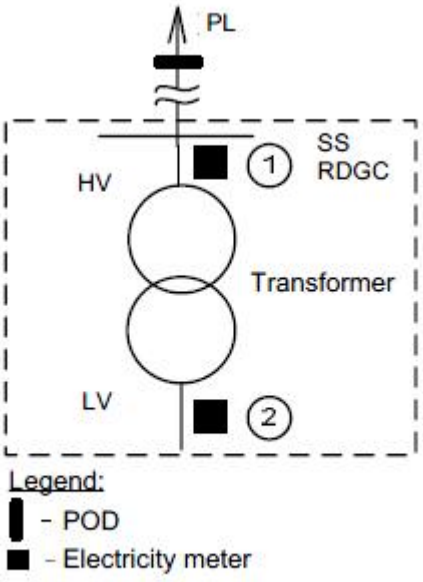
PL
SS
RDGC
1
HV
Transformer
LV
2
Legend:
- POD
- Electricity meter

Fig. 7

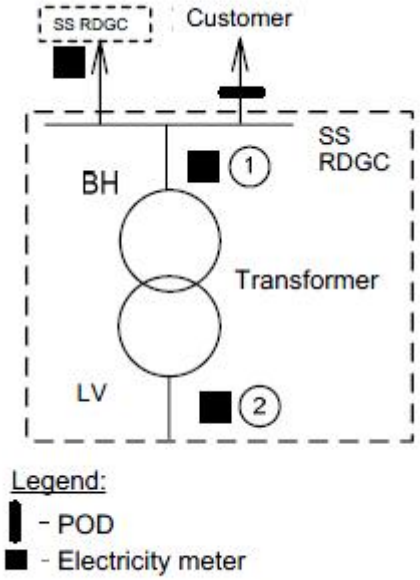
SS RDGC
Customer
SS
RDGC
1
BH
Transformer
LV
2
Legend:
- POD
- Electricity meter

Fig. 8

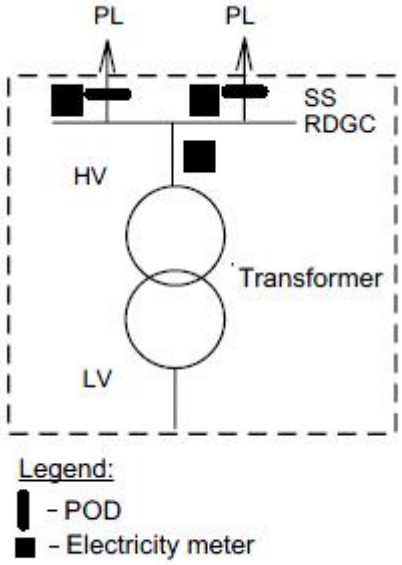
PL
PL
SS
RDGC
HV
Transformer
LV
Legend:
- POD
- Electricity meter

Fig. 9

APPENDIX # 2
to STO BP 7/02-02/2014

The record of changes and additions

Serial number of change / additions	Item of change / addition	Contents of change (addition)	Reason (reference t organizational and executive documentation)	Date of entering of change / additio	Surname, initials, post of the employee who has mad changes (additions)	Signature of the employee who has made changes (additions)