TRANSMISSION SYSTEM DEPARTMENT/
MEASUREMENTS AND INSTRUMENTS SECTION   **May 2011**

TECHNICAL SPECIFICATION TMO-1105-MHE

ELECTRICAL ENERGY ELECTRONIC METERS
ACCURACY CLASS 0,2S & 0,5S

A. GENERAL TECHNICAL REQUIREMENTS

1. According to the Description of the Table of Materials and Quantities of the Inquiry, the meters will be electronic for indoor application and suitable for the measurement of large quantities of electrical energy of unbalanced load, for the following connection types:
   - Electronic three-phase, 3-element / 4-wire active (kWh) and reactive (kVarh) energy meters of unbalanced load.
   - Electronic three-phase, 2-element / 3-wire active (kWh) and reactive (kVarh) energy meter, of unbalanced load.
   - Electronic one-phase, 1-element / 2-wire active (kWh) and reactive (kVarh) energy meters.

2. The accuracy of the meters must be of class 0,2S or 0,5S (as required) for the active energy (kWh) according to EN/IEC 62053-22 and 0,5 or 1 respectively for the reactive energy (kVarh).
   There must be the possibility of the error adjustment by ± 0,1%, for a load from 5% to 120%.
   For both cases (0,2S and 0,5S), the accuracy classes must comply with the influence quantities referred to the Table 6 of the paragraph 8.2 of the EN/IEC 62053-22 standard.

3. The meters must be suitable for the measurement of large quantities of electrical energy for a period of more than 20 years in medium, high and ultra high voltage networks in Transmission Substations, International Interconnections, Power Generation Plants, Industrial Consumers, Self-Producers and Independent Power Producers. For this purpose and for the accurate measurement of energy peaks, the instantaneous values of the voltage and the current per phase should be multiplied to form the instantaneous values of the power per phase, which should be integrated over an integration interval not bigger than 0,25 sec.

4. Upon the delivery, each energy meter must be accompanied by a test protocol issued by the production factory's testing laboratory, which must be accredited according to EN ISO / IEC 17025 by an internationally recognized competent authority.
   Each test protocol should include the accuracy tests and the power frequency voltage insulation tests for class 0,2S and 0,5S meters (3-element or 2-element). Test protocols should contain at least measurements for 2% In at cosφ=0,5 and 10% In at

cosφ=0,25. For reactive energy test protocols should contain at least measurements for 10%In sinφ=0,25.

The manufacturer will have to be able to provide a statistical summary over the whole batch, including an analysis of the measurement deviation for the starting load point over the whole batch.

Actual test protocols as above must be submitted, as samples, together with the technical offer.

5. All the energy meters will have to measure automatically the incoming and outgoing energy, in two directions kWh and KVarh in four quadrants (± A , ± Ri , ± Rc).

These six (6) measured quantities plus two (2) for losses, i.e. eight (8) available registers, will have to be saved into a respective load profile and be transmitted via the corresponding pulse output contacts (at least eight (8)).

Additionally, the meters shall be capable of measuring the apparent energy in two directions (± S), the total harmonic distortion of active energy in two directions (± THD), the active and reactive copper losses, the active and reactive iron losses, the total active energy losses in two directions and the total reactive energy losses in two directions.

6. Integration periods of 1, 3, 5, 10, 15, 30 and 60 minutes must be available for selection. At the end of the integration period, the content of the total energy of registers will have to be stored in the load profile. The measured values that are captured in the load profile should have to be selected by parameterization.

Diagnostic registers like instantaneous voltages per phase (primary and secondary), instantaneous currents per phase (primary and secondary), active power, network frequency, import and export last average power factor, all as average values over the selected integration period, should be also available for selection.

7. There should be an internal calendar clock for generating the date and time information, for:
   - the display of date and time on the LCD of the meter
   - controlling the time switch for tariff switching
   - the time stamping in the load profile, event logs etc
   - the formation of the integration period of the load profile

It should be possible to set the date and time on the meter remotely via the Central System and locally via the optical port of the meter.

The accuracy of the calendar clock at 23° C should be < 5 ppm according to EN/IEC 62054-21.

For keeping securely the date and time data, the meter should be equipped with a super-capacitor with back-up power for more than 15 days and an exchangeable battery with back-up power with lifetime of at least 10 years.

The access to the battery should be controlled (e.g. via sealing), but it should be easily and safely replaceable from the front side of the meter, without disassembling the meter or opening its main cover.

8. Capabilities of the time switch:
   - used for the tariff's control
   - for creation of day tables, week / season tables and special day tables (for more than 50 special days)
   - defined according to DLMS (EN/IEC 62056)

9. The meter will have to be provided with:
   - a digital LC – display, for displaying the measured values (KWh, KVarh) in 8 digits and 6 digits for the measured values identification code according to OBIS EN/IEC 62056-61 (DLMS)
   - two (2) LEDs for signalling imp/KWh and imp/KVarh, for meter's testing purposes
   - one (1) LED and a change-over contact for signalling alarms like :

- missing voltage in every phase
- current without voltage in every phase
- missing auxiliary voltage supply
- invalid time and date

10. Depending on the meter's connection type, the secondary values of the voltage transformers will be according to the Table of Materials and Quantities of the Inquiry:
    - for three (3) elements meter:
      ..... kV / 120 : $\sqrt{3}$ (V) or ..... kV / 100 : $\sqrt{3}$ (V)
    - for two (2) elements meter: ..... kV / 100 (V)
    - for one (1) elements meter: 150 kV / 100 (V) line to line
    and the secondary values of the current transformers will be : ..... / 1 (A) or ..... / 5 (A) [Imax = 1,2 x In].
    It should be provided the possibility of easy change of the Voltage Transformer secondary voltage from Un = 120 : $\sqrt{3}$ (V) to Un = 100 : $\sqrt{3}$ (V) and vice versa and the Current Transformer secondary current from In = 1 (A) to In = 5 (A) and vice versa, after the delivery of the meters.

11. The meter's measuring voltage range should be as follows:
    - Voltage range, for measurement within the nominal accuracy class:
      (80% - 115%)xUn (EN/IEC 62053-22)
    - Voltage range, for measurement function: (70% - 130%) x Un

12. The starting current of the meter with continuous recording should be at $0,001I_N$, at unity (1) power factor, with balanced load in both directions.

13. The transmitted output impulses from 24 V DC to 125 V AC/DC should be energized by opto-switches (not conventional relays).
    The transmitted output impulses must be programmable by the user in length (20ms, 40ms, 80ms) and value (MWh/imp, KWh/imp or Wh/imp) via the meter's parameterization software.
    The energy registers' resolution (decimal point) should be separately programmable for different pulses values of incoming +A or outgoing –A energy.

14. The Central Station will collect the required data from all metering points remotely, via the master meter, and all meters should be provided with a communication interface RS 485 (3-wires) port according to ISO 8482, for cascade meters in a cluster (master – slaves).

15. The master meter in the cluster shall have the possibility of being equipped with an integrated, detachable (modular) V.34b – PSTN modem for communication with the Central Station. It is noted that anyone of the delivered meters shall have the possibility of being used as master or slave meter, without any further intervention apart from the necessary installation and connection of the modem. The PSTN modem should have an RS485 (3-wires) port wired to the meter's terminals.
    For telecommunication requirements, it should be possible to replace easily the PSTN modem with GSM/GPRS or Ethernet modem, if necessary.

16. The maximum number of meters that can be connected together in a cluster (cascade) via the RS485 (3-wires) Interface must be at least 32 without additional external devices. The maximum cable distance in the cluster for data transfer via DLMS protocol (EN/IEC 62056–42/46/53/61/62) at a bit rate >34 kbps should be greater than 500 m.

17. The Central Station should have direct access to every meter remotely for automatic reading and display of the registers of the meter with the following functions:
    - Meter reading (energy registers, load profile)
    - Adjustments (as far as time, date, parameters, tariffs etc are concerned)

- Meter's status check for verification that the meter functions normally
- Time synchronization (with the time of the Central Station by GPS)

18. The meters will have to communicate smoothly with the Central Telemetering Station via the standard DLMS – short name communication protocol according to EN/IEC 62056-42/46/53/61/62.

19. The Central Station collects the data every day and the relevant collection time for each meter should be less than 40 sec (excluding modem's connection time), for a daily LP of 8 measured values (8 LP – channels) and an integration period of 15 minutes via PSTN v.34b modem.
Only one call from the Central Station is necessary for collection of the data by all cascaded meters.

20. Further to the basic energy measurements $\pm$ A, $\pm$ Ri, $\pm$ Rc, the meters must have the possibility of measuring the apparent energy in two directions ($\pm$ S), the copper losses (proportional to I^2) of the power transformers - transmission lines and the iron losses (proportional to U^2) of the power transformers. For this purpose, the meter must be provided with at least 6 additional registers for the recording of the apparent energy and the losses.
In order to calculate the energy losses, the copper resistance of the lines as well as the iron and copper resistance of the power transformer must be programmable in the meter.
The following measured quantities must be recorded and shall be available for registration in load profile via an appropriate parameterization:
- Apparent energy in positive and negative direction ($\pm$ S)
- Active energy of copper losses of the lines and the transformer windings
- Active energy of iron losses of the power transformer
- Total active losses in positive direction
- Total active losses in negative direction
The basic energy measurements ($\pm$ A, $\pm$ Ri, $\pm$ Rc) and the apparent energy in both directions ($\pm$ S) shall be available for selection and storage in load profile, by appropriate parameterization, as delta values per capture period and per billing period.

21. The meter must be provided with additional recordings for all phases, regarding power quality, diagnostics and measuring parameters, as follows:
- Number of voltage dips with the corresponding time duration
- Total harmonic distortion ($\pm$ THD) per phase of active energy, voltage and current
- Voltage and current per phase
- Phase angles among voltages, where it is applicable
- Phase angles among voltage and current, where it is applicable
- Phase failures
- Frequency monitoring and power monitoring (thresholds and activation delays can be selected)
- Number of over-voltages, under-voltages and over-currents (thresholds and activation delays must be selectable)
For the above features, additional available memory registers are required.

22. For the recording of the energy and demand values, the losses, the diagnostics, quality and operational parameters of the measurement, more than 32 captured registers are required and for an integration period of 15 minutes the total capacity of the memory must not be less than 90 days.
In particular, eight (8) maximum demand registers must be provided for active and apparent demand in positive and negative direction and they must be available for registration in monthly billing values. Also, at least four (4) registers for average demand, for active and apparent demand in two directions, must be available for registration in load profile.

23. There should be provided appropriate software, under Windows environment and suitable for installation in laptop PC, for the parameterization and display of the meter locally, via the optical interface according to EN/IEC 62056 – 21 and according to the DLMS communication protocol EN/IEC 62056 – 42/46/53/6162 and remotely according to the above DLMS - short name protocol, together with all the respective technical manuals and operating instructions in Greek or English language. Also, there should be provided appropriate software as above, for remote parameterization and display of the meter's measured quantities and metering data.

24. There should be the possibility of entering passwords in multiple security levels for the meter's programming or parameterization and for the protection of the parameters and the measurements.

25. Parameterization of the meter for the following:
- Measurements for primary or secondary values
- Voltage and current transformers ratio
- Impulses values (e.g. KWh/imp., KVarh/imp.)
- Alarms and operating indications
- Resolution of registers
- Number and type of measured quantities
- Measurement units and decimal digits, separately for incoming values, outgoing values, active, reactive and apparent energy ($\pm$ A, $\pm$ R, $\pm$ S)
- CT/VT error correction, for compensating the measurement deviations of the external voltage transformers (VT) and current transformers (CT)

26. In case of interruption of the network's measuring voltage or the auxiliary voltage supply to the meter, the measured values and the parameters must be permanently stored in EEPROM memory for the security of the data, without the use of battery.

27. The auxiliary voltage supply is needed for the safety of the meter's readings on the display and for the meter's readings via the communication interface, in case of interruption of the measuring voltage. When the measuring voltage is on, the auxiliary voltage supply should be automatically interrupted.

28. Auxiliary voltage supply range: 100 ÷ 230 V AC / 50 Hz and DC, with tolerance -20% to +15%.
Temperature range according to EN/IEC 62052-11: metrological -10°C ÷ +45°C, functional -20°C ÷ +55°C.
Short voltage interruptions according to EN/IEC 62052-11 should have no influence in the meter's operation.

29. The power consumption in the voltage circuits, current circuits and auxiliary power supply circuits of the meter shall be less than the limit values which are specified in the EN/IEC 62053–22 standard.

30. The meter must be of rigid and standard construction with all its units built-in, including the detachable modem where it is applicable (external wirings are not acceptable), with external enclosure protection degree IP 51 according to EN/IEC 60529, in 19" rack–mounted version, back-connected, appropriate for flush-installation into standard metering cabinets. There must be the possibility of sealing meter contacts and meter front cover for the protection of the parameters and the measurements.
All necessary fixing material (e.g. set of mounting brackets etc) for the meter's fastening into the metering cabinet must be included in the offer and they will be delivered together with each meter.

31. All the terminals of the meter (voltages, currents, auxiliary voltage, RS485 port, pulse outputs, PSTN modem etc) must be appropriate type male ESSAILEC connectors for the smooth and safe exploitation as well as the maintenance of the equipment. The female connectors for the current circuits must be appropriate type for the automatic short-circuiting the circuits upon the disconnection.

Furthermore, the respective female ESSAILEC meter-connectors of the meter's terminals must be also included in the offer and they will be delivered separately together with the meters.

32. An additional software tool as above, under Windows environment and suitable for installation in laptop PC, should be provided together with the meters, for the purpose of changing remotely in a massive way, the passwords and the tariff table of the meters (remote mass re-parameterization software).

B. <u>TYPE TESTS</u>

According to the requirements of the latest versions of the following EN/IEC standards:
- EN/IEC 62052-11, metering equipment
- EN/IEC 62053-22, static meters for active energy
- EN/IEC 62053-23, static meters for reactive energy

1. Accuracy tests according to EN/IEC 62053-22 (paragraph 8.1 ÷ 8.6).

2. AC voltage test (Protective class II) according to EN/IEC 62053-22.

3. Impulse voltage tests (1,2/50μs 6kVp) according to EN/IEC 62052-11.

4. Tests of immunity to electrostatic discharge according to EN/IEC 62052-11, EN/IEC 61000-4-2.

5. Test of immunity to electromagnetic RF fields according to EN/IEC 62052-11, EN/IEC 61000-4-3.

6. Fast transient burst test according to EN/IEC 62052-11, EN/IEC 61000-4-4:
   – 4 kV at metering circuits
   – 2 kV at auxiliary circuits
   – 1 kV at auxiliary circuits <40V

7. Surge immunity test according to EN/IEC 62052-11, IEC 61000-4-5.

8. Radio interference suppression frequency 0.15 – 1.000 MHz according to EN/IEC 62052-11, EN 55022.

9. Tests of mechanical strength:
   – Vibrations test according to EN/IEC 62052-11, EN/IEC 60068-2-6.
   – Shock test according to EN/IEC 62052-11, EN/IEC 60068-2-27.
   – Protection against penetration of dust and water class IP 51 according to EN/IEC 62052-11, EN/IEC 60529.
   – Dry heat test according to EN/IEC 62052-11, EN/IEC 60068-2-2.
   – Cold test according to EN/IEC 62052-11, EN/IEC 60068-2-1.
   – Damp heat cyclic test according to EN/IEC 62052-11, EN/IEC 60068-2-30.

C. CERTIFICATES

The following documents and certifications must be submitted together with the technical
offer:

1. Manufacturer's quality system certificate according to EN ISO 9001:2008 for the equipment production factory, issued by an internationally recognized competent organization.

2. Manufacturer's environmental system certificate according to EN ISO 14001:2004 for the equipment production factory, issued by an internationally recognized competent organization.

3. Declaration of Conformity (CE) for the offered meters and modems, according to the requirements of the EU Directive 2004/108/EC for Electromagnetic Compatibility (EMC).

4. Certificate of compatibility for the communication protocol of the offered meters' type, according to DLMS / COSEM (IEC 62056), issued by the competent organization
   "DLMS – User Association".

5. Complete Type Tests Certificates for the offered meters according to the applicable standards IEC 62052-11, IEC 62053-22 and IEC 62053-23, issued by internationally recognized private or state laboratories accredited according to EN ISO / IEC 17025.

D. ADDITIONAL REQUIREMENTS

1. For reasons of uniform and unified technology, technical know-how, technical and software programming and communication support, immediate intervention and quick restoration of potential malfunctions, it is required that the supply of all meters (class 0.2S and 0.5S) is made by one manufacturer.

2. Meter's (Class 0,2S and 0,5S) and modem's programming-parameterization software program must be common. In addition, ten (10) user licenses (of unlimited duration), five (5) optical heads (or other suitable device, for meter's programming and data reading locally) with the appropriate connecting cable for laptop PC, accompanied by three (3) sets of technical manuals (operation, adjustments, programming, communication, maintenance etc) for the meter and modem, all in Greek or English language, must be delivered upon the first delivery of the meters.

4. For the technical evaluation of their offer, the Bidders must provide complete and operational samples of their offered meters and modems, together with all the respective software tools (for programming, parameterization, communication etc) and an optical head with connecting cable for laptop PC for local communication with the meter, along with one (1) set of their technical manuals (operation, adjustments, programming, communication, maintenance etc).
   The sample meters with modem, must be one (1) pc per accuracy class (0,2S / 0,5S) and connection type if they are different.

During the technical evaluation by PPC S.A., the following tests will be performed as a minimum

a) Check of the software tools (programming-parameterization, communication) with the meter and modem
b) Check of meter's accuracy, insulation and installation
c) Check of meter's communication, via the modem, with the Central Station using the DLMS protocol

5. The nameplate shall be appropriately designed and installed so that the following features or information shall be provided without removing the meter cover:

a) PPC logo
b) The meter constant of the optical test output for active and reactive energy and the nominal values of meter.
c) The check LED DIODE, with accuracy class reading
d) Optical head communication port (IR Port)
e) The symbol for CE mark for compatibility with EU regulations/standards
f) Push-buttons for rolling display indications
g) Meter information (type, serial number, nominal values/ratings, year of manufacture)
h) The nominal values / ratings shall include the nominal voltage, nominal current (on removable label)
i) The codes of the measured quantities shall be explained on the meter nameplate, according to OBIS EN/IEC 62056-61 (DLMS) codes
j) The resistances upon which losses are calculated (on removable label).
k) Pulse outputs information (on removable label)

6. Before the begin of the production of the first batch of the meters, modems, their programming and parameterization, together with their face-plate data and text, shall be provided to PPC S.A. for checking and confirmation (attached, sample of the required face-plate with indicative data).

7. Detailed reference to every single paragraph of the present technical specification must be included in the technical offer, with all the required technical characteristics explained according to the manufacturer's technical manuals, otherwise it will be a reason for rejection of the offer.