United Arab Emirates دولة الإمارات العربية المتحدة
الهيئة الاتحادية للكهرباء والماء
Federal Electricity & Water Authority

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TECHNICAL SPECIFICATION

METERING PANELS

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MICRO-PROCESSOR BASED ENERGY METERS OF ACCURACY CLASS O.2S

1. GENERAL

This Specification covers the design, manufacturing, testing, marking, packing, shipping, transportation to Site, installation, site testing and commissioning of 3 phase, 1A, 50 Hz, 110 Volt, micro-processor based type of main and check energy meters of accuracy class 0.2S.

These meters shall be in conformity with IEC-60687 and the quality and performance requirements by FEWA.

They are meant to be fed from CTs and VTs of high voltage installations. Main and check meters preferred to be from different manufacturers.

Further detailed and specific data are contained in the data sheets and other documents that form part of this Specification.

The Meters to be offered shall be complete in all respects necessary for their effective and trouble free operation when connected to the system.

The required Meters shall be totally micro-processor based polyphase electricity meter with a large LCD display and integral register that collects, processes and memorizes energy use and demand data on multiple rates, time of the use and demand basis.

2. TECHNICAL DESCRIPTION

2.1. CONSTRUCTION AND DESIGN DETAILS

2.1.1. General

The Meter shall be designed and assembled with the state-of-art microprocessor components to perform without any metrological degradation over a wide dynamic current range under harsh operating conditions. The meter shall maintain accuracy throughout its useful life. These energy meters shall be micro-processor based, high precision three phase type meters of accuracy class O.2S for active mode and 0.5S for reactive mode, conforming to IEC-60687, capable of performing functions of energy audit, load survey, tariff and suitable for bidirectional power flow.

Each meter whether main or check meter, shall provide at least two outputs per each measured quantity. These outputs shall be fed to the duplicate outstations to establish full redundancy in the metering and data exchange system.

The micro-processor based meter shall carryout measurement of active energy (both import and export) and reactive energy (both import and export) by:

- 3-phase 2-element 3-wire
- 3-phase 3-element 3-wire
- 3-phase 3-element 4-wire

The active and reactive energy shall be directly computed in CT & VT primary ratings and stored in four different registers of the memory of the meter as kWh(E) or MWh(E), kWh(I) or MWh(I), kVARh(E) or MVARh(E) and kVAh(I) or MVAh(I).

Meter shall be capable of displaying the energy readings without the need for any multiplying factors.

Meters shall compute the energy sent-out/received from/to the station bus bars during each successive demand period as per metering code, and stored in the respective registers.

Meter shall display, on demand, the energy sent-out/received during the previous 30-minute block.

Further, the meter shall continuously integrate the energy readings of each register up to that time. All these readings shall be displayed on demand.

Cumulative reading of each register shall be stored in non-volatile memory at the end of each hour of the day. These readings shall be stored for a period of 45 days before being erased.

The micro-processor based meter shall have a built-in clock and calendar of an accuracy that allows a maximum time error of not more than 1 minute per month without assistance of external time synchronizing pulse. The clock shall be synchronized by GPS time synchronizing equipment or other external time signals like Outstation, Meter Reading Instrument (MRI), laptop, etc. through security code. Date and time shall be displayed on demand.

Each meter shall have a unique identification code provided by the purchaser and shall be marked permanently on the front and also on the non-volatile memory.

The meter shall normally operate with power drawn from VT supplies. The power supply to the meter shall be healthy even with a single-phase VT supply. Date and time of VT interruption and restoration shall be automatically stored in non-volatile memory.

The meter shall have energy pulse transmission facility for connecting to external systems.

The microprocessor-based meter shall have an optical port at the front of the meter for data collection by a hand-held device, as well as multiple serial communication facilities for outstation and for Remote Meter Reading System. The meter shall have built-in self-diagnostic features as well as tamper-evident features.

Meter shall have means to test accuracy and calibration at site in-situ, for which test terminal block shall be provided.

Meter shall have scripting facility for any special purpose like multiple-tariff features. The meter shall be minimum 16-bit microprocessor based energy measuring device employing latest microprocessor controlled instrumentation and measurement technology.

Main and check meters shall be a part of the settlement-metering scheme shall include:

- Electricity meter
- Outstation
- Communication
- Local/remote interrogation
- Central Data Collection and Verification System (DCVS) or In-station.

Constructional and functional details of an outstation are given as below:

OUTSTATION:

Outstation is a site-based equipment that receives and stores data from all the connected meters, processes such data and transmits such stored and processed data to In-Station, on request.

It shall be in conformity with IEC-62056 for remote access from outstations. The requirement shall comply with OBIS codes and DLMS/COSEM standards as per applicable specifications in IEC 62056.

Outstation shall be industrial grade, rugged design, rack panel mounted and immune to vagaries of site conditions.

Outstation shall communicate with the In-Station (DCVS), using the appropriately selected communication protocols defined by FEWA.

Full duplication of Outstation is needed such that there would be two identical redundant systems at site, both are working simultaneously

Each of these outstations shall perform the following functions:

- Handle data from both main and check meters for one or more numbers of defined metering points.
- Receive and process all alarm signals and any other data.

Connect to and communicate with the central data collection system at LDC via independent communication channels.

2.1.2. Design Details

The meter shall have the state-of-art components of Surface Mount Technology (SMT). The cover shall be made of plastic and fitted in such a way that the internal parts of the meter are accessible only after breaking the meter cover seals. The plastic for terminal block, meter cover and base shall be flame retardant, UV stabilized, passing glow Wire Test at 960°C and complying with UL 94 VO standard. UV stabilization shall conform to ASTM-G5 3/26/23.

Terminal block may be integral with the meter base.

The Meter shall have tin plated brass terminals suitable for termination of CT secondary leads and potential leads.

The manner of fixing the conductors to the terminals shall ensure adequate and durable contact such that there is no risk of loosening or undue heating. Two Nickel plated Brass screws shall be provided in each current terminal for effectively clamping the external leads with thimbles. Each clamping screw shall engage at least 3 threads in the terminals. The ends of screw shall be such as not to pierce the conductor. Pressure strips of Copper, Nickel/Tin plated shall be fitted in the terminal holes to reduce chances of loosening/heating of leads in the terminal block.

The clearance and creepage distances shall conform to the relevant clauses of the Standard.

The terminal, cover shall be of the short type, which can be sealed independently of the meter cover. The terminal cover shall enclose the actual terminals, the conductor fixing screws, the external conductors and their insulation whereby no part of meter and cables shall be accessible from the front of the meter.

The fixing screws used on the terminal cover for fixing and sealing shall be held captive in the terminal cover.

The terminal block, the terminal cover and the meter case shall ensure safety against propagation of fire or thermic overload of live parts in contact with them.

2.1.3. Demand Period

Meter shall be provided with the facility to select a relevant demand period from one of the values *of;* 60; 30; 20; *15;* 10 and *5* , and 1 minute.

2.1.4. Maximum Demand Registration

Maximum Demand intervals shall be programmable and shall be configured as per FEWA's requirement. Whenever MD is reset, the MD value shall be submitted along with date and time. Meter shall have the MD re-set facility either by Meter Reading Instrument (MRI) with necessary security password or automatically at the end of certain pre-defined period or manually through a sealable push button. For automatic re-set, lock-out feature shall be provided such that re-set is disabled for the particular period. This period shall be configured as per FEWA's requirements.

MD shall be re-settable at midnight of last day of the charging period. Also re-settable for part chargeable demands.

2.1.5. Excess Demand Conditions

Meter shall be provided with visual flashing light indicator and software alarm to be registered in case of excess demand conditions.

2.1.6. Pulse Output

The meter shall be capable of providing one voltage free pulse output per metered quantity. These outputs shall be provided either direct from the meter or from an isolating relay supplied by such meter. The pulse rate at the meter full load rating shall be such that 1000 or more pulses are produced in a demand period.

2.1.7. Energy and Load Survey Data

Meter shall register maximum demand and all the historical data for the last ***45*** days billing periods and should have load curves in MW (Imp), MW (Exp), MVAR (lag), MVAR (lead) and MVA for 45 days each in 30 minutes integral period or as is conveyed by FEWA before configuration.

Following data shall be transferred at 24.00 hours on the last day of the month, or statistical review period:

- Date
- Real time
- Active energy of last month (Import)

- Reactive energy of last month (Import)
- Apparent energy of last month (Import)
- Maximum demand in MW (Import)
- Maximum demand in MVA (Import)
- Active energy of last month (Export)
- Reactive energy of last month (Export)
- Apparent energy of last month (Export)
- Maximum demand in MW (Export)
- Maximum demand in MVA (Export)
- Average pf
- Reset count of MD
- Date of automatic MD reset
- MWh reading of last 6 months
- MVAh reading of last 6 months
- MVA maximum demand of last 6 months
- The value of any energy measured in a demand period but not stored in that demand period shall be carried forward to the next demand period
- Any “Read” operation shall not delete or alter any stored metered data
- Alarm indications
- Multi-rate cumulative active energy.

All the above data shall be also available for display on computer screen on demand. Meter should log the data and time of all the program changes in a billing period.

The specified registers of measured values shall be stored in a historical data log for a period not less than three months.

2.1.8. Scrolling Display

The meter shall display the following parameters and these shall also be displayed on the computer screen on demand:

- Display test
- Real time
- Date
- Cumulative active energy in MWh (Import)
- Cumulative reactive energy in MVARh (Import)
- Cumulative apparent energy in MVAh (Import)
- Cumulative active energy in MWh (Export)
- Cumulative reactive energy in MVARh (Export)

- Cumulative apparent energy in MVAh (Export)
- Maximum demand in MW per programmable charging period, monthly or Statistical review period
- Maximum demand in MVA per programme chargeable period, monthly or statistical review period
- Maximum demand in MVAR per programme chargeable period, monthly or statistical review period
- Number of MD resets
- Multi-rate display sequence with a minimum of 8 rates selectable over the calendar year as specified by the meter supplier
- Instantaneous MW
- Instantaneous MVAR
- Instantaneous pf
- Internal diagnostic
- Tamper occurrence.

The process of above LCD/LED scrolling data display shall either be automatic in cyclic manner or through push-button, configurable at the time of installation .The above and any other essential parameter shall be mutually agreed upon between FEWA and Bidder/Supplier before configuration.

The meter shall have ON time of at least 10 seconds for each measured value for auto display cycling.

MD shall be re-settable at midnight of last day of charging period. Also re-settable for part chargeable period demands. In case of a manual reset button, the same shall be sealable.

An output pulse, which commences coincident with the end of each demand period, shall last for duration of 0.5 to 10 seconds.

Energy displayed on the meter should be total energy. It should be summation of fundamental energy and harmonic energy.

2.1.9. Display Image

The display shall be eight segments, including decimal, LCD type for display of various parameters. An additional LCD shall focus at the legend of the quantity under display. Display shall provide indication of energy flow, potential indication for each phase, quadrants, and various TOD tariff rates and directional pulse indicators. Display image area shall be easily readable from a distance of approximately 1.5 meters.

The display shall work in either normal mode or test mode with appropriate display of relevant parameters, errors and cautions.

Necessary push buttons shall be provided to display the contents of measured and stored values, The sequence of display shall be clearly indicated on the name /rating of the meter.

2.1.9 Input Pulses

Meter shall be provided with input pulse counter for such requirements like energy pulsing inputs, time synchronization etc.

2.1.10. Event Recorder

The meter shall be provided with an Event Recorder for recording important events and occurrences of period not less than 14 days. These logs shall include such happenings as billing resets, demand resets, date and time of last reset, diagnostics, power outages, date and time of last reading, date and time of over voltage or under voltage or low power factor, set-up changes etc.

2.1.11. Self-Diagnostics and Micro-Processor Based Failure Alarms (EFA)

Indications to show the satisfactory performance of the meter shall be provided in the meter. The meter should have capability to regularly perform complete self-check of its circuits, initial memory locations, integrity of data and parity etc. against any malfunctioning.

It shall be preferred that whenever meter is optically interrogated by local or remote interrogation commands, this self-test is carried out. Any parity error shall set an error flag on display providing indication of nature of error.

For checking of any internal and external failures, meter shall be fixed with EFA. The alarms shall be logged, turn on dial LCD and activate a potential - free external pulse/relay. A series of self-diagnostics tests as well as a range of input value checks are automatically performed by the meter that include tests on analogue measurement circuits, memory devices and the real time clock. Input values shall be checked for such functions as:

- Phase rotation
- Asymmetrical power
- Voltage out of range
- VT failure.

In addition, the meter shall have indication for unsatisfactory or non-functioning of the following important equipments as display as well as equipment failure alarm:-

- Time and calendar
- Real time clock
- All display segments
- Non volatile memory
- Calibration data corrupted
- Pulse output overflow
- Integrity of interrogation ports
- Low battery.

Any fault condition detected by the software shall raise the EFA. All pre-defined abnormal status of hardware and measured values including that of the battery shall be recorded as alarm and the same shall be stored in alarm register for three months.

Fault conditions shall also be recorded as part of the load survey data so as to allow the integrity of the measured values to be verified.

2.1.12. Test Output Device

The meter shall be equipped with test out put device accessible from the front in the form of blinking LED in proportion to the meter constant to test accuracy of the meter at site.

2.1.13. Meter Constant

Meter constant shall be indicated on the nameplate.

2.1.14. Time of Day Features

The meter shall be capable of doing Time of Day (TOD) energy metering and shall have eight times of day registers for maximum demand, kWh and kVAh energy. Time and options shall be FEWA Programmable.

These TOD rates shall further be selectable on the basis of day, types and seasons. Each tariff rate shall be programmable to become active during different period of the day. Energy type data shall be pulsed from meter's own measurements or pulses from external sources. Meter shall record information up to eight rates, each rate being a time period over which the information was recorded. Meter shall store energy, maximum demand and time of maximum demand for the current billing period with provision to display readings of 6 months including external pulse inputs. Integrating period shall be programmable. It should be possible to change the time period for the TOD recordings through portable device, or a programmable block installed in the meter itself or manually with proper security. Main control for this change shall be available on the PC. Meter shall have scripting facility to programme for any selection through software.

2.1.15. Non Volatile Memory

In the event of any interruption in line potential, meter circuits shall transit to an orderly shut down and data preservation. Critical meter configuration and key billing data shall be written on to non-volatile memory not needing battery support. The micro-processor based register shall have non-volatile memory to retain data for 10 years. For any change in programme, the reading of the meter shall reset to zero and previous information shall be stored in NVM.

2.1.16. Battery Back-up on Loss of Power

Integrity of time keeping and data security shall be maintained, in case of loss of power, by a back up lithium battery. The time shall be set to universal time clock. The time switch battery shall be guaranteed for 2 years continuous operation for the clock and RAM. Warning signal of Low-Battery shall be transmitted to the main control centre. Limits of error for the time keeping allowing for a failure to communicate with the PC for a typical period of, say, 10 days shall be as under:

- The completion of each demand period shall be at a time, which shall be within **±** 10 seconds of UTC.

- The duration of each demand period shall be within **±** 1 **%,** except where time synchronization has occurred in a demand period.

2.1.17. Communication Interfacing Facility

The meters shall be provided with communication ports for local and remote interrogation through compatible ports. The communication protocol shall meet requirements as specified in the Technical Data Sheets. It shall also comply with the latest version of the metering code. Communication session shall be available through display and with Meter Reading Instrument (MRI) or Laptop.

Redundant outstation shall be connected to the metering equipment and finally to Data Collection And Verification System (DCVS) i.e. In-station. The redundant outstation shall be loaded with necessary interfacing hardware and software to enable communication and visualization of measured values running on the latest Windows software. This software shall support all standard protocols and shall be interconnectable with other equipment.

The redundant outstation shall act as a data concentrator and communicator as well as a display unit of data for control of various functions. Suitable software shall be developed to handle the assigned data. It shall be equipped with compatible hardware to download the data automatically as assigned by software.

The redundant outstation shall have flawless glitch-free, smooth and speedy communication without congestion and hanging while communicating with the network.

2.1.18. Security Features

The Meter shall have programmable facility to restrict the access to the information recorded at different security levels such as communication read, communication write, etc. There shall be at least three level multi-user access control password for security and safety of the meters and the data.

2.1.19. Tampering Protection

The meter shall provide the following anti-tampering features:

a) Lead seals on all access screws and fasteners.

b) The meter shall continue to keep registering correct energy accurately even though the CT polarities are reversed.

c) The meter should be capable of recording occurrence of a missing potential and its restoration with date and time of first such occurrence and last restoration along with total number of such occurrences during the above period for all phases. This condition shall be different from total loss of supply viz.; power failure.

d) The meter shall be working accurately irrespective of the phase sequence of the supply.

e) The customer bus to be "READ **ONLY"** i.e. it shall not be possible to re-programme the meter using this bus.

2.2. SOFTWARE AND MANUALS

The software, that shall support all standard protocols and interconnectable with other equipment, shall be supplied by the meter manufacturer, free of cost, along with operation manual of the meter and the software. Training on how to use the software shall also be provided by the manufacturer.

2.3. CALIBRATION CERTIFICATE

Each meter shall be accompanied by manufacturer's certificate, which has tractability to an international laboratory that would be proposed by the Bidder/ Supplier and approved by FEWA. Each meter shall be attached with a calibration date stamp including the validity period.

2.4. 2.4 CONNECTION DIAGRAM AND TERMINAL MARKINGS

Each meter shall be clearly marked with the connection diagram. The diagram shall also show the phase sequence.

The marking shall be of pennanent nature.

3. TESTING AND INSPECTION

3.1. GENERAL

Testing of the Meters shall be performed in line with this specification and in accordance with the relevant IEC Standards (as minimum requirement) and other Standards as may be approved by FEWA.

Fully computerized meter test bench system for carrying out acceptance tests as per IEC-61358 and error test report with error curve for each and every meter shall be provided.

The Meters shall be subject to inspection and test by FEWA's engineers. Acceptance by FEWA's representative of any unit shall not relieve the manufacturer from any of his performance guarantees or from any other obligations. Test certificates for each unit shall be submitted prior to delivery of the unit.

FEWA reserve the right to perform checks during manufacturing process at any time or all the time. It shall be at the discretion of FEWA to witness tests on 100%, or any percentage quantity of each lot for routine tests, apart from the type tests, wherever called for.

Testing of the Meters shall include the factory and site tests.

3.2. FACTORY TESTS

3.2.1. Type Test

The meters and all associated equipment shall be fully type tested. These tests shall include all type tests as defined in IEC 60687 as well as the optional including but not limited to:

- **Insulation Properties**

- Impulse voltage test
- AC. voltage test
- Insulation resistance test.

- **Tests of Accuracy Requirements**

- Test on limits of errors
- Test of meter constant
- Test of starting condition
- Test of no-load condition
- Repeatability of error test
- Test of ambient temperature influence
- Temperature rise at full load test
- Test of influence quantities
- Measurement of phase current.

- **Tests of Electrical Requirements**

- Test of power consumption
- Test of influence of supply voltage
- Test of influence of short time over currents
- Test of influence of self-heating
- Test of influence of heating
- Test of Temperature Rise at full load.

- **Tests for Electromagnetic Compatibility (EMC)**

- Radio interference measurement

- Fast transient burst test
- Test of immunity to electromagnetic HF fields
- Test of immunity to electrostatic discharge.

• **Tests of Climatic Influences**

- Dry heat test
- Cold test
- Damp heat, cyclic test.

• **Tests of Mechanical Requirements**

- Vibration test
- Shock test
- Spring hammer test
- Tests of protection against penetration of dust and water
- Test of resistance to heat and fire
- Flame retardant and UV stability tests on all parts made of plastic material.

Evidence shall be given that the Meters and Accessories to be provided, under these specifications, have successfully passed all type tests of design, service frequency, impulse, insulation level, dynamic operating range, and electrical and mechanical endurance performance,

- as appropriate and as specified.

However, if deemed necessary, FEWA shall decide if additional tests are required to be performed by the Bidder/Supplier.

The Bidder/Supplier shall supply certified copies of type test certificates covering the proposed Meters and Accessories of similar class of accuracy, operating range, data features, design and construction.

An internationally recognized laboratory shall certify the type test reports.

Type tests certificates/reports shall be considered acceptable if they are in compliance with the relevant Standards and the following:

1. Type Tests conducted at an internationally recognized laboratory acceptable to FEWA.
2. Type Tests conducted at the manufacturer's laboratory and witnessed by representatives from an internationally recognized laboratory acceptable to FEWA.

If the presented type test reports are not in accordance with the above requirements, FEWA may decide to ask for the type tests to be carried out in the manufacturer premises or other places subject to the approval of FEWA at no additional cost, and in the presence of an internationally recognized laboratory who should issue the relevant type test certificates upon successful test.

3.2.2. Sample Tests according to IEC 60687

Sample Tests shall be performed, comprising as a minimum the following tests:

- Visual checks and measurements of dimensions
- Meter marking as per this specification
- Functional tests.

3.2.3. Routine Tests

The Bidder/Supplier is required to carry out routine tests on each assembled and finished meter to demonstrate the integrity of the meter.

Routine test certificates shall be submitted for FEWA's review and approval before shipment of the meters.

The meter shall pass all the routine tests as specified in IEC 60687.

The visual inspection tests, which shall determine conformity of the meter with the requirement and the approved documents, shall be part of the routine testing.

The routine tests shall include but not limited to:

- A.C voltage test
- Insulation resistance test
- Test on limits of errors shall be IEC compliant
- Test of meter constant
- Test of starting condition
- Test of no-load condition
- Test of power consumption
- Repeatability of error test.

3.2.4. Special Tests

3.2.4.1. Transportation Test (As Acceptance Test)

At least *50%* of the samples of the meters (or the quantity as selected by FEWA) be tested

for error at Imax, Ib and 5% Ib at unity power factor and 50% Imax and 10% Ib at 0.5 power factor, besides checking them for starting current. The meters shall be tested with meters sealed properly. After recording those errors the meters be put in their normal packing and transported for at least 50 kms in any transport vehicle like pick-up van, jeep etc., on uneven and rural roads and re-tested at these loads after transportation. The variation in error before and after transportation should not exceed 0.5%.

3.3. SITE TESTS

Upon installation of the Meters they shall be tested in the presence of FEWA engineers or their representatives.

The site tests shall be performed as applicable and shall comprise but not limited to the following:

- Visual and wiring checks
- Power consumption
- Functional checks
- Calibration and zero adjustment.

3.4. CALIBRATION DEVICES

The Bidder/Supplier shall offer a device capable of verifying the accuracy of a micro-processor based energy meter in the field with sufficient accuracy as to the requirements of IEC 60736. Should this device require any additional equipment for load or cabling, these items shall be included in the offer.

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