Regulation for Installation and Maintenance of Metering Systems

Authority for Public Services Regulation

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1. Introduction

1.1 Purpose

The purpose of this Metering Regulation is to establish the requirements for metering equipment which shall be installed at all connections between networks of all licenced distribution companies and all network users.

1.2 Scope

This Regulation applies to all Metering Equipment owned by the Network User and/or the Network Operator for the provision of an electricity connection at the premises of a Network User and the financial settlement for electricity transferred. Where appropriate, it shall also apply to the transfer of electrical energy generated by the Network User and supplied to the network of the Network Operator.

This Regulation applies to all connections made to the networks owned or operated by all Licensed Network Operators in the Sultanate of Oman.

1.3 Interpretation

In addition to special meanings contained in the Definitions that follow, within this document:

- References to the masculine shall include the feminine and references in the singular shall include references in the plural and vice versa,
- Except where explicitly stated otherwise all references to section shall be a reference to a section in this document,
- All clock times or other references to time, shall refer to the standard time in the Sultanate of Oman, which is four hours in advance of Universal Time Co-ordinated (UTC),
- Any reference to a law or regulation shall be a reference to that law or regulation applicable in the Sultanate of Oman or, following the replacement of that law or regulation the new law or regulation from the date it comes into force,
- Any general reference to a standard shall be a reference to the current version of that standard from its date of implementation. A reference to a particular requirement in a standard shall be a specific reference to that requirement in the referenced version of the standard unless a later version of the standard has an equivalent requirement in which case it shall be a reference to that equivalent requirement in the current version of the standard.

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1.4 Definitions

For the purpose of these Regulations, the following definitions which, where appropriate, have been taken from the International Electrotechnical Vocabulary as defined in IEC 60050 apply unless an alternative definition has been used in the IEC Standards specified in section 2.1.1.2. In that case, the definition used in that IEC Standard shall also apply to the relevant section of this Regulation:

Sector Law - means Royal Decree 78/2004 as amended by Royal Decree 59/2009, Royal Decree 47/2013 and 78/2020.

MoCIIP - means the Ministry of Commerce, Industry and Investment Promotion

APSR – means the Authority for Public Services Regulation

Accredited Laboratory – means a testing facility accredited to ISO/IEC 17025.

Approved Conformity Assessment Laboratory – means a laboratory independent of meter manufacturers, meter suppliers and/or meter owners that holds current accreditation certificates issued by an agency or agencies recognised by MoCIIP - demonstrating compliance with the appropriate requirements of ISO/IEC 17065:2012 and ISO/IEC 17025:2017 and, having satisfied MoCIIP - of its ability in respect of conducting Conformity Assessments of electricity metering equipment is approved by MoCIIP - for this purpose.

Approved Laboratory – means a testing facility located in Oman that is either an Accredited Laboratory that has been recognised by MoCIIP or a laboratory approved by MoCIIP to undertake meter testing activities.

Base - (of an energy meter) means the back of the case by which it is generally fixed and to which are attached the measuring element, the terminals or the terminal block, and the cover

> Note – For a flush-mounted meter, the meter base can include the sides of the case. [IEV 314-07-14]

Basic Current (I_b)– means the value of current in accordance with which the relevant performance of a direct connected meter is fixed. [IEV 314-07-06]

Case - (of an energy meter) means the set that comprises the base and the cover. [IEV 314-07-17]

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Check Meter – means a meter of the same class as the Main Meter but its function is to support the Main Meter readings in the event of its failure or large errors exceeding the limits specified.

Conformity Assessment – means the demonstration that specified requirements relating to a meter are fulfilled.

Cover - (of an energy meter) means the enclosure on the front of the meter, made either wholly of transparent material or of opaque material provided with window(s) through which the operation indicator (if fitted) and the display can be read. [IEV 314-07-16]

Current Transformer – means an instrument transformer in which the secondary current, in normal conditions of use, is substantially proportional to the primary current and differs in phase from it by an angle which is approximately zero for an appropriate direction of the connections [IEV 321-02-01]

Customer – means any person, corporate body, or company who has a connection or supply agreement with a Network Operator for the provision of electricity.

Display - (for static meters) means a device which displays the content(s) of (a) memory(ies). [IEV 314-07-11]

Distribution Company – means an entity holding a licence to distribute or distribute and supply electricity issued pursuant to the Sector Law.

Indoor Meter – means a meter which can only be used in areas offering additional protection against environmental influences (e.g. in a house or in a cabinet). [IEV 314-07-20]

Interval Data – meter data collected at defined intervals for energy settlement or billing purposes.

Main Meter – means the primary Meter used for billing purposes.

Maximum Current (I_{max})– means the highest value of current at which a meter meets the specified accuracy requirements as specified by the manufacturer.

Meter Type – means a particular design of meter, manufactured by one manufacturer, having:

a) similar metrological properties;

b) the same uniform construction of parts determining these properties;

c) the same ratio of the maximum current to the reference current

Note 1 – The type may have several values of reference current and reference voltage.

Note 2 – Meters are designated by the manufacturer by one or more groups of letters or numbers, or a combination of letters and numbers. Each type has one designation only.

Note 3 – The type is represented by the sample meter(s) intended for the type tests and whose characteristics (reference current and reference voltage) are chosen from the values given in the tables proposed by the manufacturer. [IEV 314-07-07]

(Meter) Constant – means the value expressing the relation between the active energy registered by a meter and the corresponding value of the test output.

Note – If this value is a number of pulses, the constant should be either pulses per kilowatt-hour (imp/kWh) or watt-hours per pulse (Wh/imp) [IEV 314-07-08]

Memory - (for static meters) means the element which stores the digital information representing the measured energy. [IEV 314-07-10]

Minimum Current (I_{min}) – means the lowest value of current at which the meter is specified by the manufacturer to meet the accuracy requirements

Network operator – means an entity holding a licence to transmit and/or distribute electricity issued pursuant to the Sector Law

Network User – is a generic term that includes customers, generators and other network operators using a network of a licenced network operator.

Operation Indicator - means a device which gives a visible signal of the operation of the meter. [IEV 314-07-13]

Rated Current (I_n) – means value of current in accordance with which the relevant performance of a transformer operated meter is fixed. [IEV 314-07-02]

Reference Frequency – means the value of the frequency in accordance with which the relevant performance of a meter is fixed. [IEV 314-07-05]

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Reference Voltage – means the value of the voltage in accordance with which the relevant performance of a meter is fixed. [IEV 314-07-04]

Register - means an electromechanical or electronic device which stores and displays the information representing the measured energy

Note 1 – In static meters, the register comprises both memory and display.

Note 2 – A single display may be used with multiple electronic memories to form multiple registers. [IEV 314-07-09]

Socket - (of an energy meter) means a base with jaws to receive the terminals of a detachable meter and which has terminals for connection to the supply line

Note – The socket can be intended to receive one or several meters. [IEV 314-07-15]

Terminal Block – means the support made of insulating material on which all or some of the terminals of the meter are grouped together. [IEV 314-07-18]

Terminal Cover – means the cover which protects the meter terminals and, generally, the ends of the external wires or cables connected to the terminals [IEV 314-07-19]

Test Output Device - (of an energy meter) means a device which can be used for determining the meter error.

Note – This device can be, for electromechanical induction meters, a mark on the disk, where the passage of the mark is detected by an external photoelectric device, or, for static meters, an internal electronic pulse emitting device. [IEV 314-07-12]

Transitional Current (I_{tr}) – means the value of current at and above which the meter is specified by the manufacturer to lie within the smallest maximum permissible error corresponding to the accuracy class of the meter

Verification – means the process whereby a meter, following manufacture or refurbishment, is tested in an Accredited Laboratory, prior to installation, and is demonstrated to meet the accuracy requirements of this Technical Standard.

Verification Life – means the period which a Meter used for billing purposes can remain in service without being laboratory tested. This period is defined for each type of Meter and is based upon ongoing sample testing.

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Year – means a calendar year according to the Gregorian calendar.

2. Use of Approved Meters

2.1 Conformity Assessment

No natural or legal person shall permit the introduction of a meter to the market in the Sultanate of Oman unless that meter is of a type that appears on the list of approved meters maintained by the Ministry of Commerce, Industry and Investment Promotion (MoCIIP).

2.1.1.1 For a meter to be included in the list of approved meters, an acceptable conformity assessment certificate must be provided from an Approved Conformity Assessment Laboratory, demonstrating that the meter meets the requirements of relevant IEC Standards as amended by this Regulation and Technical Standards issued by MoCIIP. In the absence of any instruction to the contrary, the conformity assessment test shall be undertaken in accordance with the requirements of IEC 62052-11:2016.

2.1.1.2 In the context of section 2.1.1.1, relevant IEC Standards, include:

a) IEC 62052-11 – Electricity metering equipment (AC) – General requirements, tests and test conditions - Part 11: Metering equipment;
b) IEC 62053-21 - Electricity metering equipment (AC) - Particular requirements - Part 21: Static meters for active energy (classes 1 and 2);
c) IEC 62053-23 - Electricity metering equipment (AC) - Particular requirements - Part 23: Static meters for reactive energy (classes 2 and 3); and
d) IEC 62052-31 - Electricity metering equipment (AC) - General requirements, tests and test conditions - Part 31: Product safety requirements and tests.

Together with those sections of other IEC Standards to which specific mention is made in these standards[1].

2.2 Responsibilities of Network Operators and Suppliers

2.2.1.1 No network operator or supplier shall permit a new connection to be made to its network using a meter of a type that is not on the approved list and/or for which a Verification certificate has not been provided. Where a meter has been approved

[1] For example, in section 5.2.2.2 of IEC 62052-11:2016 it is required that the shock test be undertaken in accordance with the requirements of IEC 60068-2-27 and the basis for the environmental conditions specification in IEC 62052-31:2015 is IEC 61010-1:2010.

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at the time of its installation but that approval has subsequently been withdrawn other than by virtue of the verification period expiring, the transmission or distribution operator to whose network the relevant connection is made shall ensure the replacement of that meter within a maximum period of two years unless otherwise instructed by the MoCIIP.

2.2.1.2 Where a meter is otherwise discovered in use that is not of a type on the approved list, or is an approved meter but does not meet the accuracy class requirements for the capacity of the connection, the relevant network operator shall arrange its replacement by an appropriate meter of an approved type within a maximum period of one week following its discovery unless otherwise directed by MoCIIP.

2.2.1.3 The network operator shall ensure that the installed meter is of a type that permits the correct billing of the requested tariff and shall maintain the meter installation in a fully operational and verified condition until such time as the connection is removed.

2.2.1.4 The network operator shall ensure that all passwords which permit access to meter data and parameter settings have been changed from manufacturer's default passwords prior to energising the connection.

2.2.1.5 Following energisation of a new connection, the network operator shall assume responsibility for the ongoing of the maintenance of the meter and all network equipment:

- On the network side of the outgoing terminals of a direct connection meter;
- On the network side of the demarcation isolator which shall normally be on the network user's side of the measurement CTs in the event of CT connected meters.

2.3 Meter Markings and Information Requirements

2.3.1.1 The meter manufacturer or supplier shall comply with the information requirements of section 5.12 of IEC 62052-11, section 5 of IEC 62052-31 with the clarifications stated in this section 2.3 regarding markings and information declared optional in section 5 of IEC 62052-31 and the meter purchase contract regarding optional markings and information.

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2.3.1.2 The designation of function shall be included on either the case marking or the display.

2.3.1.3 The IP rating shall be shown on the meter case.

2.3.1.4 The case and display markings shall be indelible, distinct and legible from outside the meter. Symbols shall be at least 2.75 mm high. Text shall be at least 1.5 mm high and contrast in colour with the background with a preference for black lettering on a white background.

2.3.1.5 The markings of meters intended for outdoor locations shall withstand solar radiation. Multiple values of U_{nom} and f_{nom} may be marked if so specified by the manufacturer and an appropriate conformity assessment certificate has been obtained.

2.3.1.6 The serial number shall be provided in a position where it is not readily disassociated from parts determining the metrological characteristics.

2.3.1.7 The language for all text included in meter case and display markings shall be English with all hazard warning details repeated in Arabic

2.4 Upgrading of Software

2.4.1 Protection for Legally Relevant Software

2.4.1.1 Meters supplied to the market in Oman shall be fitted with a sealable setting (physical switch, software upgrade socket, secured parameter or other approved arrangement) that prevents the upgrading of legally relevant software without breaking the calibration seal.

2.4.1.2 All modifications to legally relevant software shall be considered as a repair after which the meter will be submitted for verification testing in accordance with the requirements of section 5.3.

2.4.2 Availability of Software Upgrades

2.4.2.1 The supplier of any meter into the market in Oman shall arrange that the meter manufacturer provides secured updates of all legally relevant software and/or other software to MoCIIP together with either:

- an application for approval of the meter with the updated software installed;

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- details of the already approved meter designation with the updated software installed.

2.4.2.2 Where the software upgrade affects the legally relevant software, an application for approval of the meter shall be accompanied with an appropriate conformity assessment which may include sections relating to the unchanged physical capability, functionality and parameters that have been submitted as part of the previous approval. Only those sections that relate to the changes being introduced by the upgrade require repeat testing.

2.4.3 Approval to Upgrade

2.4.3.1 MoCIIP shall consider the impact of the installation of this software and issue such instructions as are appropriate. Where the software does not affect legal metrology and does not conflict with any aspect of functionality that is required in Oman, there shall be a presumption that installation is appropriate. Based on the nature of the proposed upgrade to non-legally relevant software, MoCIIP shall determine whether the upgrade:

a) Can be carried out on meters currently installed without verification being necessary;
b) Must be carried out on all meters or only those meters where there is another requirement for this upgrade to be installed; and
c) Where installation is required on all meters, the period of time after which full installation must have taken place.

2.4.3.2 Where the software upgrade affects the legally relevant software MoCIIP shall determine whether the upgrade:

a) Must be carried out on all meters or only those meters where there is another requirement for this upgrade to be installed; and
b) Where installation is required on all meters, the period of time after which full installation or the removal from service of all affected meters must have taken place.

2.4.3.3 Details of all changes to installed software shall be recorded in a separate event log.

2.4.3.4 Where MoCIIP issues an instruction for the upgrade of any meter software, no person shall prevent its installation, or the replacement of the meter to permit installation as part of a repair, being carried out at any reasonable time.

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2.5 Determination of Verification Life

2.5.1 Initial Verification Lives

2.5.1.1 As part of the approval process, MoCIIP shall assign a verification life to each new meter approved for use in Oman. Unless an application for approval is accompanied by an appropriate assessment of reliability according to an internationally recognised procedure that indicates a longer verification life would be appropriate, the verification life assigned to a meter as part of the approval process shall be no more than 10 years.

2.5.1.2 MoCIIP will approve the acceptability of internationally recognised procedures for reliability assessment of electronic equipment as being relevant for application to meters at its sole discretion.

2.5.1.3 Unless the verification life is extended in accordance with the requirements of section 2.5.2 or section 2.5.3, the meter shall be removed from service at the end of this initial verification life.

2.5.2 Extension of Verification Life

2.5.2.1 At least 3 years prior to the end of verification life of a particular meter type, the person responsible for its maintenance may apply to MoCIIP for the verification life to be extended. The applicant shall provide details of the number of meters in service, their age and the number of that meter type that has been replaced because of defect by year of manufacture.

2.5.2.2 MoCIIP shall seek information from all parties that would be affected by such an extension in verification life on the number of meters for which they are responsible of that manufacture and type by year of manufacture and verification.

2.5.2.3 MoCIIP shall create a sampling plan and instruct the affected parties to remove a sufficient number of meters from service, approximately in proportion to the number for which they are responsible, as will form a homogenous sample. Sufficient additional meters shall be included to allow for the number of rejections permitted by section 8.3 and table 1 in Annex 2 of OIML Guide G 20 for the Surveillance of utility meters in service on the basis of sampling inspections.

2.5.2.4 For a population of meters to be considered homogeneous, they shall have the same characteristics, namely:

- Manufacturer

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- Type or model
- Capacity/rating
- Year of manufacture
- Number of the conformity assessment certificate
- Number of registers (unless multi–rate versions share approval characteristics and are metrologically equivalent)
- The dates of the last verification may differ at most by 1 year.

2.5.2.5 Where necessary, up to 5 years' meter installations will be combined to form a single sample. The earliest installed meters shall be the group tested.

2.5.2.6 The meters that are provided as part of the sample shall be inspected and tested at an approved or accredited laboratory or approved or accredited laboratories designated by MoCIIP to test the sample or parts of the sample. The designated laboratory or laboratories may be operated by an affected party or parties but shall be independent from the meter manufacturer and any meter supplier providing meters manufactured by the manufacturer. The inspection and test of the sample shall be the same as that required for initial verification. The tests undertaken shall be the verification tests specified in section 6.

2.5.2.7 The parties providing meters as part of the sample shall be permitted to count this provision as part of their routine calibration requirement.

2.5.2.8 The results shall be collated and analysed by MoCIIP.

2.5.2.9 Following submission of the test data to MoCIIP, the designated laboratory or laboratories shall retain the meters that formed the sample tested for a period of 3 months to allow MoCIIP to request further testing if necessary. At the end of this period, they shall be returned to the providing party.

2.5.2.10 In the event that the test indicates that there is not a case for extending the verification life of the meter type, all parties responsible for maintenance of that type of meter shall ensure their removal from service at the end of the initial verification period.

2.5.2.11 In the event that the test indicates that it would be reasonable to extend the verification life of the meter, MoCIIP shall revise the record of verification lives accordingly. MoCIIP shall define any maintenance or component replacement that may be required to permit extension of the verification life. The replacement of a

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battery by a battery of the same type shall not be considered as a component replacement provided it is not necessary to replace a verification seal.

2.5.2.12 Nothing shall prevent a person responsible for maintenance of electricity meters from requesting a further extension to the verification life of meters of a type for which it is responsible.

2.5.2.13 It shall be for MoCIIP as its sole right to determine whether it is likely to be in the best interests of electricity consumers to proceed with any part of the sampling process.

2.5.2.14 Except where MoCIIP contracts with a designated laboratory that is not part of the electricity sector, the parties involved in the process shall be responsible for their own costs. In the event that MoCIIP contracts with a designated laboratory that is not part of the electricity sector, that laboratory's costs shall be met by the person or organisation requesting a change to the verification life.

2.5.3 Regulatory review of Verification Lives

2.5.3.1 Where APSR considers that it may be in the best interests of electricity consumers to consider whether it may be reasonable to extend the verification life of any particular meter type, it shall be entitled to commence the extension process outlined in section 2.5.2 by making application to MoCIIP.

3. Meter Verification, Acceptance and Calibration Requirements

3.1 Requirements for Approved Laboratories

3.1.1.1 Approved Laboratories must satisfy MoCIIP that they are capable of accurately undertaking acceptance and verification testing as outlined in sections 4 and 5 but do not require to be accredited to ISO/IEC 17025. MoCIIP shall:

- formally approve all laboratories in this category;
- investigate the operation of an approved laboratory where there is a suspicion of non-compliance with the necessary requirements;
- issue improvement notices to the operator of an approved laboratory where necessary;
- remove the status of approved laboratory where appropriate.

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3.1.1.2 An approved laboratory which is subject to an improvement notice shall not conduct any activity specified in the improvement notice until such time as MoCIIP has formally stated that the issue that was the subject of the improvement notice has been resolved. In the event that MoCIIP removes approval of a laboratory, the operator shall immediately cease all acceptance, verification and routine calibration activity that relied on the use of that laboratory.

3.1.1.3 To ensure traceability to international standards, all equipment used by Approved Laboratories to undertake acceptance and/or verification testing shall be calibrated annually by an ISO 17025 accredited calibration laboratory and all standards used shall be maintained in a temperature-controlled dust-free environment at all times. A copy of the calibration certificate issued by the accredited calibration laboratory plus a copy of its current accreditation certificate shall be provided to the MoCIIP prior to the next use of the relevant equipment. Any test carried out using any equipment after the expiry date shown on its calibration certificate registered with MoCIIP or more than one year after the date of issue of that certificate, whichever is the earlier, shall be void.

3.1.1.4 It is accepted that approved laboratories may not keep all equipment used for testing energised at all times. However, before undertaking any acceptance or verification testing, all equipment required to complete that test shall have been energised for a minimum period of 2 hours.

4. Acceptance of Meters

4.1.1.1 Prior to meters being accepted into Oman, an acceptance test shall be carried out on behalf of the distribution company. This acceptance test shall normally be carried out by an Approved Laboratory but may be undertaken in an Accredited Laboratory outside Oman provided that the purchaser submits proof of Accreditation, obtains the approval of MoCIIP and all tests are witnessed by a suitably qualified representative of the purchaser. Prior to undertaking the electrical verification tests, a visual inspection as outlined in section 4.1.2 shall be undertaken.

4.1.1.2 The form of the acceptance test shall be a visual inspection as specified in section 4.1.2 followed by an electrical test that shall the same as a Verification test as defined by IEC 62058-31:2008 and detailed in section 6. Where the batch of meters being introduced is less than 40, all Meters shall be tested.

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4.1.1.3 Where more than 40 Meters are being introduced, acceptance testing may be carried out on a statistical basis:

- If the batch does not exceed 100 meters, 5% of that batch should be sampled and tested. If 2 or more meters are out of specification, the batch shall be rejected. If only 1 meter is non-conforming, another sample may be tested. In this second sample every meter shall be within specification for the batch to be accepted.
- For batches of more than 100 meters, the minimum number of meters to be tested shall be 40. For a batch size less than 1000 the purchaser may specify one of the sample sizes in Table 4. If only 1 meter more than the maximum number specified in Table 4 is non-conforming, another sample may be tested. In this second sample, the maximum number of meters shall be as specified in Table 4 for the batch to be accepted.
- For batches of 1000 or more the purchaser shall ensure that the batch is split into sub-batches of no more than 1000 meters and may specify one of the sample sizes for each 1000 Meters as shown in Table 1. The maximum number of non-conforming meters that are found in the sample for the remainder of the batch of 1000 meters or sub-batch where there are more than 1000 meters to be accepted are also shown in Table 1.

Table 1 - Statistical Testing for a batch of 1000 Meters

Number of Meters tested	40	70	100	1000
Maximum number of non-conforming meters	0	1	2	10

4.1.1.4 Samples shall be randomly taken from the batch or sub-batch of Meters. The sampler shall ensure that they are taken from all parts of the batch or sub-batch and represent the batch or sub-batch as a whole.

4.1.1.5 In all cases, any Meter found to be non-conforming shall be rejected even if the remainder of the batch of which it was a part is accepted.

4.1.1.6 A test certificate recording the test results for the meters tested and recording details of all other meters that are part of the batch or sub-batch shall be provided to the purchaser.

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4.1.2 Visual Inspection of New Meters at Acceptance

4.1.2.1 Visual Inspection of new meters at Verification and acceptance shall include an inspection that confirms:

a) Calibration seals are in place and intact;
b) The Meter has not suffered any damage and has no parts missing;
c) The meter markings specified in section 2.3 are complete.

5. Calibration and Verification

5.1 Calibration requirements

5.1.1.1 Meters shall be subjected to verification testing prior to first installation and, where reinstallation following the expiry of its verification life is permitted, prior to such re-installation.

5.1.1.2 Meters shall be replaced or re-verified following refurbishment at the end of their verification lives as established in accordance with the requirements of section 2.5.

5.1.1.3 Verification tests shall always be undertaken by an accredited laboratory or an approved laboratory.

5.2 Calibration and Verification of New Meters

5.2.1.1 Following manufacture, all meters shall be sealed and subjected to calibration and Verification in an Accredited Laboratory or Approved Laboratory according to the requirements of IEC 62058-31:2008 for individual Verification and the calibration requirements specified in section 6. Statistical Verification is not permitted. Prior to Verification the Meter shall be sealed in accordance with the requirements of section 7. Prior to undertaking the electrical verification tests, a visual inspection as outlined in section 5.2.1.4 shall be undertaken.

5.2.1.2 A Verification certificate, signed by the individual responsible for the test, shall be issued by the Accredited Laboratory or Approved Laboratory for each Meter that successfully passes Verification testing. This certificate may be in the form of an individual certificate for each Meter or a certificate recording the details of all Meters that passed Verification and were included in a batch tested together. The certificate must be provided by the Accredited Laboratory or Approved Laboratory to the party submitting the meter for test.

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5.2.1.3 The month and year of the Verification shall be indelibly marked on the Meter Case prior to the meter being returned to the party submitting the meter for test.

5.2.1.4 Visual Inspection of new meters at Verification shall include an inspection that confirms:

a) Calibration seals are in place and intact;
b) The Meter has not suffered any damage and has no parts missing;
c) The meter markings specified in section 2.3 are complete.

5.3 Calibration and Verification of Meters after Repair

5.3.1.1 Following repair, all meters shall be sealed and subjected to calibration and Verification in an Accredited Laboratory or an Approved Laboratory according to the requirements of IEC 62058-31:2008 for individual Verification and the calibration requirements specified in section 6. Statistical Verification is not permitted. Prior to Verification the Meter shall be sealed in accordance with the requirements of section 7. Prior to undertaking the electrical verification tests, a visual inspection as outlined in section 5.3.2 shall be undertaken

5.3.1.2 A Verification certificate, signed by the individual responsible for the test, shall be issued by the Accredited Laboratory or Approved Laboratory for each Meter that successfully passes Verification testing. This certificate may be in the form of an individual certificate for each Meter or a certificate recording the details of all Meters that passed Verification and were included in a batch tested together. The certificate must be provided by the Accredited Laboratory or Approved Laboratory to the party submitting the meter for test.

5.3.1.3 The month and year of the Verification shall be indelibly marked on the Meter Case prior to the meter being returned to the party submitting the meter for test.

5.3.2 Visual Inspection of Meters at Verification following Repair

5.3.2.1 Visual Inspection of meters at Verification following repair shall include an inspection that confirms:

a) Calibration seals are in place and intact;
b) The Meter has not suffered any damage and has no parts missing;
c) If the year of manufacture is 2020 or later, that the meter markings specified in section 2.3 are complete; or, if the year of manufacture is 2019 or earlier, that, at minimum the meter markings that exist include:

- Manufacturer's Name
- U_{nom}
- I_{max}
- I_{base}
- Serial number
- Number of phases
- Number of wires
- Register multiplier (if other than unity)
- Meter constant(s)
- Year of manufacture
- Accuracy class
- Directionality of energy flow if the meter is bidirectional or unidirectional. (No marking is required if the meter is capable only of positive direction energy flow.)
- Meter type
- f_{nom}
- Environmental Class
- The connection mode(s) for which the Meter is specified and for which approval has been given by MoCIIP
- Connection terminals uniquely identified to distinguish between terminals.

6. Verification Tests

6.1.1 Reference Conditions for Tests

6.1.1.1 Before calibration, it should be confirmed that the requirements as specified in Table 2 are fulfilled. This table contains the requirements for ambient temperature, warming up of the equipment and the permissible error of the power source used for the calibration.

Table 2 - Reference Conditions for Verification Tests

Influence quantity	**Reference Value**	**Permissible tolerances for meters of class**			
		0.2S	**0.5S**	**1**	**2**
Ambient Temperature	23 °C	± 2 °C			
Voltage	U_{nom}	± 1.0%			

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Influence quantity	Reference Value	Permissible tolerances for meters of class			
		0.2S	**0.5S**	**1**	**2**
Frequency	f_{nom}	± 0.3%	± 0.3%	± 0.3%	± 0.5%
Phase Sequence	L1 – L2 – L3	-			
Voltage unbalance	Zero	-			
Waveform	Sinusoidal voltages and currents	Distortion			
		< 2.0%	< 2.0%	< 2.0%	< 3.0%
Continuous magnetic induction of external origin	Zero	-			
Magnetic induction of external origin at the reference f_{nom}	Zero	Induction value that causes a variation of error not greater than			
		± 0.1%	± 0.1%	± 0.2%	± 0.3%
		but should be<0.05 mT			
Electromagnetic RF fields 30 kHz to 6 GHz	Zero	< 1 V/m			
Equipment warm-up period prior to testing		> 2 hours			
Current	Current range of device under test	1%	1%	2%	2%
Power factor	Power factor range of device under test	Current to voltage phase difference ± 2°			

6.1.1.2 Before calibration of polyphase meters, it should also be confirmed that the voltage and current balance requirements as specified in Table 3 are fulfilled.

Table 3 - Voltage and current balance for polyphase meters

Condition	Class of Meter			
	0.2S	**0.5S**	**1**	**2**
Each of the voltages between phase and neutral and between any two phases shall not differ from the average corresponding voltage by more than	± 1%			

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Condition	Class of Meter			
	0.2S	0.5S	1	2
Each of the currents in the conductors shall not differ from the average current by more than	± 1%		± 2%	
The phase displacements of each of these currents from the corresponding phase-to-neutral voltage, irrespective of the phase angle, shall not differ from each other by more than	2º			

6.1.2 Verification Tests to be Undertaken

6.1.2.1 The minimum tests to be undertaken prior to issuing a verification certificate or installation approval certificate shall be conducted in the following order:

a) AC voltage test
b) No Load Test
c) Starting Load Test
d) Accuracy Tests
e) Register Test

Where a meter is intended for use as a bidirectional meter, the starting load test, accuracy tests and register test shall be repeated for currents in the reverse direction.

Where the meter is to be certified for multiple values of U_{nom}, the no load test, starting load test, accuracy tests shall be carried out at the lowest and highest values of U_{nom}.

Prior to tests being undertaken, the meters shall be energised at U_{nom} and loaded with a current at unity power factor of $0.1I_b$ for direct connected meters or $0.1I_n$ for transformer connected meters to reach thermal stability.

6.1.2.2 These tests shall be conducted as detailed:

a) AC Voltage Test – Test number 1

A test voltage that shall be substantially sinusoidal, having a frequency between 45 Hz and 65 Hz, and be applied for 2 s. The power source shall be capable of supplying at least 500 VA. The rise time and the fall time of the test voltage shall be ≤ 2 s. The auxiliary circuits with reference voltage equal to or below 40 V

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shall be connected to earth. During this test, no flashover, disruptive discharge or puncture shall occur.
In the case of meters of insulation class I the rms test voltage applied shall be 1.6 kV. In the case of meters of insulation class II the rms test voltage applied shall be 3.2 kV.

b) No Load Test – Test number 2

The no load test to be undertaken shall be in accordance with the requirements of section 5.4 of IEC 62058-31.

c) Starting Current Test – Test number 3

When the meter is energised at the reference voltage (and, in the case of polyphase meters, with balanced load) and connected as shown in its diagram of connections, a meter for which a basic current is specified shall start and continue to register at the current given in Table 4.

Table 4 - Value of current for starting current test

Meter Connection	Class of Meter				Power Factor
	0.2S	0.5S	1	2	
Direct Connection	-	-	0.004 I_b	0.005 I_b	1
CT Operated	0.001 I_n	0.001 I_n	0.002 I_n	0.003 I_n	1

Where a starting current I_{st} is specified, the meter shall be started at unity power factor and 1.5*t* allowed for the first pulse to occur and a further 1.5*t* allowed for the second pulse to occur. The effective time between the pulses should be determined and it shown that a third pulse occurs in the same time period. The objective of the test is to prove that the meter starts and continues to operate at the specified I_{st}.

The expected time *t* between pulses is:

$$\frac{3.6 \times 10^6}{m \cdot k \cdot U_{nom} \cdot I_{st}}$$

where:

k is the number of pulses emitted by the meter per kWh

m is the number of elements

d) Accuracy Tests

Accuracy tests shall be carried out for single phase meters for which a value of I_b is specified and polyphase meters for which a value of I_n is specified at the test points specified in Table 5. Tests shall be undertaken in the order specified without waiting for thermal equilibrium to be attained between the measurements.

Table 5 – Accuracy test points and percentage error limits

Test	Value of current for		Power factor	Meter type	Load (for polyphase metes)	Limits or percentage error for meters of class			
	Direct connected meters	Transformer connected meters				0.2S	0.5S	1	2
4	0.05 I_b	0.01 I_n	1	Single and polyphase	Balanced	± 1.0	± 0.4		
		0.02 I_n						± 2.5	± 1.5
5	I_b	I_n	1	Single and polyphase	Balanced	± 0.2	± 0.5	± 1.0	± 2.0
6	I_b	I_n	0.5 lag	Single and polyphase	Balanced	± 0.3	± 0.6	± 1.0	± 2.0
7	I_b	I_n	1	Polyphase	Single phase	± 0.3	± 0.6	± 2.0	± 3.0
8	I_b	I_n	1	Polyphase	Single phase	± 0.3	± 0.6	± 2.0	± 3.0
9	I_{max}	I_{max}	1	Single and polyphase	Balanced	± 0.2	± 0.5	± 1.0	± 2.0

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Test 7 shall be undertaken with the meter supplied with three phase symmetrical voltage. The current shall be applied to any of the phases.

Test 8 shall be undertaken with the meter supplied with three phase symmetrical voltage. The current shall be applied to a different phase from that in test 7.

Where meters are designed to measure bidirectional flows, tests shall be carried out with current in each direction sequentially.

Where a meter is stated to measure flows in one direction only, a test shall be carried out at unity power factor with reversed current flow at each of I_b and I_{max} to demonstrate that no measurement takes place.

Where the manufacturer has defined values for I_{min}, I_{tr} and I_{max}, rather than I_b or I_n and I_{max} , accuracy tests shall be carried out at the test points detailed in Table 6 at U_{nom} instead of the tests specified in Table 5.

Table 6 - Accuracy test points and percentage error limits

Test	Value of current	Power factor	Meter type	Load (for polyphase metes)	Limits or percentage error for meters of class			
					0.2S	0.5S	1	2
4	$I_{min} \leq I < I_{tr}$	1	Single and polyphase	Balanced	± 0.4	± 1.0	± 1.5	± 2.5
5	$I_{tr} \leq I < I_{max}$	1	Single and polyphase	Balanced	± 0.2	± 0.5	± 1.0	± 2.0
6	$I_{tr} \leq I < I_{max}$	0.5 lag	Single and polyphase	Balanced	± 0.3	± 0.6	± 1.5	± 2.5
7	$I_{tr} \leq I < I_{max}$	0.8 lead	Single and Polyphase	Balanced	± 0.3	± 0.6	± 1.5	Test 5 result ± 2.5
8	I_{max}	1	Single and polyphase	Balanced	± 0.2	± 0.5	± 1.0	± 2.0
					Change from tests 5 and 6			

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Test	Value of current	Power factor	Meter type	Load (for polyphase metes)	Limits or percentage error for meters of class			
					0.2S	0.5S	1	2
9	$I_{tr} \leq I < I_{max}$	1	Polyphase	Single phase	± 0.3	± 0.7	± 1.0	± 1.5*
10		0.5 lag			± 0.5	± 1.0	± 1.5	± 2.5*
11	$I_{tr} \leq I < I_{max}$	1	Polyphase	Single phase	± 0.3	± 0.7	± 1.0	± 1.5*
12		0.5 lag			± 0.5	± 1.0	± 1.5	± 2.5*

Tests 9 and 10 shall be undertaken with the meter supplied with three phase symmetrical voltage. The current shall be applied to any of the phases.
Tests 11 and 12 shall be undertaken with the meter supplied with three phase symmetrical voltage. The current shall be applied to a different phase from that in tests 9 and 10.

* in these tests. the error shift for class 2 meters may be greater than these values provided the overall error remains within ± 2.5%

Where meters are designed to measure bidirectional flows, tests shall be carried out with current in each direction sequentially. Where a meter is stated to measure flows in one direction only, a test shall be carried out at unity power factor with reversed current flow at each of I_{min} and I_{max} to demonstrate that no measurement takes place.

e) Register Test
This test shall be performed by measuring a sufficient amount of energy to verify that the accuracy of incrementing the register reading is better than ±1.0%. The test shall be done for each meter on at least one tariff register.

7. Sealing of Meters for Verification

7.1.1.1 All Meters shall be sealed prior to Verification. The sealing may be undertaken by:

a) the use of a one-piece case which cannot be opened; or
b) the use of a crimped security seal as specified in section 7.1.2.

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7.1.2 Form of Crimped Security Seal

7.1.2.1 A seal shall be comprised of two parts – a short piece of wire rope and a sealing ferrule - which, when fitted together and compressed by a sealing tool, will prevent the removal of a seal without clear evidence of that removal. The following specification for the seal is intended to ensure that it cannot reasonably be accidentally broken or removed.

7.1.2.2 The wire rope shall be 150mm long, have a minimum diameter of 0.9mm, have a breaking load of at least 880N and be manufactured from 7 strands of zinc coated steel wire.

7.1.2.3 The sealing ferrule shall be a tin plated, annealed copper ferrule between 5.0 and 6.0mm in length with an internal diameter between 1.95 and 2.25mm, an external diameter between 4.0 and 4.6mm and be constructed such that at no point the wall of the ferrule is less than 0.8mm thick.

7.1.2.4 The sealing tool will comprise a compression tool and compression dies such that the tool will compress the ferrule onto the wire rope so that the formed seal will withstand a minimum tensile load of 200N. The compression dies shall be designed to mark the compressed ferrule on two opposing sides:

- On one side with an identifying mark or up to 3 alphanumeric characters as approved by MoCIIP uniquely identifying the Accredited Laboratory, and
- On the other side with 3 alphanumeric characters that will uniquely identify the operative who has fitted the seal.

7.1.3 Control of Sealing Tools

7.1.3.1 Sealing tools must be provided by the Accredited Laboratory for each operative authorised to remove and replace verification seals. The Accredited Laboratory shall provide facilities for the operative to store the sealing tool in a secure location to which only that operative has access when it is not in use. The owners of the Accredited Laboratory shall ensure that a senior member of their staff examines all sealing tools each month and maintains a signed record detailing the presence (or otherwise) of the tool and its condition.

7.1.3.2 Compression dies must not be used by more than one operative but may be transferred between operatives provided two operatives do not use the same tool in the same month. No Accredited Laboratory shall hold duplicate sets of dies.

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Where an operative will no longer seal Meters tested on behalf of the Accredited Laboratory, the Accredited Laboratory must immediately recover the compression dies issued to that operative.

7.1.3.3 Compression dies that no longer make legible marks must not be used and must be immediately destroyed by the Accredited Laboratory. The Accredited Laboratory may arrange that a replacement set of dies with the same identifier are manufactured and issued to the operative or alternatively issue a replacement sealing tool with a different identifier to the operative at its choice.

7.1.3.4 The Accredited Laboratory shall keep a record of when a sealing tool is issued to an operative or sent for repair. For dies in use, this record shall show:

- The identification mark of each set of dies held,
- The name or the person to whom the dies were issued or the person or company to whom they have been sent for repair,
- The dates of issue and return

7.1.3.5 For dies destroyed this record shall show the date and reason for their destruction.

7.1.3.6 For dies that have been lost or stolen, a record shall be kept showing the date and location of loss. The Accredited Laboratory shall immediately advise MoCIIP and all affected meter purchasers the details of all meters that are marked as having successfully passed Verification tests during the month in which the loss occurred.

7.1.3.7 All records kept in accordance with sections 7.1.3.4 to 7.1.3.6 shall be retained for a period of 10 years following the destruction or loss of the dies and shall be made available to MoCIIP on request.

7.1.3.8 On being given reasonable notice, the Accredited Laboratory shall produce any dies for inspection by MoCIIP or their agent on request. In this respect, the agency retained by the Accredited Authority to undertake their accreditation review should be considered as an agent of MoCIIP.

7.2 Sealing of Meter Terminations

7.2.1 Equipment to be Sealed

7.2.1.1 To ensure that the accuracy of the measurement displayed by the metering equipment is maintained, termination seals shall be applied to provide an indication of access having been taken to any part of the metering system or immediate

network area. It is acknowledged that, where indicative seals are used, their removal does not constitute proof of tampering and that the removal of any termination seal may indicate that legitimate work has been undertaken.

7.2.1.2 Seals shall be applied to the following locations and any other locations where it may be possible to access equipment in a manner that could result in an incorrect measurement being made:

- All meter terminal block covers;
- All covers protecting communications modules associated with the metering system;
- All cut-out fuse units and terminations and MCCB terminations associated with LV supplies;
- All VT secondary fuses associated with the metering system;
- All termination blocks on which any CT or VT secondary wiring is terminated;
- All test block covers; and
- All withdrawable VT units.

7.2.2 Type of Seal

7.2.2.1 Tamper evident security seals as specified and provided by the relevant network operator and approved by the Authority for Public Services Regulation, Oman shall be used to seal all terminations.

8. On Site Calibration

8.1.1 Calibration requirements

8.1.1.1 Meters shall be replaced or re-verified following refurbishment at the end of their verification lives as established in accordance with the requirements of section 2.5. Verification tests shall always be undertaken by an accredited laboratory or an approved laboratory.

8.1.1.2 The person responsible for maintenance of metering systems shall undertake intermediate calibration checks on metering systems as detailed in Table 7. These checks may be carried out in an approved laboratory or on-site provided

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appropriate test equipment is used. If any metering equipment is removed from site or replaced, a full recommissioning test shall be conducted on the reconnected metering installation.

Table 7 – Routine On site Calibration Requirements for Metering Installations

Connection Capacity	Installation Type	On Site Calibration Required
≤ 1MVA	Direct	None
	CT Operated	Every 5 years
> 1MVA - 5 MVA		Every 5 years
> 5 MVA	Main and Check Meters of Same Type	Every 5 years
	Main and Check Meters of Different Type	None

8.1.1.3 Verification seals shall not be removed during an on-site calibration check. If a verification seal is removed at an approved laboratory, a full verification test shall be carried out following its replacement.

8.1.1.4 Calibration checks will also be undertaken within 2 business days of:

a) Any cumulative register not recording the same value as the sum of the values recorded in the relevant interval registers for any day;
b) The values recorded by main and check meters differing by more than 1.5 times the limit of error in Table 9

8.1.2 On-site Calibration Equipment

8.1.2.1 Equipment used for on-site calibration shall be portable meter test equipment capable of delivering a measurement uncertainty within the values shown in Table 8.

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Table 8 - Measurement uncertainty for equipment used to test active energy meters on site

Maximum overall uncertainty of calibration equipment	Class of meter under test			
	0.2S	**0.5S**	**1**	**2**
Measurement at unity power factor	±0.06%	±0.1%	±0.4%	±0.4%
Measurement at other than unity power factor	±0.12%	±0.2%	±0.6%	±0.6%

8.1.2.2 Equipment used for on-site calibration testing shall be verified by an accredited laboratory annually and a copy of the certificate issued shall be provided to the MoCIIP prior to its next use. Any test carried out using any equipment after the expiry date shown on its calibration certificate registered with MoCIIP or more than one year after the date of issue of that certificate, whichever is the earlier, shall be void.

8.1.2.3 Equipment used for on-site calibration testing shall be confirmed by an approved laboratory at least every three months and records kept of these tests although a formal certificate need not be issued.

8.1.2.4 Such a three-monthly test may be carried out by simultaneously calibrating the same three phase kWh meter using the meter test bench of the approved laboratory and the portable test equipment. In this case the difference between the error of the reference meter as determined by the test bench and that determined by the mobile testing station is to be considered as the error of the on -site test equipment. The accuracy of the reference meter shall not be considered relevant as it is only an intermediate instrument that has no bearing on the result of the reference measurement.

8.1.2.5 If it is not possible to simultaneously measure the reference kWh-meter (with the optical scanning heads of both the test bench and the on-site test equipment scanning the led output) as described in section 8.1.2.4, the measurements must be performed in direct succession. As the stability of the reference kWh-meter is important for this sequential test, class 0.2S kWh-meter shall be used as the reference meter.

8.1.2.6 The requirements for the reference measurements for tests as described in sections 8.1.2.4 and 8.1.2.5 are:

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- difference error ('bench error' minus 'mobile error') < 0.3 %

- change in subsequent error measurements < 0.1 %

8.1.2.7 At least once per month, the on-site test equipment shall be used to carry out an on-site calibration test on the same three-phase kWh meter and a record kept of these monthly tests. Where the change in subsequent error measurements is >0.2%, all onsite tests carried out since the previous monthly test shall be considered void and the equipment returned to an approved laboratory for investigation. A network operator may conduct this calibration test more frequently than once per month, in which case the test considered void will be those since the last test where the error was within the prescribed limit.

8.1.2.8 When conducting the tests outlined in sections 8.1.2.4 to 8.1.2.7 the equipment must always be tested with the current clamps used for its annual verification which shall also be used when conducting all on-site tests.

8.1.2.9 A copy of the test record for each test described in sections 8.1.2.4 to 8.1.2.7 shall be provided to MoCIIP or APSR on request.

8.1.2.10 Equipment used for on-site calibration testing shall be stored and transported using a proprietary aluminium or steel transport case with rigid foam protection designed to accommodate each article.

8.2 Routine On-site Calibration Checks

8.2.1.1 An on-site calibration check shall include at minimum:

a) A visual check without removing covers that confirms:
   i. The current transformers are of the correct ratio and polarity and correctly located to record the required power flow;
   ii. (Where fitted) the voltage transformers are of the correct ratio and polarity and correctly located to record the required power flow;
   iii. The meters are set to the same current transformer and voltage transformer ratios as the installed measurement transformers;
   iv. The meters have the correct compensation for errors in the measurement transformers/connections and losses in power transformers where appropriate;
   v. The cabling is such that the burdens on the measurement transformers will be within the correct limits;

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vi. All of the appropriate calibration seals and terminal cover seals are in place, noting that terminal cover seals are required at all locations where the CT and/or VT cabling is terminated and on all VT fuses. The identification marks on these seals shall be recorded as part of the programme for all on-site calibration checks.

b) A test programme that demonstrates:

i. The relationships between voltages and currents are correct and that phase rotation is standard at the meter terminals;

ii. The metering equipment detects phase failure and operates the required remote alarms and/or local indications as appropriate;

iii. The output of the metering system correctly records the energy in the primary system at the connection point. This test programme shall include a series of at least three accuracy tests of different duration including one that is of sufficient duration to cause the cumulative energy register to advance. Where a metering installation records power flows in both directions, the on-site calibration check shall prove active energy flows in both directions and (at minimum) reactive flows in one direction are being accurately displayed.

c) Where remote reading of the meter data via a communications link is proposed, the on-site calibration test shall include a comparison of each register data with that recorded by the remote reading system for the same period. The relevant network operator shall ensure that the appointed data collector provides the necessary assistance and information to allow this confirmation check to be undertaken.

8.2.1.2 It is anticipated that routine on-site calibration tests shall make use of such reasonable load flows as are possible with confirmation being demonstrated that the metering equipment is recording such flows accurately. Where such tests are not conclusive additional testing may be required including testing and an Accredited Laboratory or Approved Laboratory as detailed in section 6.

9. Overall Metering System Accuracy Requirements

9.1.1.1 The combined maximum permissible errors for metering installations shall be as recorded in Table 9.

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Table 9 – Combined Maximum Permissible Errors for each Connection Capacity

Condition	Limits of error at stated Power Factor for Active Power and Energy measurement				
Current expressed as a percentage of rated measuring current	**Power Factor**	**Limits of error for Connections**			
		>100 MVA	**>20–100 MVA**	**>1–20 MVA**	**<=1 MVA**
120% to 10% inclusive	1	±0.5%	±1.0%	±1.5%	±1.5%
Below 10% to 5%	1	±0.7%	±1.5%	±2.0%	±2.5%
Below 5% to 1%	1	±1.5%	±2.5%		
120% to 10% inclusive	0.5 lag	±1.0%	±2.0%	±2.5%	±2.5%
120% to 10% inclusive	0.8 lead	±1.0%	±2.0%	±2.5%	±2.5%
Condition	**Limits of error for Reactive Power and Energy at stated Power Factor**				
Current expressed as a percentage of rated measuring current	**Power Factor**	**Limits of error for Connections**			
		>100 MVA	**>20–100 MVA**	**>1–20 MVA**	**<=1 MVA**
120% to 10% inclusive	0	±4.0%	±4.0%	±4.0%	±4.0%
120% to 20% inclusive	0.866 lag	±5.0%	±5.0%	±5.0%	±5.0%
120% to 20% inclusive	0.866 lead	±5.0%	±5.0%	±5.0%	±5.0%

9.1.1.2 To ensure that this is achieved, the accuracy classes of metering equipment installed shall be as shown in Table 10.

Table 10 - Accuracy Classes by Connection Capacity for Metering Installation Components

Connection Capacity	Active Power and Energy Meters	Reactive Power and Energy Meters	Current Transformer	No of Secondary Windings	Voltage Transformer	No of Secondary Windings
≤ 1MVA	2	2	0.5	1	1	-
> 1MVA - 5 MVA	1	2	0.5	1	1	1
> 5 MVA - 20 MVA	1	2	0.5	2	1	2
> 20 MVA – 100 MVA	0.5S	2	0.2S	2	0.5	2
> 100 MVA	0.2S	2	0.2S	2	0.2	2

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10. Commissioning of CT Operated Metering Installations

10.1.1.1 Where CTs and/or VTs are mounted in equipment under the control of the network operator, the network operator shall be responsible for ensuring that the appropriate commissioning tests are undertaken. In all other circumstances, the person providing and installing the equipment shall be the person responsible for commissioning the metering system.

10.1.1.2 At the time CT operated metering systems are installed, the person responsible for installation shall undertake a commissioning test to confirm the installation is correctly installed and sealed.

10.1.1.3 This check shall include:

a) Tests that demonstrate that:
   i. The current transformers are of the correct ratio and polarity and correctly located to record the required power flow;
   ii. (Where fitted) the voltage transformers are of the correct ratio and polarity and correctly located to record the required power flow;
   iii. The relationships between voltages and currents are correct and that phase rotation is standard at the meter terminals;
   iv. The burdens on the measurement transformers are within the correct limits;
   v. The meters are set to the same current transformer and voltage transformer ratios as the installed measurement transformers;
   vi. The meters have the correct compensation for errors in the measurement transformers/connections and losses in power transformers where appropriate;
   vii. The output of the metering system correctly records the energy in the primary system at the connection point;
   viii. The metering equipment detects phase failure and operates the required remote alarms and/or local indications as appropriate;
   ix. An accuracy test of the complete metering system as soon as the installation is energised and supplying load. Where a metering installation records power flows in both directions, the post commissioning check shall prove active energy flows in both directions and (at minimum) reactive flows in one direction are being accurately displayed.

b) A visual inspection that confirms of all of the appropriate calibration seals and terminal cover seals are in place. Terminal cover seals are required at all locations where the

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CT and/or VT cabling is terminated and on all VT fuses. The identification marks on these seals shall be recorded as part of the commissioning programme.

c) Where remote reading of the meter data via a communications link is proposed, the commissioning test shall include a comparison of each register data with that recorded by the remote reading system for the same period. The relevant network operator shall ensure that the appointed data collector provides the necessary assistance and information to the person responsible for commissioning.

10.1.1.4 A copy of the commissioning details shall be provided to the network operator and the network user by the person responsible for them being undertaken.

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Schedule 1 – Approved List of Approved Conformity Assessment Laboratories

As a starting point, the list could include those laboratories approved in EU for this work, defined as “Notified Bodies” in the list available at:

http://ec.europa.eu/growth/tools-databases/nando/index.cfm?fuseaction=directive.pdf&refe_cd=2014%2F32%2FEU&requesttimeout=900

This is a complete list for all measuring instruments and it would be necessary to extract those approved for assessing Active Electrical Energy Meters (Annex V MI-003).

Should MoCIIP wish to create its own list from scratch, a possible mechanism for assessing laboratories is available at https://www.oiml.org/en/oiml-cs/oiml-issuing-authorities.

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