METERING CODE

Energy Market Authority of Singapore

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Metering Code

1 GENERAL AND ADMINISTRATIVE PROVISIONS

1.1 Purpose of this Code

1.1.1 This Code sets the minimum conditions that a metering service provider must meet in carrying out its obligation to provide services to metered entities. This Code sets out rights and obligations of metering service providers and metered entities in respect of both the wholesale electricity market and the retail electricity market. Specifications for meter installations and equipment are described in this Code.

1.2 To Whom this Code Applies

1.2.1 Subject to section 1.2.2, this Code applies to a Licensee who is subject to this Code as a condition of its electricity licence and a Licensee defined in section 1.4.1 of this Code.

1.2.2 A Licensee may, by condition of its electricity licence imposed pursuant to section 9(7)(a)(iii) of the Act, be exempted from compliance with this Code, in whole or in part. A Licensee that has been so exempted shall not, subject to such conditions or restrictions as the Authority may determine, be required to comply with the provisions of this Code that are the subject of the exemption unless and until such exemption is withdrawn or modified by the Authority.

1.3 Prohibition

1.3.1 No meter or metering equipment shall be:

(a) installed or maintained by a person who is not a MESP, as defined in this Code; or

(b) read by a person who is not a MR, as defined in this Code.

1.3.2 No person shall receive, store or process data received from a MR or a MESP unless that person is a MDM, as defined in this Code.

1.4 Definitions

1.4.1 In this Code, unless the context otherwise requires:

"account" means a contractual relationship between a metered entity and a metering service provider;

"Act" means the Electricity Act (Cap. 89A);

"Authority" means the Energy Market Authority of Singapore, established under the Energy Market Authority of Singapore Act (Cap. 92B);

"auxiliary load" means electricity usage by any electrical plant of a generation facility that is not directly a part of the boiler plant or generating unit or substation primary equipment but is required for the boiler plant's or generating unit's or substation's primary equipment's functional operation;

"business day" means, where expressed by reference to a person in Singapore, any day other than a Saturday, a Sunday or a day on which banks are authorised or required to be closed in Singapore;

"check meter" means a meter that is used to cross-check the measurements made by a main meter;

"circuit breaker" means a switching device having a switching capacity sufficient to withstand the electrical stresses occurring when connecting and disconnecting equipment and sections of installations under fault and fault-free conditions, and in particular under short-circuit conditions;

"Code of Conduct for Retail Electricity Licensees" means the Code of practice issued by the Authority that describes the standards of performance and practice to be used by Retail Electricity Licensees;

"Code" means this Metering Code;

"common usage" means the difference between total metered electricity use in a master-metered installation over a period of time and the sum of all electricity use for all accounts of sub-metered consumers associated with the installation of such sub-metered consumers in the same installation over the same period of time;

"connect" means in respect of a consumer's or Generation Licensee's or Importer Licensee's installation, to put into place a physical link between the relevant service connection and the relevant connection point, but excluding the physical link between the service connection termination and the installation, and "connection", "disconnection", "reconnection" and all grammatical variations thereof shall be interpreted accordingly, provided that the term "disconnection" shall be interpreted to mean the removal of the physical link and/or discontinuing the flow of electricity to or from an installation;

"connection point" means

- for a load, the point at which the circuit breaker or other isolating device owned and controlled by the Transmission Licensee is located on the Transmission Licensee's side of a service connection, other than that of an interconnector;
- for a generating station including one that has an import facility that is connected to the station's switch-house, the point on the transmission system where the generating station is connected to; and
- for an import facility that is connected directly to a Transmission Licensee's substation, the point on the transmission system where the import facility is connected to.

"demand response aggregator" or "DRA" means a market participant, including Retail Electricity Licensee, who registers one or more installations under a load registered facility (LRF) with restricted energy bids (REB) with the Market Company for the purposes of load curtailment;

"direct access " means access by a contestable consumer to a wholesale electricity market;

"electricity licence" has the same meaning as in the Act;

"embedded generation facility" means a generation facility that has been classified as such in accordance with the Market Rules;

"energise" means

- in the case of a consumer's installation other than an installation of a sub-metered consumer or of any other consumer that receives a supply of electricity via another consumer's internal electrical system, the closing of a circuit breaker or other isolating device, owned and controlled by the Transmission Licensee, located at a connection point and "energisation', 'de-energisation' and "re-energisation" and all grammatical variations thereof shall be interpreted accordingly; and
- in the case of a sub-metered consumer's installation or any consumer that receives supply of electricity via another consumer's internal electrical system, the closing of a circuit breaker or other isolating device, located at the boundary between the electrical system of the master-metered installation and the installation of a sub-metered consumer and "energisation', 'de-energisation' and "re-energisation" and all grammatical variations thereof shall be interpreted accordingly;

"extra high voltage" means voltages exceeding 22 kilovolts but less than 230 kilovolts;

"generating station" means any installation used for, or for purposes connected with, the production of electricity;

"generating unit" means any apparatus used for, or for purposes connected with, the production of electricity;

"generation facility" or "GF" means one or more generating units, including its associated equipment such as switchgears, transformers and all auxiliary equipment;

"Generation Licensee" has the same meaning as in the Act;

"generation meter" means the main meter and check meter, associated with a generating unit or a generation facility;

"generation registered facility" or "GRF" means a generation facility that has been registered as a registered facility, as that term is defined in the market rules, with the Market Company to provide one or more of energy, reserve, regulation or contracted ancillary services, as those terms are defined in the market rules;

"generation settlement facility" or "GSF" means a generation facility that has been registered for settlement purposes only in accordance with section 5.4 of Chapter 2 of the Market Rules;

"high voltage" means voltages exceeding 1000 volts, including but not exceeding 22 kilovolts;

"incoming electrical switch" means the circuit breaker, load switch or other mechanism by which load current or an electrical circuit may be broken, located at the connection point or the intersection of a feeder line and the electrical system of a consumer installation or a generation facility by which electricity flow may be activated or deactivated;

"indirect access" means access by a contestable consumer to a wholesale electricity market through a Market Support Services Licensee;

"installation meter" means the main meter and, for consumers other than those connected to the low voltage transmission system, the check meter that measure the flow of electricity to and from the consumer's installation;

"intermittent generation facility" means any generation facility whose power output, in the course of its ordinary and proper operation, cannot be predicted or be directly controlled or varied at will. This includes solar photovoltaic generation facility;

"intertie meter" means a main meter and the check meter used to measure the flow of electricity into or from the transmission system across an interconnection between the transmission system and an electricity system that is outside Singapore and under the control of a control area operator, as that term is defined in the market rules, other than the Power System Operator;

"interval meter" means a meter that is capable of recording electricity usage in each half-hour dispatch period as defined in the market rules or in such other increment of time as may be required by the market rules or a code of practice, as the case may be, to allow for settlement for regulated supply service or for settlement in the wholesale electricity market or the retail electricity market;

"isolating device" means a device for achieving isolation;

"kilovar-hour meter" means a meter that records the cumulative flow of reactive energy without reference to specific time intervals;

"kilowatt-hour meter" means a meter that records the cumulative flow of active energy without reference to specific time intervals;

"Licensed Electrical Worker" or "LEW" means a person who holds a valid electrical worker licence permitting him to perform personally such electrical work as is specified in his licence;

"Licensee" means:

(i) a Generation Licensee;

(ii) an Importer Licensee;

(iii) a Market Company Licensee;

(iv) a Market Support Services Licensee;

(v) a Retail Electricity Licensee;

(vi) a Transmission Licensee;

(vii) a Wholesaler Licensee;

"Load Profile" means the average consumption pattern of a residential contestable consumer across each half-hour interval, commencing 0:00 hours, as determined by the Authority;

"Load Profiling" means the metering option chosen by a residential contestable consumer where its energy usage is determined based on the Load Profile or variations thereto;

"Load Registered Facility (LRF) with restricted energy bids (REB)" means a load facility that is registered with the Market Company and subject to scheduling of energy withdrawal for the purposes of load curtailment;

"low voltage" means voltages not exceeding 1000 volts;

"main meter" means a meter other than a check meter that is capable of and used to measure the flow of active or reactive power from or to a generation or load facility;

"Market Company Licensee" means the company which holds an electricity licence authorising it to operate any wholesale electricity market pursuant to section 42 of the Act;

"market participant consumer" means a contestable consumer that receives direct access or purchases electricity from a market participant retailer;

"market participant retailer" means a Retail Electricity Licensee that is a market participant;

"Market Support Services Code" means the code of practice issued by the Authority that describes the standards of performance by which a market support services licensee is required to perform market support services;

"Market Support Services Licensee" has the same meaning as in the Act;

"master-metered consumer" means a consumer responsible for the common usage of a master-metered installation;

"master-metered installation" means an installation in which supply is received by a master-metered consumer and sub-metered consumers;

"meter" means any electrical device capable of measuring and permitted in terms of this Code to be used to measure the flow of real or reactive electrical power, and includes an installation meter, a prepaid meter, a pool meter, an intertie meter, and a generation meter, from which readings are to be taken for settlement purposes;

"meter data manager" or "MDM" means a person responsible under the terms of its electricity licence, for the management of data related to meter reading including storing meter data in the Metering Data Registry, transforming raw meter data to settlement ready data, aggregating data for settlement purposes, and transmitting data to all relevant parties for billing, calculation of settlement or other suitable purposes;

"meter equipment service provider" or "MESP" means a person responsible under the terms of its electricity licence, for installing, maintaining and/or verifying the accuracy of a meter installation;

"meter installation" means the meter and, if so equipped, the self-contained meter transformers, wiring, test links, fuses, lamps, data recorders, miniature circuit breakers, and communication modem required to provide remote access to the metered data so that readings from the meter can be taken for settlement purposes;

"meter reader" or "MR" means a person responsible under the terms of its electricity licence, for the reading of the registry of any meter and delivering meter data to a MDM;

"metered entity" means a consumer, Generation Licensee, Importer Licensee, Retail Electricity Licensees, Wholesaler Licensee or any other person responsible for the flow of electricity measured by a meter at which the transmission system is terminated at the associated installation, and shall include the Transmission Licensee or any person through whose plant or equipment there is a flow of electricity that is being metered for the purposes of settlement by an electricity licensee;

"Metering Data Registry" means a database that contains meter information and the meter readings collected by a MR, including data that has been verified, estimated and edited by a MDM;

"metering equipment" means any equipment that is required for or used in a meter installation to enable any meter in that installation to perform as required by this Code;

"metering service provider" or "MSP" means a person who is a MESP, MR or MDM;

"metering services" means services relating to meter installations, meter reading, meter data management and meter data aggregation, being services provided by a MESP, MR or MDM;

"MEUC" refers to the monthly energy uplift charge, which is estimated by the EMC under section 3.5.3 of chapter 7. of the Market Rules

"non-market participant consumer" means a contestable consumer that receives indirect access or purchases electricity from a non-market participant retailer;

"non-market participant retailer" means a Retail Electricity Licensee that is not a market participant retailer;

"pool meter" means the main meter and the check meter, that measure the offtake due to an aggregation of loads, rather than the loads for specific consumers, connected to the transmission system at voltages below 66kV;

"Power System Operator" means the Authority acting in its capacity as the person responsible for ensuring the security of supply of electricity to consumers and arranging for the secure operation of the transmission system in accordance with the market rules and applicable codes of practice as described in section 3(3)(e) of the Act;

"prepaid meter" means a meter with the additional capability to allow electricity consumption to be based on the amount of payment made in advance by the consumer for the electricity to be consumed. For the purpose of this code, prepaid meters refer to those

installed at non-contestable consumers' domestic premises in accordance with the Regulated Supply Service Code;

"raw meter data" means the data that is obtained or derived from the application of the procedures specified in section 3.7;

"regulated supply service" means the supply of electricity and the provision of market support services to a non-contestable consumer under section 21 of the Act;

"Regulated Supply Service Code" means the code of practice issued by the Authority that describes the standards of performance and practice to be used with respect to regulated supply service;

"relevant legislation" means the Act and the Energy Market Authority of Singapore Act 2001, and includes in each case the regulations made thereunder;

"retail electronic business transaction system" means the combination of rules, protocols, software, hardware and communication devices developed, operated and maintained by a Market Support Services Licensee for the exchange of communications referred to in the Market Support Services Code;

"Retail Electricity Licensee" has the same meaning as in the Act;

"SAC-SINGLAS" means the Singapore Accreditation Council-Singapore Laboratory Accreditation Scheme;

"service connection" means two or more insulated electrical conductors which provide, or are intended to provide, an electrical link between the transmission system and a customer's or Generation Licensee's installation;

"settlement" means the settling of monies owed to or by a Market Support Services Licensee, the Market Company, a market participant, a market participant retailer, a non-market participant retailer, or a consumer, as the case may be;

"settlement entity" means a Market Support Services Licensee, Market Company, or the Retail Electricity Licensee that is responsible for settlement of monies owed by or to the metered entity or consumer associated with a meter installation;

"settlement-ready data" means meter data that has been managed in accordance with the applicable standards prescribed in this Code so as to produce a quantity value that can be used for the settlement of transactions, purchases or sales associated with regulated supply service, the retail electricity market or the wholesale electricity market;

"Singapore HUB" or "SHUB" means the market network node, as defined in the market rules, at which all energy taken from the transmission system by load facilities, as defined in the market rules, is deemed to be withdrawn and all energy injected into the transmission system by generation facilities having a name-plate rating of less than 1MW is deemed to be injected;

"site-specific adjustment factors" means a loss factor applied to a pool meter to account for the notional metering point being on the high voltage side of the transformer whereas the physical metering point is on the low voltage side of the transformer or a loss factor, as a result of connection at busbars of different voltages, applied to a *GF* that provides power directly to a consumer;

"Solar Generation Profile" means the estimated generation for a contestable consumer with embedded solar photovoltaic generation facility across each half-hour interval, commencing at 0:00 hours as determined by the Authority;

"Solar Generation Profiling" means the metering option chosen by a contestable consumer with embedded solar photovoltaic generation facility where its generation is determined based on the Solar Generation Profile;

"sub-metered consumer" means a consumer, other than a master-metered consumer, that receives supply in a master-metered installation;

"trading day" means a 24 hour period commencing at midnight;

"Transmission Code" means the code of practice issued by the Authority that describes the standards of performance which a Transmission Licensee and those electricity licensees subject to such code of practice are required to observe with respect to the provision or use of transmission services;

"Transmission Licensee" has the same meaning as in the Act;

"turn-off" means

- in the case of a consumer's installation other than an installation of a sub-metered consumer or of any other consumer that receives a supply of electricity via another consumer's internal electrical system, the opening of an incoming electrical switch located on the consumer's installation side of service connection or, for a Generation Licensee's installation, the opening of a circuit breaker located on the Generation Licensee's installation side of service connection, to prevent flow of electricity to or from the relevant installation; and
- in the case of a sub-metered consumer's installation or any consumer that receives supply of electricity via another consumer's internal electrical system, the opening of an incoming electrical switch located at the boundary between the electrical system of

the master-metered installation and the installation of a sub-metered consumer to prevent flow of electricity between the relevant installations;

"turn-on" means

- in the case of a consumer's installation other than an installation of a sub-metered consumer or of any other consumer that receives a supply of electricity via another consumer's internal electrical system, the closing of an incoming electrical switch located on the consumer's installation side of service connection or, for a Generation Licensee's installation, the closing of an circuit breaker switch located on the Generation Licensee's installation side of service connection, to allow flow of electricity to or from the relevant installation; and
- in the case of a sub-metered consumer's installation or any consumer that receives supply of electricity via another consumer's internal electrical system, the closing of an incoming electrical switch located at the boundary between the electrical system of the master-metered installation and the installation of a sub-metered consumer to allow flow of electricity between the relevant installations;

"ultra high voltage" means voltages equalling or exceeding 230 kilovolts; and

"Wholesaler Licensee" means a person who is authorized by an electricity licence to trade in any wholesale electricity market operated by the Market Company for the purpose of ;

(i) selling electricity generated by the Licensee under the exemption set out in the Electricity (Electricity Generation Licence) (Exemption) (No. 2) Order; and/or

(ii) providing ancillary services or any electricity-related product or service through a load reduction;

1.5 Interpretation

1.5.1 Unless otherwise defined in this Code, words and phrases shall have the meaning ascribed to them in the Act or the Market Rules, and words and expressions used in this Code shall be construed as if the Interpretation Act (Cap. 1) applied to them.

1.5.2 Nothing in this Code shall alter or affect the conditions of the electricity licence of any electricity licensee that is subject to this Code.

1.5.3 Headings are for convenience only and shall not affect the interpretation of this Code.

1.5.4 A reference in this Code to any statute, subsidiary legislation, proclamation, ordinance, by-law, resolution, rule, order, supplements, gazette notification or directive includes all statutes, subsidiary legislation, proclamations, ordinances, by-laws or resolutions, rules,

orders, supplements, gazette notifications or directives varying, consolidating, re-enacting, extending or replacing it.

1.5.5 A reference in this Code to a document or provision of a document includes a modification or supplement to, or replacement or novation of, that document or that provision of that document, as well as any exhibit, schedule, appendix or other annexure thereto.

1.5.6 A reference in this Code to a body, whether statutory or not, which ceases to exist or whose functions are transferred to another body includes a reference to the body which replaces it or which substantially succeeds to its functions, powers or duties.

1.5.7 A reference in this Code to the word "including" or a grammatical variation thereof means "including but not limited to".

1.6 Hierarchy of Codes

1.6.1 Nothing in this Code shall be construed as affecting the obligation of a Market Support Services Licensee or any other electricity licensee to comply with the provisions of any relevant legislation or its electricity licence and, in the event of an inconsistency between the provisions of such relevant legislation or electricity licence and the provisions of this Code, the provisions of such relevant legislation or electricity licence shall prevail to the extent of the inconsistency.

1.6.2 The hierarchy of codes of practice, subject to any specific conditions in the market rules or in any person's electricity licence, is as follows:

(a) Transmission Code;

(b) Regulated Supply Service Code;

(c) Market Support Services Code;

(d) Metering Code; and

(e) Code of Conduct for Retail Electricity Licensees.

1.6.3 In the event of a conflict between conditions contained in more than one code of practice, the condition in the higher code of practice referred to in section 1.6.2 shall prevail.

1.6.4 In the event of an inconsistency between provisions contained in this Code and provisions contained in the market rules, the provision contained in the market rules shall prevail to the extent of the inconsistency.

1.7 Modifications to this Code

1.7.1 In furtherance of the authority contained in section 16(2) of the Act, the process by which this Code may be modified from time to time by the Authority shall be as follows:

(a) Before making any modification to this Code, the Authority shall give written notice to all Licensees and other persons likely to be affected by the proposed modification:

(i) stating that the Authority proposes to make a modification in the manner specified in the notice;

(ii) stating the reasons why the Authority proposes to make the modification, including whether the need for the modification was the subject of a prior representation made by a Licensee or third party; and

(iii) specifying the period from the date of the giving of the notice (not being less than 28 days) within which written representations with respect to the proposed modification may be made.

(b) If no written representation is received by the Authority within the period specified in the notice referred to in section 1.7.1(a) or if all written representations made in response to such notice are subsequently withdrawn, the Authority may modify this Code as specified in such notice.

(c) Where the Authority receives any written representation under section 1.7.1(a), the Authority shall, except to the extent that such representation is withdrawn, consider such representation and may:

(i) reject the representations;

(ii) amend the proposed modification in accordance with the representations; or

(iii) withdraw the proposed modification,

and the Authority shall, where section 1.7.1(c)(i) or 1.7.1(c)(ii) applies but subject to section 1.7.1(d), modify this Code accordingly.

(d) The Authority shall, before modifying this Code, respond with reasons to all written representations received in respect of the modification that were not subsequently withdrawn, and advise all Licensees of the outcome of the Authority's deliberations in respect of the modification.

(e) A modification to this Code shall not come into force until such time as the Authority has complied with section 1.7.1(d), where applicable, and 10 business days, or such longer period of time as may be specified by the Authority, have

elapsed since the date on which the Authority gave notice of the modification as required by section 16(2) of the Act.

1.7.2 Nothing contained in clauses 1.7.1 shall prohibit any electricity licensee or any other party from notifying the Authority of suggested code changes.

1.8 Coming into Force

1.8.1 This Code shall come into force on the appointed day.

2 METER EQUIPMENT SERVICE PROVIDER

2.1 Identification of the MESP

2.1.1 Subject to section 2.4.7, for those meter installations associated with a generation facility, the Generation Licensee or Wholesaler Licensee that owns the generation facility shall be the MESP.

2.1.2 For those meter installations other than those that are associated with a generation facility, the Transmission Licensee shall be the MESP.

2.2 General Obligations

2.2.1 A MESP shall provide, install, commission, maintain, repair, replace, inspect and test each meter installation for which it is responsible, in accordance with the provisions set forth in this Code and any standards that are specified in Appendix A or any modification thereto.

2.2.2 A MESP may not use or permit the use of any metering equipment that does not meet or exceed the performance or functional requirements set forth in this Code or in any policies or standards established by the Authority that are specified in Appendix A or any modification thereto.

2.2.3 Wholesaler Licensee with embedded generation facility may engage the Transmission Licensee to provide, install, commission, maintain, repair, replace, inspect and test each meter installation. The Wholesaler Licensee shall pay the relevant charges based on the metering services provided.

2.3 Timing of and Responsibilities During Installation of Meter Installations

2.3.1 The timing and responsibilities of a MESP when installing a meter installation associated with a generation facility that is not generating electricity, with an intertie meter or a pool meter that is located on a part of the transmission system that is not energised, or with an installation that is not receiving electricity supply prior to the date of installation of the meter installation are as follows:

(a) The MESP shall not be obliged to accept a request for installation of a meter installation unless it is provided at least four business days prior to the date of electrical turn-on and the request contains contact information of the prospective metered entity, the applicable MDM, and the scheduled date for electrical turn-on.

(b) Upon receipt of a request for installation of a meter installation, the MESP shall contact the prospective metered entity to arrange an installation date. The installation date shall be prior to the scheduled date for electrical turn-on.

(c) Prior to the installation of a meter installation, the MESP shall ensure that the meter:

(i) meets the applicable standards described in this Code;

(ii) is in working condition; and

(iii) has been tested for accuracy.

(d) For kilowatt-hour and kilovar-hour meters, the MESP shall provide the applicable MDM with an initial meter register reading prior to or immediately following energisation.

(e) The MESP shall ensure that the meter is operational and for a remotely read interval meter, the meter can be read remotely, at the time of energisation or consumer turn-on as the case may be. If the meter is not operational or cannot be read remotely, if applicable, the MESP shall upon being notified by the metered entity, MR or MDM or through its own inspection, replace the meter at the earliest possible date and shall inform the metered entity, the applicable MDM and the Transmission Licensee of the new installation date.

(f) No later than two business days prior to the date of energisation, the MESP shall provide to the applicable MDM the meter information delineated in section 2.7 of this Code.

2.3.2 The MESP may replace a meter installation for which it is responsible at any time after it has been installed, subject to the provisions set forth in this Code.

2.3.3 The timing and responsibilities of the MESP when replacing or modifying a meter installation associated with a generation facility, an intertie meter, a pool meter or an installation meter that is associated with an installation that has an existing meter installation and is connected to the transmission system are as follows:

(a) Upon receipt of a request from a metered entity to replace or modify a meter installation, or upon a decision by the MESP to replace or modify a meter installation for whatever reason, the MESP shall contact the metered entity to arrange an installation date;

(b) Prior to any modification or replacement of all or part of the meter installation, the MESP shall ensure that any meter that forms part of a meter installation has been tested for accuracy and meets the applicable standards described in this Code;

(c) The MESP shall ensure that the new meter and meter installation are operational before they are used to replace the existing meter and meter installation. If the existing meter installation is operational and the new meter installation is not

operational, the MESP shall leave the existing meter installation in place. If the existing meter installation is not operational and the new meter is also not operational, the MESP shall modify or repair the meter installation at the earliest possible date and shall arrange a new installation date with the metered entity;

(d) No later than two business days following meter installation, other than that for a prepaid meter, the MESP shall provide to the applicable MDM the meter information delineated in section 2.7 of this Code; and

(e) Following the installation of a prepaid meter, the applicable Market Support Services Licensee shall provide the MESP with the relevant meter information delineated in Section 2.7.2 of this Code within two business day from the said installation.

2.4 Standard Metering Equipment

General

2.4.1 All meters, excluding the metering current transformers and voltage transformers associated with a meter installation, which shall be provided by the metered entity, shall

(a) be installed by a MESP; and

(b) comply with the relevant standards identified in Appendix A or any medication thereto.

2.4.2 Prior to installation, all meters shall be submitted by the applicable MESP to a laboratory, that has been accredited by SAC-SINGLAS, for testing and certification.

2.4.3 Prior to the installation of any metering current transformers and voltage transformers associated with a meter installation, such transformers shall be:

(a) submitted by the metered entity to a laboratory that has been accredited for testing and certification by SAC-SINGLAS; or

(b) received directly from a manufacturer with a test certificate endorsed by a national accredited laboratory,

as the case may be. A copy of the test certificate received under paragraph (a) or (b), as the case may be, shall be delivered by the metered entity to the MESP at the time of application for meter installation.

2.4.4 No meter installation shall be certified as complying with this Code unless and until the MESP responsible for the installation has received from the relevant metered entity satisfactory test certificates by the SAC-SINGLAS accredited laboratory or the manufacturer (as the case may be), pursuant to sections 2.4.2 and 2.4.3. In the event that the MESP is also a SAC-SINGLAS accredited laboratory for the purposes of sections 2.4.2 and 2.4.3, no certificate shall be required to be issued, but the MESP shall ensure that records confirming the satisfactory testing of all equipment required to be tested under sections 2.4.2 and 2.4.3 are kept for at least six years and shall produce these records upon reasonable notice from the MDM or the settlement entity for the meter installation.

Generation Facilities

2.4.5 Prior to the commissioning of any generating unit, the MESP responsible for the provision of the meter installation associated with such generating unit shall install the metering equipment and communication links necessary for the monitoring and reading of the generation meter.

2.4.6 Generation meters and metering equipment, of which the meter installation for a generating unit or generation facility is comprised, that were or are provided and installed by a MESP that is also the owner of that generating unit or generation facility, shall be and remain the property of, and shall be maintained by, that MESP.

2.4.7 Section 2.4.6 does not apply to:

(a) Any generation facility or generating unit that was in existence and commissioned by or on the market commencement date that already had a meter owned by a person other than the Generation Licensee responsible for that generation facility; and

(b) Any generation facility or generating unit exempted from the application of this section by the Authority, in which case the Authority shall ensure before granting such an exemption that a suitably qualified MESP has accepted responsibility for the installation and maintenance of the associated meter installation.

2.4.8 A *GF* shall:

(a) have a main meter;

(b) have a check meter;

(c) have a recording device for each of the main and check meters capable of storing all half-hourly measured quantities for up to 30 days;

(d) have a dedicated communication link to the relevant telecommunication network and, where required, isolation equipment approved under applicable telecommunication laws and regulations; and

(e) be capable of being remotely read by a MR.

2.4.9 The main and check meters for a *GF* shall, individually or in combination, be capable of measuring the net injections of active energy, measured in units of kWh, and reactive energy, measured in units of kVarh, with such injections being measured and recorded for each half-hour interval in time. For the purposes of this section, net injection shall be generating unit or generation facility output less auxiliary load (including energy withdrawn by station and excitation transformers, where applicable) and transformation losses.

2.4.10 Except in relation to an embedded generation facility, the main and check meters for a generation facility (GF) with total generation capacity above 10MW or solar photovoltaic (PV) facilities of capacity above 10Mwac, shall be a 3-phase, 4-wire type or 3-phase, 3-wire type of accuracy class 0.2s. Metering current transformers of accuracy class 0.2 with 1 or 5 amperes secondary current and 30VA burden shall be provided for each circuit. The rated short-time current rating shall not be less than 40kA 3 seconds for supply at 66kV or 63kA 1 seconds for supply at 230kV and above. Metering voltage transformers shall be of accuracy class 0.5 with 110 volts secondary voltage and a burden of not less than 100VA per phase per circuit. Refer to table F2.4.10a for reference.

2.4.11 Except in relation to an embedded generation facility, the main and check meters for a generation facility (GF) connected to the distribution network at 22kV or 6.6kV and with generation capacity 10MW and below or solar photovoltaic (PV) facilities of capacity 10Mwac and below, shall be a 3-phase, 4-wire type or 3-phase, 3-wire type of accuracy class 0.5. Metering current transformers of accuracy class 0.5 with 1 or 5 amperes secondary current and 30VA burden shall be provided for each circuit. Metering voltage transformers shall be of accuracy class 1.0 with 110 volts secondary voltage and a burden of not less than 100VA per phase per circuit. Refer to table F2.4.10a for reference.

2.4.12 Except in relation to an embedded generation facility, the main meter for a generation facility (GF) connected to the low voltage network shall be either 1-phase, 2-wire or 3-phase, 4-wire type of accuracy class 2.0, and metering current transformers shall be of accuracy class 0.5 with 5 amperes secondary current and a burden of not less than 5VA. Section 2.4.8 (b) does not apply to a GF connected to the low voltage network. Refer to table F2.4.10a for reference.

2.4.13 Nothing in this Code shall apply with respect to any generating unit or generating generation facility that has a name-plate rating of less than 1MW and is not (i) a *GRF* or (ii) a *GSF* or (iii) comprised in a *GSF* registered by the market support services licensee.

2.4.14 For embedded generation facility, the wire-type, accuracy class and burden requirements for its generation meters and their metering transformers shall follow the prevailing requirements for its associated installation meter and metering transformers.

2.4.15 For embedded generation facility, associated installation meter at intake supply point shall be capable of measuring positive and negative injection of active energy, measured in units of kWh, and reactive energy, measured in units of kVarh (i.e. bidirectional flows) for each half-hour interval.

2.4.16 Section 2.4.8 to 2.4.12 and 2.4.14 do not apply to intermittent embedded generation facilities on Solar Generation Profiling.

Figure F2.4.10 a – Metering requirement for Generation facility ('GF")

GF and connection setups	**Meter Wiring**	**Meter Accuracy Class**	**Current Transformer (CT) Class**	**CT Burden**	**CT Secondary Current**	**Voltage transformers (VT) accuracy class**	**VT Burden**	**VT Secondary Current**	**Check Meter Needed?**
GF with a total generation capacity above 10MW or solar photovoltaic (PV) facilities of capacity above 10MWac	3-phase, 4-wire type or 3-phase, 3-wire type	0.2s	0.2	30VA burden shall be provided for each circuit	1 or 5 A	0.5	Burden of not less than 100VA burden per phase per circuit	110 volts secondary voltage	Yes
GF connected to the distribution network at 22kV or 6.6kV and with generation capacity 10MW and below or solar photovoltaic (PV) facilities of capacity 10MWac and below	3-phase, 4-wire type or 3-phase, 3-wire type	0.5	0.5	30VA burden shall be provided for each circuit.	1 or 5 A	1.0	Burden of not less than 100VA per phase per circuit	110 volts secondary voltage	Yes

GF connected to the low voltage network	1-phase, 2-wire or 3-phase, 4-wire type	2.0	0.5	Not less than 5VA	5 A	[redacted]	No

Pool Meters

2.4.17 A pool meter shall:

(a) have a main meter;

(b) have a check meter;

(c) have a recording device for each of the main and check meters capable of storing all measured quantities for up to 30 days;

(d) have a dedicated communication link to the relevant telecommunication network and, where required, isolation equipment approved under applicable telecommunication laws and regulations; and

(e) be capable of being remotely read by a MR.

2.4.18 The main meter and check meter referred to in section 2.4.17 shall, individually, or in combination, be capable of measuring:

(a) Active energy for each half-hour interval; and

(b) Reactive energy with lagging power factor for each half-hour interval.

2.4.19 A pool meter shall be connected to an extra high voltage or high voltage transmission line and shall be 3-phase, 3-wire type of accuracy class 0.5. Two metering current transformers of accuracy class 0.5 with 5 amperes secondary current and 30VA burden for 66kV supply or 15VA burden for 22kV or 6.6kV supply shall be provided for each circuit. The rated short-time current rating shall not be less than 40kA 3 seconds for supply at 66kV or 25kA 3 seconds for supply at 22kV or 20kA 3 seconds for supply at 6.6kV and below. For each circuit, metering voltage transformers of accuracy class 1.0 with 110 volts secondary voltage and 100VA burden per phase for star-star connection or 180VA burden per phase for 'V' connection shall be provided.

Intertie Meters

2.4.20 An intertie meter located in Singapore shall:

(a) have a main meter;

(b) have a check meter;

(c) have a recording device for each meter capable of storing all measured quantities for up to 30 days;

(d) have a dedicated communication link to the relevant telecommunication network, and, where required, isolation equipment approved under applicable telecommunication laws and regulations; and

(e) be capable of being remotely read by a MR.

2.4.21 The main meter or check meter referred to in section 2.4.20 shall, individually or in combination, be capable of measuring positive and negative injections of active energy, measured in units of kWh, and reactive energy, measured in units of kVarh into the transmission system (i.e. bi-directional flows) for each half-hour interval.

2.4.22 An intertie meter located in Singapore shall be 3-phase, 4-wire type of accuracy class 0.2s. Metering current transformers of accuracy class 0.2 with 1 or 5 amperes secondary current and 30VA burden shall be provided for each circuit. Metering voltage transformers shall be of accuracy class 0.5 with 110 volts secondary voltage and a burden of not less than 100VA per phase per circuit.

High Voltage Installation Meters

2.4.23 A MESP shall require a consumer whose installation is connected to an ultra high voltage, an extra high voltage or a high voltage transmission line to provide:

(a) metering current and voltage transformers;

(b) a suitable facility (including all necessary pre-wiring) in which to house the meter installation; and

(c) a communication link to the relevant telecommunication network, and, where required, isolation equipment approved under applicable telecommunication laws and regulations.

It is the responsibility of the Licensed Electrical Worker employed or engaged by the consumer requiring metering services to ensure that the metering current and voltage transformers are tested and comply with the standards specified in Appendix A or any medication thereto.

2.4.24 A MESP shall not install metering equipment until the equipment referred to in section 2.4.23 has been installed by the consumer and the relevant test reports from the licensed electrical worker referred to in section 2.4.23 have been received.

2.4.25 A meter installation for a consumer whose installation is connected to an ultra high voltage, an extra high voltage or a high voltage transmission line shall:

(a) have a main meter;

(b) have a check meter;

(c) have a recording device for each of the main and check meters capable of storing all measured quantities for up to 30 days; and

(d) be capable of being remotely read by a MR.

2.4.26 The meters contained in a meter installation for a consumer whose installation is connected to an ultra high voltage, an extra high voltage or a high voltage transmission line shall, individually or in combination, be capable of measuring:

(a) Active energy (kWh) for each half-hour interval; and

(b) Reactive energy (kVarh) for each half-hour.

2.4.27 A meter for a consumer whose installation is connected to an ultra high voltage, an extra high voltage or a high voltage transmission line shall be 3-phase, 3-wire type of accuracy class 0.5. Two metering current transformers of accuracy class 0.5 with 5 amperes secondary current and 30VA burden for 66kV supply or 15VA burden for 22kV or 6.6kV supply shall be provided for each circuit. The rated short-time current rating shall not be less than 40kA 3 seconds for supply at 66kV or 25kA 3 seconds for supply at 22kV or 20kA 3 seconds for supply at 6.6kV and below. For each circuit, metering voltage transformers of accuracy class 1.0 with 110 volts secondary voltage and 100VA burden per phase for star-star connection or 180VA burden per phase for ‘V’ connection shall be provided.

Low Voltage Installation Meters

2.4.28 With the exception of a residential contestable consumers on Load Profiling, a meter installation for a contestable consumer whose installation is connected to a low voltage transmission line shall have:

(a) a main meter;

(b) a recording device capable of storing all measured quantities for up to 30 days;

(c) a communication link, provided by the contestable consumer, to the relevant telecommunication network that may, at the consumer's discretion, be shared with other users;

(d) where applicable, metering current transformer provided by the contestable consumer; and

(e) a suitable facility (including all necessary pre-wiring), provided by the contestable consumer, in which to house the meter installation.

It is the responsibility of the Licensed Electrical Worker employed or engaged by the consumer requiring metering services to ensure that the metering current transformer, where applicable, are tested and comply with the standards specified in Appendix A or any medication thereto.

2.4.29 A MESP shall not install metering equipment until the equipment referred to in section 2.4.28 has been installed by the consumer and the relevant test reports from the Licensed Electrical Worker referred to in section 2.4.28 have been received.

2.4.30 With the exception of a residential contestable consumer on Load Profiling, a meter installation for a contestable consumer whose installation is connected to a low voltage transmission line shall be capable of measuring active energy (kWh) for each half-hour.

2.4.31 A meter installation for a non-contestable consumer or a residential contestable consumers on Load Profiling, whose installation is connected to a low voltage transmission line shall have:

(a) a meter capable of measuring active energy (kWh); and

(b) suitable facilities (including all necessary pre-wiring), provided by the non-contestable consumer or residential contestable consumer on Load Profiling respectively, in which to house the meter installation.

2.4.32 A meter for a consumer whose installation is connected to a low voltage transmission line shall be either 1-phase, 2-wire or 3-phase, 4-wire type of accuracy class 2.0 and metering current transformers, where applicable, of accuracy class 0.5 with 5 amperes secondary current and 5VA burden.

Master-metered and Sub-metered Consumers

2.4.33 In any master-metered installation, the MESP shall install installation meters capable of measuring the supply of electricity to:

(a) each sub-metered consumer who receives or is to receive supply in the master-metered installation; and

(b) the master-metered consumer in the same installation.

2.5 Alternatives to Standard Meter installations

2.5.1 Metering equipment or a meter installation may exceed the level or standards of accuracy and other requirements set forth in this Code and in any policy or standard established by the Authority pursuant to the Code.

2.5.2 Upon the request of a metered entity associated with a meter installation, the MESP for that meter installation may arrange for the meter installation to contain features or equipment in addition to those specified in this Code provided that:

(a) the metered entity agrees to pay the full current and future incremental costs of the additional features or equipment; and

(b) the additional features and equipment do not lead to any degradation of the capability of the meter installation that would cause the meter installation to fail to meet any standards of performance prescribed by this Code.

2.5.3 Upon the request by the applicable market support services licensee, the MESP may arrange to provide a prepaid meter provided the market support services licensee agrees to pay for the full current and future incremental cost as compared to a standard meter installation.

2.6 Removal of Meter installations

2.6.1 Until any meter or metering equipment removed in accordance with this section 2.6 is replaced, and while electricity is still flowing to the installation associated with that meter or metering equipment, the MESP for the associated meter installation shall notify with the applicable MR or MDM of any change in the status of the removal or replacement of the meter or metering equipment and/or energisation of that installation. The applicable MR or MDM shall ensure that suitable data is obtained or estimated as prescribed in Section 4.6 for the period of time between the removal of that meter or metering equipment and its replacement.

2.6.2 A MESP for a meter installation, other than that for a prepaid meter, shall report all relevant meter parameters for a replacement meter in that meter installation, as described in section 2.7, to the applicable MDM.

2.6.3 A MESP for a meter installation for a generation facility, an intertie meter, a pool meter or an installation meter shall report to the applicable MR the permanent removal of that meter

installation to ensure a final meter read is obtained. A MESP for a meter installation for a generation facility, an intertie meter, a pool meter or an installation meter shall report to the applicable MDM the permanent removal of that meter installation to ensure that the meter installation record is no longer maintained in the Metering Data Registry as described in section 4.3.

2.6.4 A MESP shall take reasonable measures to ensure that no person other than a person authorized by it removes a meter or metering equipment from a meter installation that is owned by the MESP.

2.6.5 Before a meter or metering equipment is removed from a meter installation, the MESP that owns the meter installation shall give prior notice to the applicable MR of its intention to remove the meter or metering equipment. The applicable MR shall ensure that metering data stored in the meter installation is retrieved.

2.7 Meter Data

2.7.1 A MESP shall provide the following information for each meter installation, other than that for a prepaid meter, for which it acts as MESP to the MDM responsible for managing the data from that meter installation:

(a) A unique identifier assigned by the MESP to the meter installation, cross-referenced to the location of the meter installation;

(b) The date of installation of the meter installation;

(c) The functionality of the meter and the unit of measurement used to measure energy flowing through the meter installation;

(d) Identification of the ancillary equipment;

(e) Any site-specific adjustment factors as defined in the Market Support Services Code to be applied, including the sign of the loss adjustment;

(f) The existence of redundancy and sources of check metering data, where required by this Code, and identification of the meters designated as the main meter and as the check meter; and

(g) Initial meter register reading.

2.7.2 The applicable Market Support Services Licensee shall provide the following information for each prepaid meter installation that it installed to the relevant MESP:

(a) A unique identifier assigned by the MESP to the meter installation, cross-referenced to the location of the meter installation;

(b) The date of installation of the meter installation; and

(c) Initial meter register reading

2.7.3 A MESP shall maintain the following information for each meter installation for which it acts as MESP:

(a) Location details of the meter installation;

(b) A record of any problem experienced by the meter installation including any test results and of repairs made to the meter installation; and

(c) Documentation of meter testing prior to installation.

2.7.4 The MESP shall, for each meter installation, make the information listed in section 2.7.2 available upon request to:

(a) a Transmission Licensee who owns the transmission system to which the metered entity associated with the meter installation is connected;

(b) a Market Support Services Licensee responsible for the metered entity associated with the meter installation;

(c) the Market Company, if the metered entity is a market participant;

(d) the MR for the metered entity associated with the meter installation;

(e) the MDM for the metered entity associated with the meter installation; or

(f) the metered entity associated with the meter installation.

2.8 Technical Requirements and Accuracy of Meters

2.8.1 The MESP for a meter installation shall ensure that the accuracy of the meter is certified by an accredited meter test laboratory recognised by SAC-SINGLAS and meets the applicable accuracy limits specified in section 2.8.2.

2.8.2 The prescribed limits of accuracy for the following classes of meters shall be as follows:

(a) ± 0.5% for class 0.2 S static watt-hour meters.

(b) ± 1.0% for class 0.5 S static watt-hour meters.

(c) ± 1.3% for class 0.5 watt-hour meters.

(d) ± 1.5% for class 1.0 watt-hour meters.

(e) ± 2.5% for class 2.0 watt-hour meters.

2.8.3 In the event of noncompliance with the required accuracy standards, the MESP for a meter installation shall ensure that the accuracy of any meters in that meter installation is restored to comply with the accuracy standards described in section 2.8.2 as soon as is reasonably practicable.

2.8.4 The MESP for a meter installation shall maintain certification records and test results pertaining to the accuracy class and compliance with the relevant standards for the particular type and model of meter in that meter installation.

2.8.5 The MESP for a meter installation shall maintain records of the information referred to in this section 2.8 for each meter in a meter installation for at least six years and shall produce these records as and when required by the MDM or the settlement entity for the meter installation.

2.9 Audit and Installation Tests

2.9.1 The MESP shall ensure that each meter installation for which it acts as MESP is inspected and tested in accordance with the following minimum frequencies:

Type of Meter or Associated Facility	**Cycle**
Generation Facility	Once every two years
Embedded Generation Facility (Including installation meter connected to the transmission system)	Prevailing cycle for associated installation meter shall applies
Pool Meter and Intertie Meter	Once every two years
Ultra High Voltage Consumer	Once every two years
Extra High Voltage Consumer	Once every two years
High Voltage Consumer	Once every five years

Type of Meter or Associated Facility	Cycle
Low Voltage Consumer	
3-phase Low Voltage (more than 100A)	Once every 10 years
3-phase Low Voltage (not exceeding 100A)	Once every 15 years
1-phase Low Voltage	Once every 15 years

2.9.2 If any of the audits or tests referred to in section 2.9.1 may affect the meter reading, the MESP shall inform the applicable MR and the applicable MDM regarding the timing of the audit or test, and shall not conduct such audits or tests until it has received confirmation from the MR and MDM for any meter installation that appropriate arrangements have been made to ensure meter data integrity during the audit or test period.

2.9.3 The Authority, the metered entity associated with a meter installation or the MR or MDM for such meter installation may request the MESP to conduct an audit to establish consistency between the metering data recorded in the Metering Data Registry and the metering data recorded in the meter installation.

2.9.4 The MESP for a meter installation shall commence the performance of an audit referred to in section 2.9.3 or 2.9.5 on a date agreed with the requesting party and, except in the case of unannounced audits referred to in section 2.9.5, with the metered entity.

2.9.5 The MDM or a settlement entity responsible for settlement of the charges associated with a meter installation may direct the MESP for the meter installation to carry out periodic, random and unannounced audits of the meter installation for the purpose of ascertaining whether the meter installation complies with the requirements set forth in this Code.

2.9.6 The MESP for a meter installation shall conduct an audit referred to in section 2.9.3 or 2.9.5 and the metered entity associated with that meter installation shall ensure that the MESP's auditor is provided with unrestricted access to the meter installation for the purpose of such audit.

2.9.7 The MESP shall, as soon as practicable, make the results of any audit conducted pursuant to this section 2.9 available to the requesting party and to the metered entity, the MDM and the settlement entity associated with the meter installation.

2.9.8 The settlement entity associated with a meter installation may direct the MESP for that meter installation to conduct tests on a meter in that meter installation to determine whether the meter complies with the limits of accuracy prescribed in this Code for that meter, and the MESP shall conduct such tests.

2.9.9 Subject to section 2.9.10, the costs and expenses associated with the testing and auditing of a meter installation shall be paid by the MESP for that meter installation.

2.9.10 If the metered entity, the MR, the MDM, the settlement entity associated with a meter installation has directed that a test or audit of the meter installation be performed and the results do not indicate a faulty meter installation, the party who directed the MESP to conduct the test or audit shall pay for the costs of the test or audit.

2.10 Procedures for Faulty Meter installations

2.10.1 A meter shall be considered faulty and not in compliance with this Code if it is determined that the meter does not comply with the accuracy standards prescribed in section 2.8.

2.10.2 If a meter does not comply with the requirements of this Code, the MESP for the meter installation shall advise the MR, the MDM and the metered entity for the meter installation as soon as reasonably practicable, and in any event within two business days, after the receipt of historical metering data from the MDM, of the detection of such discrepancy and of the length of time such discrepancy may have existed.

2.10.3 If a meter installation outage, defect or malfunction occurs, the MESP for the meter installation shall ensure that repairs are made to the meter installation as soon as reasonably practicable after becoming aware of the outage, defect or malfunction by whatever means.

2.10.4 If the outage, defect or malfunction of a meter installation relates to a metering transformer for which the MESP is not responsible in accordance with this Code, the MESP for the meter installation shall inform the metered entity and direct the metered entity to repair or replace the defective metering transformer as soon as reasonably practicable.

2.10.5 Until any meter or metering equipment affected by an outage, defect or malfunction is repaired or replaced, the MESP for the associated meter installation shall notify the applicable MR of any change in the status of the removal or replacement of the meter or metering equipment. The applicable MR or MDM shall ensure that suitable data is obtained or estimated as prescribed in Section 4.6 for the period of time between the occurrence of any outage, defect or malfunction of that meter or metering equipment and the repair or replacement thereof.

2.11 Access to Meter installations for Maintenance, Repair and Testing

2.11.1 A MESP shall be granted access to each meter installation for which it is the MESP so as to enable the MESP to fulfil its functions under this Code in respect of such meter installation.

2.11.2 The access rights referred to in section 2.11.1 shall include rights of access by the representatives, agents and contractors of the MESP to the installation of the metered entity associated with a meter installation provided that such rights of access are conditional upon:

(a) prior arrangement by the MESP; and

(b) the production of authenticated documents authorizing the bearer to carry out metering related activities on such installation.

2.11.3 Nothing in section 2.11.2 shall require prior arrangement by the MESP in respect of the periodic, random and unannounced audits referred to in section 2.9.5.

2.12 Access to Meter installations for Meter Interrogation

2.12.1 The MESP for a meter installation shall, no later than the time of installation of the meter installation, make all reasonable endeavours to ensure that the meter installation is and remains accessible to each other metering service provider for the meter installation.

2.12.2 The access rights referred to in section 2.12.1 shall include rights of access by the representatives, agents and contractors of each other metering service provider for the meter installation to the installation of the metered entity associated with the meter installation provided that such rights of access are conditional upon:

(a) prior arrangement being made by the metering service provider; and

(b) if requested by the metered entity, the production of identification and documentation authorising the bearer to carry out metering related activities.

2.13 Security of Meter Installations

2.13.1 The MESP for a meter installation shall use reasonable endeavors to ensure that the persons entitled to have either direct or remote access to metering data recorded in that meter installation are limited to the following:

(a) the MR who has responsibility for recording the energy that flows through that meter installation; and

(b) the Authority.

2.13.2 The MESP for a meter installation shall ensure that electronic access to remotely read meters or to any meter that is read by electronic means is password protected. Passwords shall control three types or levels of access to metering data to be granted to metering service providers by the MESP in accordance with sections 2.13.3 to 2.13.5:

(a) Unlimited read/write access;

(b) Limited read/write access in which the write capability allows the password holder to adjust the meter time clock; and

(c) Read only access.

2.13.3 The MESP for a meter installation shall hold unlimited read/write access to the meter installation as the exclusive right of the MESP.

2.13.4 The MESP for a meter installation shall grant limited read/write access to the MR for the meter installation.

2.13.5 The MESP for a meter installation shall grant read only access to the meter installation to the Authority.

2.13.6 The MESP for a meter installation shall use reasonable endeavors to ensure that physical access to a meter contained in that meter installation is protected in the following manner:

(a) all associated links, circuits and information storage and processing systems are secured by means of seals;

(b) the meter installation meets all of the requirements pertaining to the security of meter installations set forth in this Code.

2.14 Remote Metering Equipment

2.14.1 The MDM or MR may, in consultation with and subject to agreement from the Transmission Licensee and Generation Licensee, specify the type of equipment to be used for communication with remote meters, subject to section 2.14.2, and shall compensate any party that must change equipment so as to comply with the MDM's or MR's requirements.

2.14.2 The MDM or the MR shall not be liable to compensate any party under section 2.14.1 where the change required by the MDM or the MR is to ensure compatibility of communication equipment or systems employed by the MDM or the MR on or before the date this Code comes into force.

3 METER READER

3.1 General Obligations

Unless otherwise determined by the Authority, there shall be a single Meter Reader who will perform meter reading services for all meter installation.

3.1.1 The MR for a meter installation shall:

(a) in coordination with the MESP for that meter installation, endeavor to ensure that each meter contained in that meter installation is accessible for the purpose of interrogation both under normal operating procedures and in the event of a failure of normal operating procedures (e.g., if communication to a remotely accessible meter fails);

(b) interrogate the meters in the meter installation and provide the meter data to the MDM for the meter installation in electronic form at such times and in such format as may be determined by the MDM;

(c) implement an initial validation process in accordance with the procedures described in section 3.4;

(d) report evidence of faulty meters or energy theft in respect of the meter installation to the Retail Electricity Licensee, Market Support Services Licensee or Market Company responsible for settlement of the charges arising from the flow of electricity through that meter installation; and

(e) use reasonable endeavors to maintain the security of the metering data stored in or obtained from the meter installation prior to transfer of the metering data to the MDM.

3.2 Access to Meter Installations

3.2.1 The MR for a meter installation may obtain from the metered entity for that meter installation, and the metered entity shall provide, information pertaining to the physical location of all meters in that meter installation, whether manually or remotely read.

3.2.2 The MR for a meter installation shall obtain from the MESP for that meter installation, and the MESP shall provide, the passwords referred to in section 2.13.2(b), for purposes of accessing the meter installation, and shall keep such passwords confidential.

3.2.3 When remote access, for remotely read meters, has not been achieved after the second attempt referred to in section 3.5.1, and the meter is located in a secured area where

physical access is difficult or where safety is an issue, the MR for a meter installation may arrange for another party who has control over the secured area to obtain the metering data from the meter installation on behalf of the MR. In this event, the MR shall not deliver the metering data to the MDM and once remote access has been restored, the MR shall check the metering data obtained from the other party against the metering data obtained via remote access to confirm that the previously supplied metering data was accurate. If it was not accurate, the MR shall submit the new remotely read metering data to the MDM for the meter installation. But, if remote access is not restored in four business days the metering data obtained from the other party must be delivered to the MDM by the MR for settlement purposes.

3.2.4 The MR for the meter installation shall inform the MDM for the meter installation if there is a communication failure and, if it is known, whether that failure is due to a faulty line or a faulty modem.

3.2.5 Provided that official identification is produced on request, a metered entity must make available to the MR or its authorized representatives convenient and unhindered access to a meter installation on its installation for the purposes of obtaining a manual reading of a meter.

3.3 Meter Reading Timing and Schedule

Remotely Read Meters

3.3.1 For remotely read interval meters, the meter reading frequency may vary in accordance with whether a metered entity purchases electricity;

(a) directly from a Market Support Services Licensee in accordance with the Regulated Supply Service Code;

(b) as a non-market participant consumer; or

(c) as a market participant consumer;

and in accordance with the settlement schedules associated with those arrangements.

3.3.2 The MR for a meter installation shall act on any change to the meter reading schedule for a remotely read meter within that meter installation that are advised by the MDM for that meter installation and shall implement such change provided that notice of such change is received not later than the close of business three business days prior to any newly scheduled date for reading a remotely read meter in that meter installation. A change to a meter reading schedule that is received less than three business days prior to the desired

read date may be implemented at the discretion of the MR or the MR may request from the MDM a new date that meets the above criterion.

3.3.3 All remotely read meters shall be interrogated by the applicable MR between 12:01 am and 6:00 am on the scheduled read date, unless a communication failure occurs.

3.3.4 In the event that a communication failure prevents remote access to a meter within a meter installation, the MR for that meter installation shall, following the second attempt referred to in section 3.5.1 and in accordance with section 3.3.3 where applicable, dispatch a person to obtain the metering data manually, no later than the close of business two business days after the scheduled read date.

Manually Read Meters

3.3.5 All manually read meters, other than prepaid meters, within a meter installation shall be scheduled to be read by the MR for the meter installation at least once every two months, in accordance with the schedule dictated by the MDM for the meter installation.

3.3.6 Changes in the meter reading schedule shall be submitted no later than the close of business ten business days prior to the previously scheduled read date.

3.3.7 If a request to change the read date for a manually read meter within a meter installation would degrade the read route efficiency, the MR for the meter installation may refuse such a request. In this event, the MR shall negotiate with the MDM for the meter installation in an attempt to determine a more efficient read route configuration that accommodates the request. If negotiations fail to reach a mutually agreeable solution, the Authority shall determine the outcome.

3.3.8 Ad hoc or unscheduled requests for a meter to be read on a date other than the scheduled read date for manually read meters within a meter installation shall be submitted by the MDM for the meter installation to the MR for the meter installation no later than five business days prior to the requested read date. An ad hoc or unscheduled request for a meter to be read on a date that does not meet this criterion may be implemented at the discretion of the MR or may be returned to the MDM with a request for a new date that meets the criterion.

Data Delivery

3.3.9 The MR for a meter installation shall deliver metering data as delineated in section 3.7 from that meter installation that has been validated according to the procedures delineated in section 3.4 to the MDM for the meter installation by close of business on the business day following the scheduled read date or following the actual read date if read on a date other than the scheduled read date.

3.3.10 All metering data from a meter installation shall be delivered by the MR for the meter installation to the MDM for the meter installation in electronic form and in such formats as may be determined and advised to the MR by the MDM, provided that:

(a) If the MR, the MDM and the Market Support Services Licensee for the meter installation are one and the same entity, the metering data may be delivered to the MDM by whatever internal systems are deemed to be appropriate.

(b) If the MR, the MDM and the Market Support Services Licensee for the meter installation are different entities, the metering data shall be delivered via the retail electronic business transaction system.

3.4 Initial Data Validation

3.4.1 For kilowatt-hour meters, other than prepaid meters, the MR for the meter installation shall verify at the time of the meter being read that the meter identification number on the meter matches the meter identification number for the read-route location schedule.

3.4.2 For interval meters, prior to delivering metering data to the MDM for the meter installation, the MR for the meter installation shall:

(a) Compare the meter identification number for the meter contacted remotely with the meter identification number associated with the contact telephone number to determine that the appropriate meter is being queried. If a match is not obtained, the metering data shall not be recorded and a failed read shall be reported to the MDM.

(b) Compare the clock time of the meter reading device with the meter clock. If there is a difference of less than three minutes, the difference may be ignored for purposes of reporting the metering data to the MDM and the meter clock shall be reset to match the time of the meter reading device. If there is a difference of more than three minutes, the metering data shall be recorded and forwarded to the MDM. In this case, the meter clock shall not be reset to match the meter reading device clock and the MR shall report the discrepancy between times to the MDM.

(c) Check for pulse overflow conditions and report any intervals where a pulse overflow has occurred. A pulse overflow is a condition in which the actual electrical flow during an interval is larger than can be captured by the meter or recorder. A pulse overflow interval shall be flagged for the attention of the MDM prior to the metering data being sent to the MDM.

3.5 Procedures for Meter Reading Failures and Meter Tampering

Remotely Read Meters

3.5.1 If an initial attempt to query a meter remotely fails, the MR for the meter installation shall attempt to query the meter at the normal read time on the following day. In the event that the second query fails, the MR shall report to the MDM for the meter installation that a communication failure has occurred and shall implement procedures to read the meter manually no later than two business days after the scheduled read date in accordance with sections 3.2.3.

3.5.2 If it has been determined that there has not been any communication failure but metering data cannot be obtained from the meter, the MR for the meter installation shall report to the MDM for the meter installation that the meter cannot be read but that the inability to read the meter is not the result of a communication failure. The MR shall implement procedures to read the meter manually unless the MR can establish remotely that an error or failure of the metering equipment associated with the meter will prevent a manual reading from being obtained. If metering data cannot be obtained manually on site from the meter, the MR shall report the failure to the MDM and shall provide any additional information pertaining to the potential nature of the failure. The MR shall not attempt or be required to attempt to read the meter again until the MDM advises the MR that the failure has been corrected.

3.5.3 The MR for a meter installation shall report to the MDM for the meter installation any evidence of meter tampering that is found by the MR when a manual meter reading is made or attempted to be made.

Manually Read Meters

3.5.4 The MR for a meter installation shall report to the MDM for the meter installation any evidence that a manually read kilowatt-hour meter may be faulty or has been tampered with based on visual inspection of the meter at the time of the meter reading.

3.6 Qualifications of Persons Performing Meter Reading Services

3.6.1 A MR shall only use suitably qualified or trained persons to perform meter reading services and to act on behalf of the MR in accordance with the requirements of this Code.

3.7 Data Delivery

3.7.1 For metered entities having interval meters, the MR for the meter installation shall deliver the following raw meter data to the MDM for the meter installation in such data format as

may be determined by the MDM, subject to all delivered metering data having been validated in accordance with the procedures delineated in section 3.4:

(a) The meter identification number;

(b) Energy used or withdrawn (kWh/kVarh) in each half hour for all half-hour intervals in the meter reading period along with the date and time of the half hour interval;

(c) For a generation facility or an embedded generation facility, the energy injected (kWh/kVarh) in each half hour for all half-hour intervals in the meter reading period along with the date and time of the half hour interval;

(d) A flag for each half hour interval in which a pulse overflow condition exists;

(e) Details for meter readings in which the meter clock differs from the meter reading device clock by more than three minutes; and

(f) Details of any meter alarms that were recorded during the period (e.g., power failure, VT failure).

3.7.2 For metered entities having manually read kilowatt-hour meters, or manually read meters capable of recording the peak demand (measured in either kilowatts or megawatts) for a period of time, the MR for the meter installation shall deliver the following raw meter data to the MDM for the meter installation in such data format as may be dictated by the MDM:

(a) Meter identification number;

(b) Cumulative energy usage (kWh) for the meter reading period;

(c) The meter reading and read date at the beginning of the meter reading period;

(d) The meter reading and read date at the end of the meter reading period; and

(e) If demand metered, the peak demand reading for the period.

3.8 Security Controls

3.8.1 The MR for a meter installation shall not deliver any data described in section 3.7 to any person other than the MDM for the meter installation.

3.8.2 The MR for a meter installation shall use reasonable endeavors so that all metering data in each meter installation that is transferred electronically is transferred in a secure manner.

3.8.3 The MR for a meter installation shall use reasonable endeavors to maintain the confidentiality of all records of passwords to be used for gaining electronic access to metering data within that meter installation.

4 METER DATA MANAGER

4.1 General Obligations

4.1.1 The MDM for a meter installation has the following responsibilities, which are described in detail in this section 4:

(a) Establishing the meter reading schedule for each meter for which it is responsible and communicating this schedule to the MR for that meter installation;

(b) Receiving metering data from the MR for the meter installation and maintaining a Metering Data Registry that contains usage data for each metered entity and data required for settlement purposes in respect of each metered entity;

(c) Validating metering data received from the MR for the meter installation;

(d) Estimating usage when meter readings are not available, inaccurate, or otherwise not suitable for settlement purposes;

(e) Applying adjustments to metering data to account for system losses and unaccounted for energy;

(f) Aggregating metering data for settlement purposes;

(g) Transmitting settlement-ready data to the Market Company, Market Support Services Licensee, market participant retailer, or DRA in accordance with each meter installation's meter reading frequency and no later than the close of business on the fifth business day after a trading day for contestable consumers who are not on Load Profiling, or on the ninth business day after the scheduled meter reading date for contestable consumers who are on Load Profiling.

(h) Use reasonable endeavors to maintain the security and confidentiality of the data contained in the Metering Data Registry; and

(i) Notifying appropriate parties regarding faulty meters or communications lines or suspicions of energy theft.

(j) Notifying the Market Company of any known errors in the settlement-ready data referred to in section 4.1.1(g), including for the affected meter installation, the

(i) account details, or if a pool or intertie meter, the meter identifier;

(ii) the non-corrected and corrected meter data;

(iii) the date on which the error was identified by the MDM; and

(iv) a description of the reason for the error.

This notification shall be by any means agreed by the parties, and need not be electronic.

4.1.2 The obligations provided in 4.1.1(j) shall be in force for a period of 12 months following the meter read date.

4.2 Establish Meter Reading Schedule

4.2.1 A MDM shall be responsible for setting the meter reading schedule for all meters for which it is the MDM that are used for settlement purposes for regulated supply service, the retail electricity market and the wholesale electricity market. When establishing such schedule, the MDM shall ensure that meters are read according to the frequency required for purposes of settlement for regulated supply service or in the market for which the metered entity is settled. The meter reading frequency required for settlement purposes shall meet the following requirements:

Type of Metered Entity or Meter Installation	Meter Reading Frequency
Generation Facility	Every business day
Embedded Generation Facility (Including installation meter connected to the transmission system)	Every business day
Pool Meter and Intertie Meter	Every business day
Market Participant Consumer not on Load Profiling, and connected to the transmission system 66kV or above	Every business day
Market Participant Consumer not on Load Profiling, and connected to the transmission system at a level below 66kV	Every business day
Non-market Participant Consumer not on Load Profiling, and connected to the transmission system 66kV or above	Every business day
Non-market Participant Consumer not on Load Profiling, and connected to the transmission system at a level below 66kV	Every business day

Type of Metered Entity or Meter Installation	Meter Reading Frequency
Non-contestable Consumer	On a business day, at least once every two months, according to a schedule set by the MDM
Contestable Consumer on Load Profiling	On a business day, at least once every two months, according to a schedule set by the MDM

4.2.2 The MDM shall, where reasonable, accommodate more frequent readings than those referred to in section 4.2.1 at the request of the applicable metered entity and shall charge the metered entity no less than the incremental cost of accommodating the new schedule.

4.2.3 The MDM for a meter installation shall act on any change to the meter reading schedule for a remotely read meter installation not associated with a residential contestable consumer that is requested by the requesting party for that meter installation and shall implement such a change provided that a request of such a change is received not later than the close of business five business days prior to any newly scheduled date for reading a remotely read meter in that meter installation. If the desired date is less than five business days after the submission date, the MDM may ask the requesting party to submit a new read date.

4.2.4 A read date other than the scheduled read date for manually read meters and interval meters associated with residential contestable consumers on Load Profiling shall, subject to section 3.3.8, be the date requested by the requesting party as long as the requested date is at least five business days after the submission date. If the read date is less than five business days after the submission date, the MDM may ask the requesting party to submit a new read date.

4.2.5 When establishing the meter reading schedule for manually read meters, the MDM shall seek to optimise read route efficiency.

4.2.6 Where a contestable consumer is a sub-metered consumer, the MDM shall assign the meter reading frequency to be no less frequent than that deemed for the master-metered installation.

4.2.7 For prepaid meters, in the event that the applicable Market Support Services Licensee detect there has not been any top-up and suspect of unauthorized usage, the applicable Market Support Services Licensee shall inspect the meter installation.

4.3 Metering Data Registry

4.3.1 The MDM shall establish and maintain a Metering Data Registry that contains the following information in respect of each meter installation for which it is responsible:

(a) A unique identifier assigned by the MESP to the meter installation cross-referenced to the location of the meter installation;

(b) The date of installation of the meter installation;

(c) The functionality of the meter and the unit of measurement used to measure energy flowing through the meter installation (e.g., kilowatt-hour meter, kilovar-hour meter, interval meter);

(d) Identification of the ancillary equipment;

(e) Any site-specific adjustment factors to be applied, including the sign of the adjustment;

(f) The existence of redundancy and sources of check metering data, where required by this Code, and identification of the meters designated as the main meter and as the check meter;

(g) Data for each meter provided by the MR for the meter installation as described in section 3.7.1;

(h) Data for each meter following completion of the validation and estimation procedures delineated in sections 4.4, 4.5 and 4.6;

(i) Settlement-ready data for each meter following completion of adjustments for losses and unaccounted for energy delineated in section 4.7;

(j) Aggregate settlement-ready data for each wholesale market settlement account based on procedures delineated in section 4.8; and

(k) Data required to develop the settlement-ready data referred to in (i) and (j) above, including:

(i) relationships between meter identification numbers and accounts;

(ii) relationships between accounts associated with the installation of consumers and Retail Electricity Licensees; and

(iii) relationships between meter identification numbers, accounts and adjustment factors for losses and unaccounted for energy.

4.3.2 The data described in section 4.3.1 shall at any given time cover a period of no less than twelve (12) months from any current date and shall be kept and be immediately accessible in electronic form.

4.4 Initial Data Validation

4.4.1 For interval meters, on receiving metering data from the MR for the meter installation and prior to data validation, the MDM shall:

(a) For meter installations with main and check meters, compare the readings between the two meters for each half-hour interval. For half-hour intervals where the main meter has a zero reading, the MDM shall substitute the check metering data for the main metering data and shall record that the source of the metering data is the check meter and report that to the MESP.

(b) For half-hour intervals where the difference between main meter and the check meter readings exceeds twice the tolerances delineated in section 2.8, the MDM shall flag those intervals, and still use the main meter for the main meter data. Where intervals are flagged as exceeding tolerances, the MDM shall report that to the MESP.

(c) For meter installations other than a generation meter, intertie meter or a pool meter, where half hour interval kVarh data are recorded, check for intervals where reactive load is present and active load is not, indicating an unusual or abnormal usage pattern and possible meter malfunction. The MDM shall flag these intervals.

4.4.2 If an installation meter consistently fails the tests described in section 4.4.1(c), the meter installation may be associated with an irregular use consumer, being a consumer whose usage pattern does not follow the normal usage patterns upon which the test parameters are based. If these tests are failed for three consecutive trading days by any intervals in that trading day and it has been determined that the installation meter is not defective, the MDM for the meter installation may designate the consumer as an irregular use consumer and shall develop an alternative set of tolerances upon which the above tests may be run for that irregular use consumer.

4.4.3 Notwithstanding section 4.4.2, the MDM in conjunction with the MR may designate a consumer as being an irregular use consumer from the date this Code comes into force or from the date consumption commences, whichever is later, if the MDM and MR reasonably expects that consumer to be an irregular use consumer.

4.5 Data Validation

4.5.1 For metering data from an interval meter, the MDM for the meter installation shall determine whether any metering data is missing for any applicable time intervals. For these purposes, metering data that fails the pulse overflow test described in section 3.4.2(c) shall be considered missing. If data is missing, the MDM shall populate the intervals for which data is missing using the estimation procedures described in section 4.6.

4.5.2 For metering data from an interval meter flagged by the MR as failing the tests referred to in section 4.4.1 (c) the MDM for the meter installation shall determine from communication with the metered entity or by other appropriate means whether or not there is an explanation for the anomalies. If the recorded data are determined to be valid, the data shall be considered as settlement-ready data if all other validation tests are passed. If the recorded data are not determined to be valid, the MDM shall use estimated data for the interval and shall direct the MESP for the meter installation to test the meter.

4.5.3 For metering data from an interval meter that fails the time check test referred to in section 3.4.2(b), the MDM for the meter installation shall substitute estimated data for the applicable intervals using the estimation procedures described in section 4.6 and shall report to the MESP for the meter installation that the meter has failed the time check test.

4.5.4 If metering data from an interval meter indicates that one or more meter alarms were tripped and if the type of alarm indicates that the data are invalid, the MDM for the meter installation shall substitute estimated data for the invalid data using the estimation procedures described in section 4.6.

4.5.5 For interval meters that are read on each business day, the MDM for the meter installation shall perform the following validation procedures:

(a) For usage during a business day, compare total energy used with the average daily usage for the previous four validated business days. If the difference is greater than 20 percent, the MDM shall examine the interval data to assess whether any anomalies exist and, if necessary, communicate with the metered entity to determine if a satisfactory explanation exists to justify the difference. If, in the opinion of the MDM, the difference is justified, the data shall be considered to be settlement-ready data.

(b) For usage on a Saturday that is not a public holiday, compare total energy used with the average daily usage for the previous four Saturdays that are not public holidays. If the difference is greater than 20 percent, the MDM shall examine the interval data to assess whether any anomalies exist and, if necessary, communicate with the metered entity to determine if a satisfactory explanation exists to justify the

difference. If, in the opinion of the MDM, the difference is justified, the data shall be considered to be settlement-ready data.

(c) For usage on a Sunday or public holiday, compare total energy used with the average daily usage for the previous four Sundays or public holidays. If the difference is greater than 20 percent, the MDM shall examine the interval data to assess whether any anomalies exist and, if necessary, communicate with the metered entity to determine if a satisfactory explanation exists to justify the difference. If, in the opinion of the MDM, the difference is justified, the data shall be considered to be settlement-ready data.

4.5.6 Sections 4.5.1 to 4.5.5 do not apply to contestable consumers on Load Profiling with interval meters installed for their meter installations.

4.5.7 For manually read kilowatt-hour meters other than prepaid meters, interval meters associated with contestable consumers on Load Profiling, and meter readings provided by non-contestable consumers and contestable consumers on Load Profiling, the MDM for the meter installation shall compare average daily usage for the meter reading period with average daily usage for the previous meter reading period, based on validation rules set out by MDM, and approved by the Authority. If the comparison fails the validation rules, the MDM shall take appropriate steps to determine if a satisfactory explanation exists to justify the difference. If, in the opinion of the MDM, the difference is justified, the data shall be considered to be settlement-ready data.

4.5.8 If data from an interval meter or a manually read kilowatt-hour meter other than prepaid meters, and meter readings provided by non-contestable consumers and contestable consumers on Load Profiling do not pass the validation procedures referred to in section 4.5.5, 4.5.6 or 4.5.7, the MDM for the meter installation shall:

(a) implement appropriate estimation procedures as delineated in section 4.6; and

(b) direct the MESP to conduct a test and report the findings.

4.5.9 If the interval data is from a generation meter, intertie meter or a pool meter, it shall not have the data validation tests as described in section 4.5 applied. Estimation procedures for a generation meter, intertie meter or a pool meter, shall be implemented by the MDM when the relevant interval data is deemed missing.

4.5.10 If any metering data referred to in this section 4.5 is not available because the intervals in question are prior to the date that the meter commenced operation or prior to the date this Code comes into force, then meter data may be based on the first 48 intervals of data and considered to be of settlement data quality.

4.6 Data Estimation

4.6.1 The MDM for a meter installation shall implement the data estimation procedures described below under the following circumstances:

(a) The validation procedures delineated in sections 3.4, 4.4 and 4.5 indicate that some or all of the data required to meet the applicable settlement deadline are not valid or fail to pass the applicable validation procedures; or

(b) Some or all of the data required to meet the applicable settlement deadline are missing.

4.6.2 For metering data from an interval meter other than a generation meter, intertie meter, and meter associated with an intermittent generation facility or contestable consumer on Load Profiling, if six or fewer consecutive intervals are not valid or missing, the MDM shall estimate the usage for those intervals using a linear interpolation between the two data points on either side of the missing intervals. If the invalid or missing intervals are at the beginning or end of the read period being estimated, the MDM shall estimate the usage for those intervals by replacing them with the first or last valid reading in that read period, respectively.

4.6.3 For metering data from an interval meter other than a generation meter, intertie meter and meter associated with an intermittent generation facility or contestable consumer on Load Profiling, if more than six but fewer than 49 intervals are not valid or missing, the MDM shall for meters that are read each business day, replace the missing intervals with validated data for the same intervals from the most recent previous like day (e.g., business day for a business day, Saturday for a Saturday, Sunday or public holiday for a Sunday or public holiday).

4.6.4 For metering data from meters associated with an intermittent generation facility that is not on Solar Generation Profiling, if any interval is not valid or missing, the MDM shall estimate the usage of all meters associated with the intermittent generation facility for the interval to zero and reconcile the usage after actual readings are obtained.

4.6.5 For each intermittent generation facility that is on Solar Generation Profiling, the MDM shall calculate the generation of the intermittent generation facility based on the nameplate rating of the facility and the Solar Generation Profile. For metering data from meters associated with such facility on Solar Generation Profiling, if any interval is not valid or is missing, the MDM shall estimate the gross generation and usage of all meters associated with such facility for the interval to zero and reconcile the generation and usage after actual readings are obtained.

4.6.6 For metering data from meters associated with an embedded generation facility for which payment is made by the Market Support Services Licensee for its net injection into the transmission system, if any interval is not valid or is missing, the MDM shall estimate the usage of all meters associated with the embedded generation facility for the interval to zero and reconcile the usage after actual readings are obtained.

4.6.7 For data from the following meters, the intervals deemed missing from the MR initial data validation tests stipulated in section 3.4 shall be replaced by estimated meter data derived from:

(i) A Generation Licensee or a Wholesaler Licensee for a generation meter. The Generation Licensee or a Wholesaler Licensee may use any means it deems appropriate, but in any case will provide justification for the approach adopted, along with supporting evidence to justify their estimation for each occasion an estimate is requested. Such information shall be recorded by the MDM and made available to the Authority or surveillance panel at their request, to support an investigation into inappropriate behaviour.

(ii) Power System Operator (PSO) for a intertie meter. PSO may use any means it deems appropriate, but in any case will provide justification for the approach adopted, along with supporting evidence to justify their estimation for each occasion an estimate is requested. Such information shall be recorded by the MDM and made available to the Authority.

The estimated meter data shall be provided to the MDM in a format specified by the MDM no later than the close of business on the second business day after a trading day. If the MDM has not received the meter data from the MR within five business days of the trading day, the data shall be deemed missing, the missing intervals will be replaced by estimated meter data no later than the fifth business day after the trading day.

4.6.8 For manually read kilowatt-hour meters other than prepaid meters, interval meters associated with contestable consumers on Load Profiling, and consumers who do not submit the meter readings to the Market Support Services Licensee within the stipulated period for the purpose of a change in the purchase arrangement or settlement, missing energy data shall be replaced by energy data from the previous meter read cycle after adjusting for any differences in the number of days in the meter read period.

4.6.9 The MDM for a meter installation shall apply the procedures delineated in sections 4.6.1 through 4.6.8 until all data elements required for settlement purposes have been determined.

4.6.10 If any metering data referred to in this section 4.6 are not available because the intervals in question are prior to the date that the meter commenced operation or prior to the date this

Code comes into force, then meter data may be based on the first 48 intervals of data and considered to be of settlement data quality.

4.6.11 For invalid or missing data for which the MDM has applied data estimation procedures, as described in sections 4.6.1 to 4.6.10, the intervals shall be deemed valid for future validation and estimation procedures, and considered to be settlement-ready data.

4.6.12 For contestable consumers on Load Profiling, the MDM shall apportion the cumulative energy usage deemed valid by the procedures described in section 4.6.8 into half-hour interval consumption based on the Load Profile as determined by the Authority.

4.7 Adjustments for Losses and Unaccounted for Energy

4.7.1 The MDM for a meter installation other than intermittent generation facility, shall obtain site-specific adjustment factors for losses, if relevant, from the MESP for that meter installation. The Authority shall inform the MDM the site-specific adjustment factors for the intermittent generation facilities.

4.7.2 The MDM for a meter installation shall obtain adjustment factors that vary by general consumer category (e.g., voltage) from the applicable Market Support Services Licensee in accordance with the Market Support Services Code.

4.7.3 The MDM for a meter installation shall multiply each valid or estimated usage or injection quantity by the appropriate adjustment factor to produce a loss adjusted usage or injection quantity.

4.7.4 The MDM for a meter installation shall maintain both unadjusted and loss-adjusted values in the Metering Data Registry in respect of that meter installation.

4.8 Data Aggregation

4.8.1 For purposes of settlement in the wholesale electricity market through the Market Company, a MDM shall calculate the following aggregate quantities for each settlement interval for each trading day, as defined in the market rules, for each meter installation for which it acts as MDM:

IEQ_h^m = Injection energy quantity (in MWh) at generation registered facility m for settlement interval h, adjusted for losses

WDQ_h^a = Loss adjusted, withdrawal quantity (in MWh) determined for the purposes of recovering load curtailment uplift charges, being the quantity of energy withdrawn by all load associated with settlement account a for settlement interval h;

WEQ_h^a = Loss adjusted, withdrawal energy quantity (in MWh), deemed to be withdrawn at the Singapore HUB, by all load facilities associated with the settlement account a for settlement interval h, grossed up to include injection energy quantities for all groups of embedded generation facilities other than intermittent generation facilities.

WEQ_h^{MSSL} = Withdrawal energy quantity (in MWh) deemed to be withdrawn at the Singapore HUB by all non-contestable consumers, all non-market participant consumers and market participant consumers who are on Load Profiling, calculated in accordance with section 4.8.2

WFQ_h^a = total withdrawal fee quantity (in MWh) for settlement account a for settlement interval h, being the quantity of energy determined as follows:

sum of

sum of net withdrawal or net injection energy quantities for every group of embedded generation facilities and its associated load which are associated with settlement account a for settlement interval h; and

withdrawal energy quantity of any other load associated with settlement account a for settlement interval h, which are not associated with any group of embedded generation facilities.

WFQ_h^{MSSL} = total withdrawal fee quantity (in MWh) for all non-contestable consumers, all non-market participant consumers and all market participant consumers on Load Profiling, calculated in accordance with section 4.8.2, determined as follows:

sum of

sum of net withdrawal or net injection energy quantities for every group of embedded generation facilities and its associated load which are associated with a non-contestable consumer or non-market participant consumer for settlement interval h; and

withdrawal energy quantity of any other load associated with non-contestable consumers, all non-market participant consumers and all market participant consumers on Load Profiling for settlement interval h, which are not associated with any group of embedded generation facilities;

$WLQ_h^{p(a)}$ = Withdrawal energy quantity (in MWh) being the quantity of energy withdrawn, in the dispatch period corresponding to settlement interval h, by LRF with REB p associated with settlement account a for settlement interval h;

WMQ_h^a = total withdrawal MEUC quantity (in MWh) for settlement account a for settlement interval h, being the quantity of energy determined as follows:

sum of

sum of net withdrawal energy quantities for every group of embedded generation facilities and its associated load which are associated with settlement account a for settlement interval h; and

withdrawal energy quantity of any other load associated with settlement account a for settlement interval h, which are not associated with any group of embedded generation facilities;

WMQ_h^{MSSL} = total withdrawal MEUC quantity (in MWh) for all non-contestable consumers, all non-market participant consumers and all market participant consumers on Load Profiling, calculated in accordance with section 4.8.2, determined as follows:

sum of

sum of net withdrawal energy quantities for every group of embedded generation facilities and its associated load which are associated with a non-contestable consumer or non-market participant consumer for settlement interval h; and

withdrawal energy quantity of any other load associated with non-contestable consumers, all non-market participant consumers and all market participant consumers on Load Profiling for settlement interval h, which are not associated with any group of embedded generation facilities;

IIQ_h^I = Net imported intertie quantity (in MWh) flowing in to or out of the transmission system due to intertie flows at intertie meter I in settlement interval h, adjusted for losses

4.8.2 WEQ_h^{MSSL} shall be calculated as the sum of all withdrawals measured at each pool meter, adjusted for losses, plus the sum of all withdrawals at load facilities by Non-market Participant consumer and non-contestable consumers connected to the transmission system at 66kV or above, adjusted for losses, minus the sum of all withdrawals at load facilities by Market Participant Consumers, other than contestable consumers who are on Load Profiling, who are connected to the transmission system at a level below 66kV, adjusted for losses, plus the quantity injected by all Generation Licensees at voltages below 66kV, adjusted for losses. This calculation is illustrated in Equation 4.1.

Equation 4.1

$$WEQ_h^{MSSL} = \sum_p \left(E_h^p \times ADJ^p \times TLF^p\right) + \sum_{mp} \left(E_{h,mp}^{nmpc \geq 66kV} \times TLF^r\right) - \sum_{mp} \left(E_{h,mp}^{mpc < 66kV} \times TLF^r\right) + \sum_{mp} \left(E_{h,mp}^{GF} \times ADJ^{GF} \times TLF^{GF}\right)$$

TLF^p = Transmission loss factor for each pool meter as stipulated in section 6.1.4 of the Market Support Services Code

ADJ^{p}	=	Site-specific adjustment factor for each pool meter to reflect transformer losses as defined in the Market Support Services Code and the Code
E_{h}^{p}	=	Energy withdrawn at pool meter p for settlement interval h
$E_{h,mp}^{nmpc \geq 66kV}$	=	Gross energy withdrawn at load facilities that are not associated with intermittent generation facilities, and net withdrawal energy quantities for the load facilities associated with intermittent generation facilities, as defined in the market rules, other than through pool meters and intertie meters, by non-market participant consumers and non-contestable consumers connected to the transmission system at 66kV or above for settlement interval h at non-pool meter point mp
$E_{h,mp}^{mpc<66kV}$	=	Gross energy withdrawn at load facilities that are not associated with intermittent generation facilities and net energy withdrawn at load facilities associated with intermittent generation facilities by Market Participant Consumers who are not on Load Profiling, and who are connected to the transmission system at a level below 66kV for settlement interval h at non-pool meter point mp
TLF^{r}	=	Transmission loss factor for consumer r at each voltage level as stipulated in section 6.1.4 of the Market Support Services Code
TLF^{GF}	=	Transmission loss factor for *GF* at each voltage level as stipulated in section 6.1.4 of Market Support Services Code
$E_{h,mp}^{GF}$	=	Energy injected onto the transmission system by a *GF* connected to the transmission system at voltages below 66kV for settlement interval h at non-pool meter point mp

ADJ^{GF}	=	Site-specific adjustment factor for each *GF* as a result of connection at busbars of different voltages, if applicable, as defined in the Market Support Services Code and the Code
mp	=	A non-pool meter point

WMQ_h^{MSSL} shall be calculated as sum of, sum of net withdrawal energy quantities for every group of embedded generation facilities and its associated load which are associated with a non-contestable consumer or non-market participant consumer and withdrawal energy quantity of any other load associated with non-contestable consumers, all non-market participant consumers and market participant consumers on Load Profiling for settlement interval h, which are not associated with any group of embedded generation facilities. This calculation is illustrated in Equation 4.2.

Equation 4.2

$$WMQ_h^{MSSL} = WEQ_h^{MSSL} - \sum_f \left(E_{h,f} \times TLF^r + E_{h,f}^G \times ADJ_f^{GF} \right) + \sum_f \left(Max\left(E_{h,f}, 0 \right) \times TLF^r \right)$$

WFQ_h^{MSSL} shall be calculated as the sum of net withdrawal energy quantities for every group of embedded generation facilities and its associated load which are not associated with any settlement account a for settlement interval h; and the withdrawal energy quantity of any other load which is not associated with any settlement account a for settlement interval h and not associated with any group of embedded generation facilities. This calculation is illustrated in Equation 4.3.

Equation 4.3

$$WFQ_h^{MSSL} = WEQ_h^{MSSL} - \sum_f \left(E_{h,f} \times TLF^r + E_{h,f}^G \times ADJ_f^{GF} \right) + \sum_f \left| E_{h,f} \times TLF^r \right|$$

$E_{h,f}$	=	The withdrawal at the embedded generation facility f (for the purposes of this calculation, $E_{h,f}$ represents a net withdrawal)

$E^{G}_{h,f}$	=	The generation at the embedded generation facility f other than intermittent generation facility (this is different to E^{GF}_{h} used to calculate WEQ which is defined in 4.8.2 to be with respect all generation embedded or otherwise, at voltages less than 66 kV)
TLF^{r}	=	Transmission loss factor for consumer r at each voltage level as stipulated in section 6.1.4 of the Market Support Services Code
ADJ^{GF}	=	Site-specific adjustment factor for each embedded generation facility as a result of connection at busbars of different voltages, if applicable, as defined in the Market Support Services Code and the Code
f	=	a facility which for the purposes of this clause includes loads with and without embedded generation
r	=	the consumer associated with facility f

4.8.3 For each electricity licensee who has been approved by the Authority for price neutralization under Chapter 7 section 4.4 of the market rules, the MDM shall calculate the aggregate WPQ for each settlement interval for each authorized settlement account, as defined in the market rules:

WPQ_{h}	=	total withdrawal price quantity (in MWh) determined for the purpose of (USEP + HEUC) nodal price neutralization as defined in the market rules, being the quantity of energy deemed to be withdrawn at the SHUB for settlement interval h by the associated load (as defined in section 4.4.4 of Chapter 7 of the Market Rules) for each group of embedded generation facilities

4.9 Data Transmission Process and Schedule

4.9.1 No later than the close of business on the fifth business day after a trading day, as defined in the market rules, the MDM for a meter installation shall deliver to the Market Company by such means as may be prescribed in the market rules:

(a) the quantities IEQ, WDQ, WEQ, WLQ, WMQ, WFQ, IIQ and, when required by the market rules, WPQ, as defined in sections 4.8.1 and 4.8.3 for each settlement account, as defined in the market rules, associated with that meter installation; and

(b) the metered data underlying the quantity IEQ for each *GF* associated with that meter installation.

4.9.2 No later than the close of business on the fifth business day after a trading day, as defined in the market rules, the MDM for a meter installation shall deliver to each market participant retailer associated with that meter installation via the retail electronic business transaction system validated, unadjusted metering data and loss-adjusted metering data for each meter used for settlement purposes in the retail electricity market and associated with each market participant consumer who is not on Load Profiling and who purchases electricity from that market participant retailer. The MDM shall also deliver the unadjusted metering data and loss adjusted metering data for those embedded generation facilities.

4.9.3 No later than the close of business on the ninth business day after the meter read date, the MDM for a meter installation shall deliver to each market participant retailer associated with that meter installation via the retail electronic business transaction system the validated, unadjusted consumption and loss-adjusted metering data for each market participant consumer who is on Load Profiling and who purchases electricity from that market participant retailer.

4.9.4 No later than the close of business on the fifth business day after a trading day, as defined in the market rules, the MDM for a meter installation shall deliver via the retail electronic business transaction system to each market participant consumer who is not on Load Profiling and is associated with that meter installation that is not being served by a market participant retailer validated unadjusted metering data and loss-adjusted metering data for each meter that is used for settlement purposes in the retail electricity market associated with that market participant consumer who is not on Load Profiling. The MDM shall also deliver the unadjusted metering data and loss adjusted metering data for those embedded generation facilities.

4.9.5 No later than the close of business on the fifth business day following the meter read date, the MDM for a meter installation shall deliver to the applicable Market Support Services Licensee validated unadjusted metering data and loss-adjusted metering data for each meter associated with each market participant consumer who is not on Load Profiling, that is used for settlement purposes in the retail electricity market or for settlement purposes for regulated supply service as follows:

(a) If the MDM for a meter installation and the applicable Market Support Services Licensee are the same entity, this data may be transferred by whatever internal systems as deemed to be appropriate; or

(b) If the MDM for a meter installation and the applicable Market Support Services Licensee are not the same entity, the data shall be transmitted via the retail electronic business transaction system.

The MDM shall also deliver the unadjusted metering data and loss adjusted metering data for those embedded generation facilities.

4.9.6 No later than the close of business on the ninth business day after the meter read date, the MDM for a meter installation shall deliver to the applicable Market Support Services Licensee the validated, unadjusted consumption and loss-adjusted consumption for each market participant consumer on Load Profiling that is used for settlement purposes in the retail electricity market or for settlement purposes for regulated supply service as follows:

(a) If the MDM for a meter installation and the applicable Market Support Services Licensee are the same entity, this data may be transferred by whatever internal systems as deemed to be appropriate; or

(b) If the MDM for a meter installation and the applicable Market Support Services Licensee are not the same entity, the data shall be transmitted via the retail electronic business transaction system.

4.9.7 The MDM for a meter installation shall accommodate a request by a non-market participant retailer or non-market participant consumer associated with that meter installation but not served by a non-market participant retailer to receive data from an interval meter directly from the MDM according to a schedule and via a transmission process that is mutually agreeable among the parties. The MDM shall also accommodate a request to receive unadjusted metering data and loss adjusted metering data for those embedded generation facilities. The price charged for such services shall cover the full incremental cost of providing the service and shall be subject to approval by the Authority.

4.10 Ownership of and Rights to Access Data

4.10.1 The MDM for a meter installation shall not provide metering data (including settlement - ready data) from that meter installation to any person other than the metered entity to whom the data relates or the settlement entity to whom the data relates, except when

(a) the data must be supplied for law enforcement purposes or for the purpose of complying with a legal requirement;

(b) otherwise permitted by this Code;

(c) as required by the licence conditions of the MDM;

(d) as required by the Transmission Licensee; or

(e) allowed by any policy or standard established by the Authority pursuant to this Code.

4.11 Metering Disputes

4.11.1 When the settlement entity responsible for settlement of the charges associated with the electricity flows measured at a meter installation receives a complaint about the accuracy of metering data or the calculation of any substitute or estimated metering data from the metered entity associated with that meter installation the settlement entity shall investigate such complaint and advise that metered entity of the result of such investigation at the earliest opportunity.

4.11.2 If the settlement entity has reason to believe that the inaccuracy complained of pursuant to section 4.11.1is due to a meter error or malfunction, the settlement entity shall inform the MDM for the meter installation who shall review all information available, including any information supplied by the metered entity or the MESP associated with the meter installation, and determine if there is an error in the metering data.

4.11.3 If the MDM for the meter installation referred to in section 4.11.2 determines that any metering data is in error, the MDM shall advise the settlement entity that referred the complaint pursuant to section 4.11.1of such determination and the extent of errors in the metering data.

4.11.4 The settlement entity for the meter installation shall on being advised by the MDM pursuant to section 4.11.3 of any errors in metering data shall make adjustments to reflect the extent of such errors in the settlement accounts of the affected metered entity in the next settlement period following receipt of the changes from the MDM by the settlement entity.

4.12 Faulty Meters and Unauthorized Energy Use

4.12.1 Upon becoming aware, by any means whatsoever, that a meter installation is faulty or that a remotely read meter cannot be interrogated, the MDM for that meter installation shall take the following actions:

(a) If the fault or impediment arises from the functionality of the communication line, the MDM shall notify the metered entity of the fault or impediment and advise the metered entity that such fault or impediment must be rectified within 5 business days. The MDM shall advise the metered entity that if the fault or impediment is not rectified within 5 business days, the metered entity will be charged for manual reading of the meter until such time as the fault or impediment is rectified.

(b) If the fault or impediment is with the meter, the MDM shall notify the MESP for the meter installation that the meter installation must be replaced or repaired and shall obtain advice from the MESP concerning when the fault or impediment will be rectified.

4.12.2 Upon being supplied with evidence of potential meter tampering or energy theft in respect of a meter installation, or upon developing evidence to this effect at its own instigation through whatever means, the MDM for that meter installation shall notify the Authority and shall provide the Authority with the relevant evidence.

APPENDIX A GENERAL STANDARDS FOR METERS AND TRANSFORMERS

All meters and associated metering current and voltage transformers used for settlement purposes shall comply with the following standards:

British Standards (BS)

BS EN 60521	Class 0.5, 1 and 2 alternating current watt-hour meters
BS EN 60687	Specification for alternating current static watt-hour meters for active energy (classes 0.2 S and 0.5 S)
BS EN 61036	Alternating current static watt-hour meters for active energy (classes 1 and 2)
BS EN 61268	Alternating current static var-hour meters for reactive energy (classes 2 and 3)
BS EN 7856	Code of practice for design of alternating current watt-hour meters for active energy (classes 1 and 2)
BS EN 60044-1	Instrument transformers. Current transformers
BS 3941	Specification for voltage transformers
BS EN 61107	Data exchange for meter reading; tariff and load control - Direct local data exchange.
BS EN 62052-11	Electricity metering equipment (AC). General requirements, tests and test conditions. Metering equipment
BS EN 62053-11	Electricity metering equipment (a.c.), Particular requirements. Electromechanical meters for active energy (classes 0.5, 1 and 2)
BS EN 62053-21	Electricity metering equipment (a.c.), Particular requirements. Static meters for active energy (classes 1 and 2)
BS EN 62053-22	Electricity metering equipment (a.c.), Particular requirements. Static meters for active energy (classes 0.2S and 0.5S)
BS EN 62053-23	Electricity metering equipment (a.c.), Particular requirements. Static meters for reactive energy (classes 2 and 3)

International Electrotechnical Commission (IEC)

IEC 60521	Class 0.5, 1 and 2 alternating-current watt-hour meters
IEC 60687	Alternating current static watt-hour meters for active energy (Classes. 0.2 S and 0.5 S)
IEC 61036	Alternating current static watt-hour meters for active energy (Classes. 1 and 2)
IEC 61268	Alternating current static var-hour meters for reactive energy (Classes. 2 and 3)
IEC 60044-1	Current Transformers
IEC 60186	Voltage Transformers
IEC 61107	Data exchange for meter reading, tariff and load control - Direct local data exchange
IEC 62052-11	Electrical metering equipment (AC) – General requirements, tests and test conditions – Part 11: Metering equipment
IEC 62053-11	Electricity metering equipment (a.c.) – Particular requirements – Part 11: Electromechanical meters for active energy (classes 0.5, 1 and 2)
IEC 62053-21	Electricity metering equipment (a.c.) – Particular requirement – Part 21: Static meters for active energy (classes 1 and 2)
IEC 62053-22	Electricity metering equipment (a.c.) – Particular requirements – Part 22: Static meters for active energy (classes 0.2S and 0.5S)
IEC 62053-23	Electricity metering equipment (a.c.) – Particular requirements – Part 23: Static meters for reactive energy (classes 2 and 3)