

GAS METERING CODE

Energy Market Authority of Singapore

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GAS METERING CODE

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1 INTRODUCTION

1.1 Defined Terms

The following definitions shall apply in this Code unless otherwise specified or the context otherwise requires:

“Accuracy Limits” means the accuracy limits for volume of gas set out in Table 2 under Clause 5.2.1;

“Affected Participants” means

- (i) the relevant Gas Shipper who ships gas to a System Offtake Point in the Distribution Network owned by or under the management or control of, the Designated Gas Transporter;
- (ii) the relevant Retail Customer who withdraws gas from that System Offtake Point; and
- (iii) the relevant Gas Retailer who supplies gas to that Retail Customer.

“Archive Period” means, where the context requires, a period not less than:

- (i) six (6) years from the date of removal of the Meter; or
- (ii) six (6) years from the date to which the Meter Data relates,

“Balancing Period” is as defined in the Gas Network Code;

“Balancing Period Capable Meter Installation” or **“BPCM Installation”** means a Meter Installation for which:

- (i) meter reading is not conducted for each Balancing Period;
- (ii) Meter Data is recorded in the Meter Installation for each Balancing Period; and
- (iii) Meter Data is available to the Designated Gas Transporter at intervals longer than every hour;

“Balancing Period Read Meter Installation” or **“BPRM Installation”** means a Meter Installation for which:

- (i) meter reading is conducted for each Balancing Period;
- (ii) Meter Data is recorded in the Meter Installation for each Balancing Period; and
- (iii) Meter Data is available to the Designated Gas Transporter at hourly intervals;

“Code” means this Gas Metering Code;

“Daily Read Capable Meter Installation” or **“DRCM Installation”** means a Meter Installation for which:

- (i) Meter Data is recorded in the Meter Installation for each day; and
- (ii) Meter Data is available to the Designated Gas Transporter at intervals longer than every day;

“Designated Gas Transporter” has the same meaning as in section 61A of the Gas Act.

“Designated Gas Transporter Meter Database” means a database which contains all Meter Data gathered or collected from BPRM Installations and is maintained by the Designated Gas Transporter;

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“**Distribution Network(s)**” is as defined in the Gas Network Code;

“**Distribution Network Injection Point**” is as defined in the Gas Network Code;

“**Distribution Network Offtake Point**” is as defined in the Gas Network Code;

“**Gas Act**” means the Gas Act (Cap. 116A) of Singapore;

“**Gas Shipper Meter Database**” means a database which contains all Meter Data gathered or collected from BPCM, DRCM and MRM Installations and is maintained by the Gas Shipper;

“**Gas Transportation IT System Solution (GTSS)**” is as defined in the Gas Network Code;

“**GTSS Meter Database**” means the repository which contains all data pertaining to a Meter Installation including: (i) Meter Installation ID; (ii) address at which the Meter Installation is located; (iii) Gas Shipper ID for the Gas Shipper whose offtake point registration notice with respect to the Meter Installation was accepted by the Designated Gas Transporter; (iv) the type of Meter Installation; (v) Customer Type; (vi) the classification of the System Offtake Point for the purposes of System Stress Curtailment Plan; and (vii) dates for when natural gas was first offtaken from such System Offtake Point and date of connection to the Transportation System;

“**Industry**” means the gas industry in Singapore;

“**Manually Read Meter Installation**” or “**MRM Installation**” means a Meter Installation for which:

- (i) Meter Data is not recorded in the Meter Installation for each day; and
- (ii) Meter Data is available to the Designated Gas Transporter at intervals longer than every day;

“**Meter Data**” comprises all data collected and transferred from a Meter Installation, including the meter readings, the Meter Installation ID, the relevant Balancing Period, energy consumption and natural gas throughput volume and quality, where applicable;

“**Meter Data Register**” is as defined in the Gas Network Code;

“**Meter Installation**” means any Meter and its associated equipment and installation including associated pipework, filter, valve, pressure regulating equipment, seal, housing, mounting, telemetry equipment, gas chromatograph and flow computer;

“**Meter Installation ID**” means the identification number given to each Meter Installation by the Designated Gas Transporter;

“**Meter Owner**” means a Person who owns a Meter Installation;

“**Non-Balancing Period Meter Installation**” or “**NBPM Installation**” means a DRCM or MRM Installation;

“**Participants**” means the Meter Owner, Direct Access Customer, Retail Customer, Gas Shipper and Gas Retailer;

“**Parties**” means the Designated Gas Transporter and the Participants and “**Party**” means any one of the Parties;

“**Person**” includes any company or association or body of persons, corporate or unincorporate;

“**Retail Customer**” is as defined in the Gas Network Code;

“**SAC-SINGLAS**” means the Singapore Accreditation Council-Singapore Laboratory Accreditation Scheme;

“**System Critical Point**” is as defined in the Gas Network Code;

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“**System Offtake Point**” is as defined in the Gas Network Code;

“**System Point**” means a point on the Transportation System identified in the Gas Network Code;

“**Transmission/Distribution Point**” is as defined in the Gas Network Code;

“**Transmission Network**” is as defined in the Gas Network Code;

“**Transmission Network Injection Point**” is as defined in the Gas Network Code;

“**Transmission Network Offtake Point**” is as defined in the Gas Network Code;

“**Transportation System**” means the main pipeline system owned and operated by the Designated Gas Transporter through which the conveyance of natural gas is authorised by the Designated Gas Transporter’s Licence; and

“**Validation Rules**” means the rules and procedures prepared by the Designated Gas Transporter in consultation with Industry players and approved by the Authority for validating the meter readings submitted by Gas Shippers in accordance with Clause 6.11 and the Gas Network Code.

1.2 Interpretation

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

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

1.2.3 A reference in this Code to any statute, subsidiary legislation, proclamation, ordinance, by-law, resolution, rule, order, supplement, 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.

1.2.4 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.

1.2.5 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.

1.2.6 A reference in this Code to the word “including” or grammatical variation thereof means “including but not limited to”.

1.2.7 A reference to:

(a) “Clause” or “Clauses” refer to a clause or clauses of this Code;

(b) “Appendix” or “Appendices” refer to an appendix or appendices to this Code; and

(c) “Table” or “Tables” refer to a table or tables set out in this Code.

1.3 Purpose of this Code

This Code sets out the obligations of (i) a Gas Shipper who shall provide Meter Data to the Designated Gas Transporter under the Gas Network Code, (ii) the Designated Gas Transporter who owns a Meter Installation and who performs balancing and settlement in the Industry; and (iii) a Gas Retailer who retails gas to Retail Customers. It also addresses issues associated with the production, storage, collection, transmission and verification of Meter Data from all Meter Installations. Specifications of Meter Installations and associated equipment are also described in this Code.

1.4 Application

This Code:

- (a) applies to the metering of gas; and
- (b) is subordinate to and shall be implemented in accordance with the Gas Network Code and all applicable laws and in the event of any inconsistency between provisions contained in this Code and provisions contained in the Gas Network Code, the provisions contained in the Gas Network Code shall prevail to the extent of the inconsistency.

1.5 To Whom this Code Applies

This Code applies to

- (a) Gas Shippers;
- (b) Gas Retailers; and
- (c) the Designated Gas Transporter.

1.6 Modifications to this Code

1.6.1 The Authority may from time to time modify this Code. The process by which this Code may be modified shall be as follows:

- (a) Before making any modification to this Code, the Authority shall give written notice to Gas Shippers, Gas Retailers and the Designated Gas Transporter:
 - (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 gas licensee or third party; and

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- (iii) specifying the period from the date of the giving of the notice (not being less than twenty eight (28) calendar 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 Clause 1.6.1(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 without giving any further notice.
 - (c) Where the Authority receives any written representation under Clause 1.6.1(a), the Authority shall, except to the extent that such representation is withdrawn, consider such representation and may at its discretion:
 - (i) reject the representations;
 - (ii) amend the proposed modification taking into account the representations; or
 - (iii) withdraw the proposed modification,and the Authority shall, where Clause 1.6.1(c)(i) or 1.6.1(c)(ii) applies but subject to Clause 1.6.1(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 relevant parties of the outcome of the Authority's deliberations in respect of the modification.
 - (e) Any modifications made under this Clause 1.6 shall be published by the Authority in such manner as will secure adequate publicity.
 - (f) A modification to this Code shall not come into force until such time as the Authority has complied with Clause 1.6.1(d), where applicable, and ten (10) calendar days, or such longer period of time as may be specified by the Authority, have elapsed since the date on which the Authority published the modification pursuant to Clause 1.6.1(e).
- 1.6.2 Nothing contained in Clause 1.6.1 shall prohibit any gas licensee or any relevant Party from notifying the Authority of suggested changes to the Code.

1.7 Coming into Force

This Code or any amendment thereto shall come into force on the day on which the Authority issued this Code or the day on which the amendment is issued, as the case may be.

2 METER OWNERSHIP, INSTALLATION AND MAINTENANCE

2.1 Ownership of a Meter Installation

2.1.1 The Designated Gas Transporter shall own a Meter Installation which is in operation and used to measure the volume or energy of natural gas injected or withdrawn at:

- (a) any Transmission Network Injection Point;
- (b) any Transmission/Distribution Point;
- (c) any System Critical Point; and
- (d) the Distribution Network Injection Point.

2.1.2 The Designated Gas Transporter shall own a Meter Installation which is in operation and used to measure the volume or energy of natural gas withdrawn at any Transmission Network Offtake Point of the Transportation System owned by, or under the management or control of the Designated Gas Transporter, when required by both the relevant Gas Shipper and the relevant Direct Access Customer.

2.1.3 The Designated Gas Transporter shall own a Meter Installation which is in operation and used to measure the volume or energy of gas withdrawn from the Distribution Network owned by, or under the management or control of, the Designated Gas Transporter to supply to any Retail Customer's premises.

2.2 General Obligation of Designated Gas Transporter who owns a Meter Installation at any Retail Customer's premises

2.2.1 The Designated Gas Transporter shall ensure that its Meter Installation at any Retail Customer's premises is installed, commissioned, maintained, repaired, replaced, tested and calibrated in a manner which complies with the provisions of this Code.

2.2.2 The Designated Gas Transporter shall ensure that its Meter is operating within the Accuracy Limits prescribed in this Code.

2.3 Meter Installation, Maintenance and Operation

- 2.3.1 The Designated Gas Transporter shall ensure that its Meter Installation at any Retail Customer's premises is installed, commissioned, maintained and operated by a competent person in accordance with the procedures and requirements of the Meter manufacturer, the standards that are specified in Appendix 1 and/or any modification thereto, the Singapore Standard SS 608 and all applicable laws, where applicable.
- 2.3.2 In the event of a conflict between the procedures and requirements of the Meter manufacturer, the standards specified in Appendix 1 and Singapore Standard SS 608 and all applicable laws, the Singapore Standard SS 608 and applicable laws shall prevail.
- 2.3.3 In the event of a conflict between the procedures and requirements of the Meter manufacturer and the standards specified in Appendix 1, the standards specified in Appendix 1 shall prevail.

2.4 International Utility Best Practice

The Designated Gas Transporter shall, at its discretion from time to time, investigate innovations relevant to the Industry, including those in respect of domestic meter reading and, if such innovations would be practical in and beneficial to the Industry, notify interested Parties of the same and encourage use of the Transportation System.

3 CATEGORISATION OF METER INSTALLATIONS

3.1 Type of Meter Installations

Where the Designated Gas Transporter owns the Meter Installation, it shall ensure that a Meter Installation is installed and maintained at each System Point in accordance with the requirements for the Meter Installations stipulated in Clause 3.3.

3.2 Requirements at System Points

3.2.1 Every Meter Installation at a System Point (except any Meter Installation owned by the Designated Gas Transporter) shall:

- (a) comply with the requirements for the Meter Installations set out in Clause 3.3; and
- (b) be installed and maintained in accordance with this Code; and
- (c) have a Meter certified by;
 - (i) a laboratory approved by the Singapore Accreditation Council under the Singapore Laboratory Accredited Scheme (SAC-SINGLAS); or
 - (ii) one of the test facilities specified in Appendix 2.
- (d) (where applicable) comply with the requirements for the gas chromatograph as prescribed in Clause 3.3.5.

3.2.2 Where the Designated Gas Transporter is or becomes aware of any non-compliance with Clause 3.2.1, the Designated Gas Transporter shall immediately

- (a) notify the relevant Gas Shipper of such non-compliance; and
- (b) give the relevant Gas Shipper a period of three (3) months or such longer period as may be determined by the Authority to cause the non-compliant Meter Installation to be rectified,

failing which the Designated Gas Transporter shall prohibit the flow of gas at the relevant System Point.

3.3 Requirements for Meter Installation

3.3.1 Each BPRM installation shall:

- (a) have the necessary characteristics specified in Category 1 or Category 2, as the case may be, of Table 1;
- (b) have a gas chromatograph and flow computer for a Meter Installation that is installed at all Transmission Network Injection Points and the Distribution Network Injection Points;

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- (c) have electronic data recording facilities such that all Meter Data can be measured and recorded for each Balancing Period and be capable of storing the Meter Data for at least thirty-five (35) calendar days;
- (d) be capable of transmitting Meter Data to and communicating with Designated Gas Transporter's supervisory control and data acquisition "SCADA" system; and
- (e) contain a device which has a visible or an accessible display of Meter Data or which allows such Meter Data to be accessed and read concurrently by a portable computer or other equipment.

3.3.2 Each BPCM installation shall:

- (a) have the necessary characteristics specified in Category 3 prescribed in Table 1;
- (b) have electronic data recording facilities such that all Meter Data can be measured and recorded for each Balancing Period and be capable of storing the Meter Data for at least thirty-five (35) calendar days; and
- (c) contain a device which has a visible or an accessible display of Meter Data or which allows such Meter Data to be accessed and read concurrently by a portable computer or other equipment.

3.3.3 Each DRCM installation shall:

- (a) have the necessary characteristics specified in Category 4 prescribed in Table 1;
- (b) have electronic data recording facilities such that all Meter Data can be measured and recorded daily and be capable of storing the Meter Data for at least thirty-five (35) calendar days; and
- (c) contain a device which has a visible or an accessible display of Meter Data or which allows such Meter Data to be accessed and read concurrently by a portable computer or other equipment.

3.3.4 Each MRM Installation shall

- (a) have the necessary characteristics specified in Category 5 prescribed in Table 1; and
- (b) be capable of measuring the volume of gas supplied or amount of energy supplied.

3.3.5 Each gas chromatograph shall:

- (a) have on-line sampling capability. The measurement cycle time shall be no more than twelve (12) minutes;
- (b) have the capability to automatically self-calibrate at the interval prescribe in Table 3 using gravimetrically prepared standard reference gases traceable to National Institute of Standards and Technology, United States of America;

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- (c) have the capability to continuously measure and analyse the natural gas components that are specified in the Singapore gas specification prescribed in the Gas Network Code;
- (d) have the capability to compute the heating value of the natural gas for each Balancing Period in accordance with ISO 6976 or the prevailing latest revision;
- (e) have a repeatability of at least $\pm 0.1\%$ on heating value over the complete temperature range; and
- (f) have the capability of measuring up to at least C₆₊ hydrocarbon range.

Table 1. Meter Installations by Maximum Volumetric Flowrates

(a) For Meter Installation that is installed at Transmission Network Injection Point, Transmission/Distribution Point, System Critical Point, Distribution Network Injection Point and Transmission Network Offtake Point

Category	Maximum Volumetric Flowrates (in scm/hr)	Description of Meter Installations
Category 1 BPRM Installation	> 150,000	(b), (c) or (d) with pressure and temperature correction, SCADA connection facilities, flow computer.
Category 2 BPRM Installation	> 30,000 ≤ 150,000	(b), (c), or (d) with pressure and temperature correction, SCADA connection facilities, flow computer.
Category 3 BPCM Installation	> 6,000 ≤ 30,000	(a), (b), (c), (d) or (e) with pressure and temperature correction, flow computer, balancing period readings retrievable
Category 4 DRCM Installation	≤ 6,000	(a), (b), (c), (d) or (e) with pressure and temperature correction, daily readings retrievable

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(b) For Meter Installation that is installed at Distribution Network Offtake Point

Category	Maximum Volumetric Flowrates (in scm/hr)	Description of Meter Installations
Category 1 BPRM Installation	> 150,000	(b), (c) or (d) with pressure and temperature correction, SCADA connection facilities, flow computer.
Category 2 BPRM Installation	> 30,000 ≤ 150,000	(b), (c), or (d) with pressure and temperature correction, SCADA connection facilities, flow computer.
Category 3 BPCM Installation	> 6,000 ≤ 30,000	(a), (b), (c), (d) or (e) with pressure and temperature correction, flow computer, balancing period readings retrievable
Category 4 DRCM Installation	> 3,000 ≤ 6,000	(a), (b), (c), (d) or (e) with pressure and temperature correction, daily readings retrievable
Category 5 MRM Installation	≤ 3,000	(a), (b), (d) or (e) with pressure correction when the supply pressure to the premises is at pressure of 10kpag or above

Meter Installation descriptions for the purposes of Table 1:

- (a) Orifice plate Meter
- (b) Turbine Meter
- (c) Ultrasonic Meter
- (d) Mass flow Meter
- (e) Positive displacement Meter (Rotary or Diaphragm)

3.3.6 Any Meter Installation that is installed at the following System Points shall be a BPRM Installation:

- (a) any Transmission Network Injection Point;
- (b) any Transmission/Distribution Point;
- (c) any System Critical Point; and
- (d) the Distribution Network Injection Point.

4. SECURITY

4.1 Security of Meter Data

The Designated Gas Transporter shall, in respect of those Meter Installations (excluding MRM installation) which it owns at Retail Customers' premises, as far as is reasonably practicable:

- (a) ensure that such Meter Installations are secure against unauthorised access, interference and tampering including, where necessary, install a remote alarm which alerts the Designated Gas Transporter to any unauthorized access to the Meter Installation;
- (b) ensure that such Meter Installations are located as close to the point of measurement on the Distribution Network as technically practicable;
- (c) ensure that Meter Data held in such Meter Installations is protected from unauthorised local or remote electronic access by implementing appropriate security measures including, where necessary, passwords protection and data firewalls;
- (d) ensure that the security measures the Designated Gas Transporter has implemented to prevent any unauthorized local or remote electronic access to the Meter Data held in the Meter Installation are reviewed periodically;
- (e) keep secure records of electronic access passwords used to prevent any unauthorized local or remote electronic access to the Meter Data held in the Meter Installation; and
- (f) provide the relevant Gas Shipper with a "read only" password to access the Meter Data held in the Meter Installation.

4.2 Meter Tampering

4.2.1 If the Designated Gas Transporter, any Gas Shipper or any Gas Retailer finds evidence for any Meter Installation that is not owned by them that:

- (a) there has been altering or tampering with that Meter Installation; or
- (b) any person has carried out, engaged in or done anything which will compromise or adversely affect the accuracy of that Meter Installation;

then the Designated Gas Transporter, Gas Shipper or Gas Retailer shall notify all of the affected Parties, as soon as reasonably practicable.

4.2.2 Upon being supplied with information that any of the events in Clause 4.2.1 is likely to occur or has occurred, the Designated Gas Transporter shall:

- (a) notify the Authority as soon as practicable;
- (b) carry out any relevant investigation or such other investigations as may be directed by the Authority;
- (c) furnish the Authority with a written investigation report; and
- (d) provide the Authority with relevant information and evidence.

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4.2.3 The Designated Gas Transporter shall arrange for tests to be conducted on the Meter Installation at any Retail Customer's premises and, if necessary, repair the Meter Installation at any Retail Customer's premises to ensure that the Meter Installation is operating within the Accuracy Limits in the event that there has been unauthorised access, interference or tampering with such Meter Installation.

4.2.4 A Gas Shipper or Gas Retailer who:

- (a) alters or tampers with any Meter Installation at any Retail Customer's premises; or
- (b) carries out, engages in or does anything that will compromise or adversely affect the accuracy of a Meter Installation at any Retail Customer's premises

shall be liable to and indemnify the Designated Gas Transporter for its reasonable costs of adjustment, repair, replacement and testing of the Meter Installation to restore it to operation within the Accuracy Limits.

4.3 Preservation of Meter Data

The Designated Gas Transporter and each relevant Gas Shipper shall ensure that any Meter Data collected from the relevant Meter Installation is not altered, corrupted or lost.

4.4 Confidentiality

The Designated Gas Transporter and Gas Shipper shall keep all Meter Data and passwords confidential, except where the Designated Gas Transporter and Gas Shipper are required to provide such information under this Code, the Gas Network Code, applicable laws or pursuant to the order of any court of competent jurisdiction.

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5. METER ACCURACY, CALIBRATION AND TESTING

5.1 Accuracy, Calibration and Testing of Meter Installation at Retail Customer's Premises

5.1.1 The Designated Gas Transporter shall subject each Meter which it owns at any Retail Customer's premises to initial and periodic testing and re-calibration to ensure that it is operating within the Accuracy Limits.

5.1.2 The Designated Gas Transporter shall ensure that each Meter which it owns at any Retail Customer's premises satisfies the Accuracy Limits within its specified range of flow rates, as specified in this Code.

5.2 Accuracy Limits

5.2.1 Table 2 sets forth the Accuracy Limits for Meters using hourly flow rate range.

Table 2. Accuracy Limits for Volume

Category	Hourly Flow Rate Range (in scm/hr)	Accuracy Limits (Volume)
1	> 150,000	± 0.7%
2	> 30,000 ≤ 150,000	± 1.0%
3	> 6,000 ≤ 30,000	± 1.5%
4	> 3,000 ≤ 6,000	± 2.0%
5	≤ 3,000	± 2.5%

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Table 3. Periodic Test and Calibration of Meter Installations

Category	Peak Flow Rate of Connection Point (in scm/hr)	Pressure and Temperature Calibration Frequency	Gas Chromatograph Calibration Frequency	Meter Test Frequency
1	> 150,000	Semi-annually	At least once every two (2) weeks	Annually
2	> 30,000 ≤ 150,000	Semi-annually	At least once every two (2) weeks	Annually
3	> 6,000 ≤ 30,000	Annually	At least once every two (2) weeks	Annually
4	> 3,000 ≤ 6,000	Annually	At least once every two (2) weeks	Annually
5	≤ 3,000	Annually	N.A.	Once in ten (10) years

5.3 Testing and Calibration of Meter Installations at Retail Customer's Premises

5.3.1 Testing and Calibration

The Designated Gas Transporter shall, for each Meter Installation at any Retail Customer's premises:

- (a) cause the Meter Installation to be tested and calibrated in accordance with the Table 3;
- (b) cause the Meter to be certified that it complies with the Accuracy Limits by:
 - (i) a laboratory approved by the Singapore Accreditation Council under the Singapore Laboratory Accredited Scheme (SAC-SINGLAS); or
 - (ii) one of the test facilities specified in Appendix 2.
- (c) where the Meter Installation includes a gas chromatograph, cause the gas chromatograph to be tested and/or calibrated by a competent person;
- (d) cause the Meter Installation to be tested or recalibrated no less frequently than as set out in Table 3; and cause the Meter to be recalibrated if the result of the test indicates the Meter is operating outside the Accuracy Limits;
- (e) provide any Affected Participants with at least fourteen (14) calendar days' written notice of the proposed time and date on which such Meter Installation is to be calibrated and the nature of the calibration to be undertaken, or such shorter notice as may be agreed by the Affected Participants;
- (f) permit the Affected Participants to have a representative present, at their own cost and risk, to observe the calibration of such Meter Installation and any consequential adjustment;
- (g) maintain the test results or certificates pursuant to Clauses 5.3.1(a) and (b) for at least six (6) years and produce such test results or certificates within seven (7) calendar days of being requested to do so by the Authority or any Affected Participants referred to Clause 5.3.1(e).

Calibrations and tests caused by the Designated Gas Transporter shall be binding on the Designated Gas Transporter, the affected Gas Shipper and Gas Retailer, notwithstanding the presence or absence of any Affected Participants at the relevant Meter Installation during such operations.

5.3.2 Right to Check the Accuracy of Meter at Retail Customer's premises

For each Meter at any Retail Customer's premises:

- (a) an affected Gas Shipper or Gas Retailer may request the Designated Gas Transporter to arrange testing to confirm the accuracy of the meter readings;

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- (b) the Designated Gas Transporter shall make the results of the test conducted pursuant to Clause 5.3.2(a) available to the affected Gas Shipper or Gas Retailer who requested for the test to be conducted; and
- (c) the Designated Gas Transporter shall keep results of the test or certificates pursuant to Clause 5.3.2 (a) for at least six (6) years; and
- (d) the Designated Gas Transporter shall produce test results or certificates within seven (7) calendar days of being requested to do so by the Authority, or the affected Gas Shipper or Gas Retailer who requested for the test to be conducted.

5.3.3 In the event that the test results prove that the Meter operates within the Accuracy Limits, the costs and expenses of the testing shall be borne by the affected Gas Shipper or Gas Retailer who requested for the testing.

5.3.4 In the event that the test results prove that the Meter operates outside the Accuracy Limits, the costs and expenses of the testing shall be borne by the Designated Gas Transporter.

5.4 Testing of Meter for all MRM Installations at any Retail Customer's premises

5.4.1 The Designated Gas Transporter shall send the Meters for all MRM Installations, which have been used and returned from site, to a laboratory that has been accredited by SAC-SINGLAS or a national accredited laboratory, for testing and/or calibration in accordance with the accredited laboratory's standard and methodology, and for certification prior to installation at any Retail Customer's premises to ensure that they operate within the Accuracy Limits at all flow rates between the badged rating and a rate of flow of not less than one-fifth of the badged rating. The Designated Gas Transporter shall ensure that the laboratory has sealed the Meters that have been tested and issued a test report or certificate of such test.

5.4.2 The Designated Gas Transporter shall ensure that a sampling test for new Meters for all MRM Installations is carried out in accordance with BS 6001. The accuracy of new Meters shall be tested in accordance with BS EN 1359, BS EN 12480 and BS EN 12261, where applicable. The Designated Gas Transporter shall keep and maintain a full record of the Meter number, date of test and test results to be recorded and held for each Meter tested at each Meter workshop from the date of the test or any subsequent re-test for at least six (6) years.

5.4.3 Any affected Gas Retailer may request the Meter for any MRM Installation in question to be tested at a laboratory that has been accredited by SAC-SINGLAS or any laboratory specified in Appendix 2 in the presence of the Affected Participants. If the accuracy of the Meter is found to have deviated beyond the Accuracy Limits, then the Affected Participants shall be notified as soon as practicable.

5.4.4 In the event that the test results prove that the Meter operates within the Accuracy Limits, the costs and expenses of the testing shall be borne by the affected Gas Retailer who requested for the testing.

5.4.5 In the event that the test results prove that the Meter operates outside the Accuracy Limits, the costs and expense of the testing shall be borne by the Designated Gas Transporter.

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- 5.4.6 If the Meter for any MRM Installation at any Retail Customer's premises is removed by the Designated Gas Transporter as part of an age related operation or any other Meter change process not arising from a Meter accuracy complaint, then the Designated Gas Transporter shall:
- (a) provide the relevant Gas Shipper (where applicable) and Gas Retailer with at least seven (7) calendar days prior written notice of the Meter change and, final meter readings (from the removed Meter) and initial meter readings (from the new Meter) to the Gas Shipper and Gas Retailer as required; and
 - (b) retain the removed Meter in a serviceable condition to permit any accuracy testing at the request of the Affected Participants for a minimum of one (1) month. The Designated Gas Transporter shall retain all records and meter readings relating to such Meter and provide reasonable access to the Authority, or any Affected Participants for the Archive Period.
 - (c) upon request by any Affected Participants, the Designated Gas Transporter shall continue retain the removed Meter in a serviceable condition until the accuracy testing is completed.
- 5.4.7 The Designated Gas Transporter shall retain Meters for all MRM Installations removed during conversion from town gas to natural gas in a serviceable condition for a period of one (1) month to permit any accuracy testing at the request of the Gas Retailer. The Designated Gas Transporter shall retain all records and meter readings relating to such Meter and provide reasonable access to the Authority, the affected Gas Retailer or affected Retail Customer for the Archive Period.
- 5.4.8 Upon request by any Gas Retailer, the Designated Gas Transporter shall continue to retain the removed Meter in a serviceable condition until the accuracy testing is completed.
- 5.4.9 The Designated Gas Transporter will be responsible for establishing a MRM Installation replacement programme by considering the accuracy test results carried out for the Meters removed from Meter Installations for age related Meter changes.

6. METER READING, METER DATA COLLECTION, VERIFICATION AND ACCESS

6.1 Meter Reading

6.1.1 The Designated Gas Transporter shall read the Meter Installations installed at:

- (a) all Transmission Network Injection Points;
- (b) all Transmission/Distribution Points;
- (c) all System Critical Points;
- (d) the Distribution Network Injection Point; and
- (e) all System Offtake Points having a BPRM installation.

6.1.2 Each Gas Shipper shall ensure that Meter Data from all BPCM and NBPM installations at which such Gas Shipper is identified in the offtake point registration notice is read and collected, and provided to the Designated Gas Transporter in accordance with the Gas Network Code. The data coding and communication protocols used shall be subject to approval by the Gas Transporter and shall comply with the GTSS.

6.2 Availability of BPRM Installations

When any BPRM installation at any Retail Customer's premises malfunctions, the Designated Gas Transporter shall repair or replace, or cause to be repaired or replaced, the BPRM Installation in such manner as may be necessary to rectify the malfunction within one (1) calendar day of his discovery of the malfunction.

6.3 Availability of BPCM Installations and NBPM Installations

When any BPCM or NBPM installation at any Retail Customer's premises malfunctions, the Designated Gas Transporter shall repair or replace, or cause to be repaired or replaced, the BPCM Installation or NBPM Installation in such manner as may be necessary to rectify the malfunction within seven (7) calendar days of his discovery of the malfunction.

6.4 Meter Time and Date

All BPRM, BPCM and DRCM Installations shall be referenced to Singapore Time and Date and such time shall be maintained within a margin of error not exceeding plus or minus two (2) seconds of the actual Singapore Time and Date for all BPRM installations and plus or minus five (5) seconds of the actual Singapore Time and Date for BPCM and DRCM Installations.

6.5 Pulse Outputs

The Designated Gas Transporter shall provide, upon the written request of an Affected Participants, pulse or electronic outputs representing the quantities and or characteristics of natural gas measured from BPRM installations or BPCM installations at any Retail Customers' premises for use by the Retail Customer in managing the flow of natural gas withdrawn from the Distribution Network.

6.6 Data Collection and Transfer

- 6.6.1 The Designated Gas Transporter and each Gas Shipper shall cause its Meter Data to be stamped with the time and date recorded.
- 6.6.2 The Designated Gas Transporter shall with respect to its BPCM and DRCM installations at Retail Customers' premises, provide the necessary means of communication to permit the relevant Gas Shipper to read and collect the Meter Data held in the relevant Meter Installation.
- 6.6.3 For the purposes of the Clause 6.6.2, "necessary means of communication" includes hand held electronic data entry or data capture units with associated downloadable communications paths if these are required to meet the time limit for Meter Data capture and transfer from the Meter Installation as stipulated in the Gas Network Code.
- 6.6.4 In the event where the communication equipment was already installed and used, each Gas Shipper may, in consultation with and subject to agreement from the Designated Gas Transporter, specify the type of equipment to be used for communication with its meter reading facility and shall compensate the Designated Gas Transporter for such a request.

6.7 Gas Shipper Meter Database

- 6.7.1 Each Gas Shipper shall create, maintain and administer a Gas Shipper Meter Database.
- 6.7.2 Each Gas Shipper shall provide the Designated Gas Transporter, the relevant Direct Access Customer and the relevant Gas Retailer access to the information in the Gas Shipper's Meter Database on a timescale to be agreed amongst the relevant Parties.
- 6.7.3 Each Gas Shipper shall ensure that all Meter Data is stored in its normally accessible form for no less than twelve (12) months from the date to which it relates and archived for the Archive Period.

6.8 Designated Gas Transporter Meter Database

- 6.8.1 The Designated Gas Transporter shall create, maintain and administer a Designated Gas Transporter Meter Database.
- 6.8.2 The Designated Gas Transporter shall provide the relevant Gas Shipper, the relevant Direct Access Customer, or the relevant Gas Retailer access to the Meter Data stored in its Designated Gas Transporter Meter Database on a timescale to be agreed amongst the relevant Parties.

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6.8.3 The Designated Gas Transporter shall ensure that all Meter Data is stored in its normally accessible form for no less than twelve (12) months from the date to which it relates and archived for the Archive Period.

6.9 Meter Data Register

6.9.1 The Designated Gas Transporter shall create, maintain and administer the Meter Data Register in compliance with the GTSS. The Meter Data Register shall contain all Meter Data, all other information used for settlement purposes and a register of all Meter Installations that provide Meter Data used by the Designated Gas Transporter.

6.9.2 The Designated Gas Transporter shall ensure that the Meter Data Register and the data contained therein is accessible by the relevant Gas Shipper during the regular office hours of the Designated Gas Transporter.

6.9.3 All data stored by the Designated Gas Transporter in the Meter Data Register shall be stored in normally accessible form for no less than twelve (12) months from the date to which it relates and archived for the Archive Period.

6.9.4 The Meter Data Register must include meter readings in mmBtu and heating value data in btu/scf, data substituted in accordance with this section of this Code, and all information used for settlement purposes.

6.10 Right of Access to Meter Data

If:

- (a) a Retail Customer is changing or proposes to change Gas Retailers;
- (b) the new Gas Retailer requires access to historical Meter Data to assist it in determining the commercial terms of its service; and
- (c) the Retail Customer has provided its consent in writing,

then such new Gas Retailer shall be given access to historical Meter Data of such Retail Customer.

6.11 Data Validation and Substitution

6.11.1 The Designated Gas Transporter shall develop Validation Rules which will include, inter alia, a process to confirm that:

- (a) the Meter Installation ID is in a valid format;
- (b) the Meter Installation ID exists in the GTSS Meter Database;
- (c) meter readings from the Meter Installation can be accepted into the GTSS for settlement purposes, on or before the date the Meter Installation becomes operational;
- (d) the Meter Installation is owned by a registered Participant;
- (e) the date and time of the meter reading is valid;
- (f) the meter reading is in the required format; and
- (g) the meter reading is within the defined maximum and minimum limit from the average monthly meter reading for that Meter.

The Designated Gas Transporter shall provide a copy of the Validation Rules to the relevant Participants.

6.11.2 If validation pursuant to the Validation Rules reveal that a Meter Installation is producing faulty meter readings or not producing meter readings, then the Designated Gas Transporter shall notify all relevant Participants as soon as practicable and, in any event, concurrently with the issuance of the next Transportation Service Invoice issued in accordance with the Gas Network Code for such Meter, and the Designated Gas Transporter shall be entitled to use substitute meter readings in place of the missing or faulty meter readings.

6.11.3 If the Designated Gas Transporter requires substitute meter readings then such meter readings shall be determined in accordance with estimation procedures set out in the Gas Network Code.

7. ESTIMATION FOR MISSING OR INACCURATE METER READING

7.1 Procedure for Resolving Disputes Involving Town Gas Meter Accuracy

7.1.1 If there is a dispute between the town gas Retail Customer and a Gas Retailer involving the accuracy of the Meter, the Meter in question shall either be tested at site or by a laboratory that has been accredited by SAC-SINGLAS. The town gas Retail Customer may require that the Meter be tested in his presence. The Gas Retailer shall inform the town gas Retail Customer of the result of the test.

7.1.2 If the accuracy of the town gas Meter is found to have deviated beyond the Accuracy Limits, the town gas consumption shall be estimated based on the following formula:-

$$V_{\text{estimated}} = V_{\text{recorded}} \times (100 - A) / 100$$

Where

$V_{\text{estimated}}$ = Estimated town gas consumption during the disputed period

V_{recorded} = Town gas consumption registered by the Meter during the disputed period

A = Percentage deviation beyond the acceptable Accuracy Limits, e.g. for a Meter running fast at 6%, "A" equals 6 and for a Meter running slow at 6%, "A" equals - 6

7.1.3 The Gas Retailer shall refund or back-charge the affected town gas Retail Customer the deviated amount for the period that the town gas Meter is inaccurate.

7.2 Procedure for Resolving Disputes Involving Natural Gas Meter Accuracy

7.2.1 If there is a dispute between the natural gas Retail Customer and a Gas Retailer involving the accuracy of the Meter, the Meter in question shall be tested by one of the facilities/parties as prescribed in Clause 5.3.1(b). The natural gas Retail Customer may require that the Meter be tested in his presence. The Gas Retailer shall inform the natural gas Retail Customer of the result of the test.

7.2.2 If the accuracy of the Meter is found to have deviated beyond the Accuracy, the natural gas consumption shall be estimated based on the following:-

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(a) for MRM Installation, the formula is

$$V_{\text{estimated}} = V_{\text{recorded}} \times (100 - A) / 100$$

Where

$V_{\text{estimated}}$ = Estimated natural gas consumption during the disputed period

V_{recorded} = natural gas consumption registered by the Meter during the disputed period

A = Percentage deviation beyond the acceptable Accuracy Limits, e.g. for a Meter running fast at 6%, "A" equals 6 and for a Meter running slow at 6%, "A" equals - 6

(b) for BPRM, BPCM and DRCM Installations, the Gas Retailer shall estimate the natural gas consumption base on the system point profile methodology set out in the Gas Network Code.

7.2.3 The Gas Retailer shall refund or back-charge the affected natural gas Retail Customer the deviated amount for the period that the Meter is inaccurate.

GENERAL STANDARDS FOR GAS METER

BS EN 1359	Diaphragm gas meter
BS EN 12480	Rotary displacement gas meter
BS EN 12261	Turbine gas meter
BS EN 12405	Conversion devices
BS 6400	Specification for installation, exchange, relocation and removal of gas meters with a maximum capacity not exceeding 6 m ³ /h
AGA Report No.3	Orifice Metering of Natural Gas and other related Hydrocarbon Fluids
AGA Report No.7	Measurement of Natural Gas by Turbine Meters
AGA Report No.8	Compressibility Factors of Natural Gas and Other Related Hydrocarbon Gases
AGA Report No.9	Measurement of Gas by Multipath Ultrasonic Meters
AGA Report No.11	Measurement of Natural Gas by Coriolis Meter

LIST OF TEST FACILITIES FOR METERS

- 1 TransCanada Calibrations, Canada
- 2 FORCE Technology, Denmark
- 3 CESAME-EXADEBIT, France
- 4 Pigsar, E.ON Ruhrgas AG, Germany
- 5 NMi EuroLoop, The Netherlands
- 6 DNV GL Flow Centre, UK
- 7 NEL, UK
- 8 Alden Research Laboratory Inc., USA
- 9 Colorado Engineering Experiment Station Inc. (CEESI), USA
- 10 Metering Research Facility, Southwest Research Institute , USA