Part D: Metering Arrangements

I Introductory rules

1 Contents of part D

The rules in part D set out the obligations of **participants** in relation to **metering standards**.

2 Application of part D

Generators, **retailers** and **grid owners** are **members** of part D unless they participate in an alternative arrangement that has been approved by the **Board** in accordance with the process that it may approve for that purpose from time to time under the **rules**.

3 Changing the rules in this section

The rules in section I can be changed only by a **resolution** passed in accordance with the voting process set out in rule 4 of section I of part A.

II Metering installations at points of connection on the grid

1 Contents of section II

The rules in section II of part D set out the obligations of **participants** in relation to **metering standards** at **points of connection** on the **grid.**

2 Changing the rules in section II

Subject to rule 4, the rules in section II can be changed by a **resolution** of **generators** (except those who are only **embedded generators**)and **retailers** voting in accordance with the process set out in rule 2 of section IV of part A and the voting entitlements set out in schedule A6, or by the **Board** under rule 1.9 of section IV of part A.

3 Fees for section II

The proportion of total fees of section II of part D allocated to each **member** of section II of part D will be equal to the **member's** share of votes allocated under rule 1.3.2 of schedule A6 as at dates specified under rule 5 of schedule A7.

4 Changing rules 1 - 4

Rules 1, 2, 3 and this rule can be changed only by a **resolution** passed in accordance with the voting process set out in rule 4 of section I of part A.

5 Responsibility for meter installations

5.1 Metering installations to be provided

Metering installations are to be provided at each **point of connection** on the **grid**. The **participant** responsible for providing a **metering installation** at existing **points of connection** is identified in Schedule D2. For any new **point of connection** the **participant** responsible for providing the **metering installation** will be determined by the **Board** following consultation with the **grid owner** and any other **asset owners** at the **point of connection**. The **Board** will have regard to the following:

5.1.1 Agreements reached

Any agreement reached between the **grid owner** and a **participant** as to assumption of responsibility for provision of a **metering installation** at the **point of connection**;

5.1.2 Participants transferring energy

The **participants** who will be transferring electrical energy across the **point of connection**; and

5.1.3 Other matters

Any other matters the **Board** considers relevant with the intention that in the absence of agreement between the **grid owner** and a **participant** as to responsibility for provision of a **metering installation** at the **point of connection**, the **grid owner** will be responsible for providing the **metering installation** when it is anticipated that electrical energy will predominantly flow out of the **grid** at the **point of connection** and the **asset owner** connecting **assets** to the **grid** at the **point of connection** will be responsible for providing the **metering installation** when it is expected that electrical energy will predominantly flow into the **grid**.

5.2 Assignment

A **participant** may assign responsibility for providing a **metering installation** to any other **participant** however will remain responsible under the rules for all obligations in relation to the **metering installation** (including provision of metering information under Part G) until written notification of the assignment, signed by both the assignor and assignee, is given to the **Board**.

5.3 Board will update the schedule

The **Board** will update Schedule D2 and advise all **participants** when a new **point of connection** is added or it receives advice of an assignment of responsibility for provision of a **metering installation**.

6 Electricity recorded will be the record of supply

Electricity recorded or deemed to be recorded on any **metering installation** referred to in rule 5 will comprise the record of the supply of **electricity** across the **point of connection** at which **the metering installation** is located.

7 Location of meters

Where any **participant** is required to provide a **metering installation** at a **point of connection** it will be sufficient if the **metering installation** measures the flow of **electricity** at that **point of connection** or if the flow of **electricity** at the **point of connection** is able to be calculated from the **metering information** available from the **metering installation** notwithstanding that the **metering installation** may not be situated at the **point of connection**.

8 Metering installations to comply with codes of practice

Each **participant** responsible for providing a **metering installation** will ensure that the **metering installation** meets the requirements of the **codes of practice** set out in schedule D1.

9 Metering information to be archived electronically or in accordance with codes of practice

The **participant** responsible for a **metering installation** will ensure that:

9.1 Manner in which metering installations to be read

All the **metering installation's** meters are read electronically or in accordance with the **codes of practice** and the data is transferred and stored in such a manner that it cannot be altered without leaving a detailed audit trail; and

9.2 Raw meter data to be kept

A copy of the **raw meter data** is kept by for a minimum period of two years and six months and is made available to the **reconciliation manager** or its agent on request.

10 When metering installations are to be tested

Each **participant** will, at its cost, test in accordance with the **metering testing requirements** the **metering installations** for which it is responsible:

10.1 On installation

Upon the installation of the **metering installation**;

10.2 Upon completion of repairs or modifications

Upon completing repairs or modifications to a **metering installation**; and

10.3 Codes of practice

When required by any **code of practice**,

and a certificate certifying as to the completion of the test and that the test complies with the **metering testing requirements** will be held by the **member** and will be made available on written request from any other **participant**.

11 Requests for metering installation tests

Any **participant** likely to be affected by a defective **metering installation** may, upon giving reasonable notice to the **participant** responsible under the **rules** for providing the **metering installation**, request a test of the **metering installation**. If any requested test indicates that the **metering installation** is inaccurate with respect to the metering standards set out in schedule D1, the cost of the test will be borne by the **participant** responsible for the inaccurate **metering installation**. If any requested test indicates that the **metering installation** is not inaccurate with respect to the metering standards set out in schedule D1, the cost of the test will be borne by the **participant** requesting the test to be performed.

12 Who conducts tests

The test, if carried out in accordance with rule 10, will be conducted by an **approved test house** appointed by the **participant** responsible for the **metering installation**. If the test is conducted pursuant to rule 11, the **approved test house** carrying out the test will be appointed by the **participant** requesting the test and be approved by the **participant** responsible for the **metering installation**. If the **participants** in question cannot agree on the test house, the **market administrator** will nominate an **approved test house** which is to conduct the test.

13 Adjustment of defective metering installation

Any **metering installation** found to be inaccurate will, once the **participant** involved (if more than one) have agreed, be adjusted, repaired or replaced as necessary. If the **participant** concerned cannot agree, any adjustment, repair or replacement will be only as directed by the **reconciliation manager**. Following the adjustment, repair or replacement a test will be completed in accordance with rule 10.

14 Reconciliation manager will determine inaccuracies

If a **metering installation** should cease to operate (temporarily or permanently) or be proven to be inaccurate, the quantity of **electricity** conveyed or consumed during the period of in operation or inaccuracy will be that measured or determined by the **reconciliation manager** as follows:

14.1 Reconciliation manager to use back up metering installations

By any additional **metering installation** used for backup (if any) by the **participant** responsible for supplying the **metering installation** or if such backup **metering installation** should be proven to be inaccurate; or, if no such backup **metering installation** exists, then

14.2 Reconciliation manager to use check metering installations

By any **metering installation** of any other **participant** or if such check **metering installation** should be proven to be inaccurate; or if no such check **metering installation** exists, then

14.3 Reconciliation manager to use such other means as agreed

By such other means as the **reconciliation manager** will agree with all **participants** concerned or, failing agreement, as determined by the **Rulings Panel**.

15 Participants will notify reconciliation manager of inaccuracies

Where a **participant** ascertains or believes a **metering installation** is or may be inaccurate, that **participant** will forthwith notify the **reconciliation manager** which, as soon as practicable after receipt of such notice, will advise all **participants** that are likely to be materially affected by such an inaccuracy.

16 Information to be included with reconciliation manager's notice

The information or advice to be given by the **reconciliation manager** pursuant to rule 15 will include:

16.1 Point of measurement's location

The location of the **point of measurement**;

16.2 Member responsible for metering installation

The **member** responsible under the **rules** for the **metering installation**; and

16.3 Details of any intended test

Whether a test will be held and if so, the time and place of the test.

17 Reconciliation manager will distribute further information

Upon the information concerning an inaccuracy becoming available (and to the extent it is available) the **reconciliation manager** will give to the persons it believes are entitled to receive such advice or information a description of the means of ascertaining the inaccuracy and, to the extent possible:

17.1 The commencement of inaccuracy

The time and date of the commencement of the inaccuracy;

17.2 The time of correction

The date and time the inaccuracy was corrected in accordance with rule 13;

17.3 The level of inaccuracy

The amount of the inaccuracy for each **half hour** during the period of inaccuracy; and

17.4 Statement setting out correct reconciliation information

A statement setting out a correction of the **reconciliation information** during the period of inaccuracy for the transactions to which the person receiving the information was a **purchaser** or **generator**.

18 If conflicted, reconciliation manager will appoint an independent person

If the person responsible for the **metering installation** being tested under rule 10 or rule 11 is the **reconciliation manager** (or a **related person** to the **reconciliation manager**), upon the request of any **member**, the **reconciliation manager** will appoint an **independent** person to carry out its duties under rules 13 and 14 in respect of that **metering installation**.

III Metering installations at points of connection on local networks

1 Contents of section III

The rules in section III of part D set out the obligations of **participants** in relation to **metering standards** at **points of connection** to **local networks**.

2 Changing the rules in section III

Subject to rule 4, the rules in section III can be changed by a **resolution** of **retailers** and **embedded generators** voting in accordance with the process set out in rule 2 of section IV of part A and the voting entitlements set out in schedule A6, or by the **Board** under rule 1.9 of section IV of part A.

3 Fees for section III

The proportion of total fees of section III of part D allocated to each **member** of section III of part D will be equal to the **member's** share of votes allocated under rule 1.3.3 of schedule A6 as at dates specified under rule 5 of schedule A7.

4 Changing rules 1 - 4

Rules I, 2, 3 and this rule can be changed only by a **resolution** passed in accordance with the voting process set out in rule 4 of section I of part.

5 Responsibility for metering installations

5.1 Retailers' responsibilities for meters

Each **retailer** is responsible for ensuring that a **metering installation** is provided at:

5.1.1 Points of connection between consumers and a local network

Each **point of connection** between its **consumer**s and a **local network**; or

5.1.2 Points of connection servicing consumers

Each **point of connection** that services **consumers** that are supplied **electricity** only by that **retailer**;

5.2 Direct consumers' responsibilities for meters

Each **direct consumer** with a **point of connection** to a **local network** is responsible for ensuring that a **metering installation** is provided at that **point of connection**.

5.3 Embedded generators' responsibilities for meters

Each **embedded generator** with a **point of connection** to a **local network** is responsible for ensuring that a **metering installation** is provided at that **point of connection**.

6 Electricity recorded will be the record of supply

6.1 Supply to retailers

Electricity recorded or deemed to be recorded on any **metering installation** referred to in rule 5.1 will comprise the record of the supply of **electricity** across the **point of connection** at which the **metering installation** is located to that **retailer** as a **purchaser**.

6.2 Supply to direct consumers

Electricity recorded or deemed to be recorded on any **metering installation** referred to in rule 5.2 will comprise the record of the supply of **electricity** across the **point of connection** at which the **metering installation** is located to that **direct consumer** as a **purchaser**.

6.3 Supply to embedded generators

Electricity recorded or deemed to be recorded on any **metering installation** referred to in rule 5.3 will comprise the record of the supply of **electricity** across the **point of connection** at which the **metering installation** is located from that **embedded generator** into the **local network**.

7 Location of meters

Where any **participant** is required to provide a **metering installation** at a **point of connection** it will be sufficient if the **metering installation** measures the flow of **electricity** at that **point of connection** or if the flow of **electricity** at the **point of connection** is able to be calculated from the **metering information** available from the **metering installation** notwithstanding that the **metering installation** may not be situated at the **point of connection**.

8 Metering installations to comply with codes of practice

Each **participant** responsible for providing a **metering installation** will ensure that the **metering installation** meets the requirements of the **codes of practice** set out in schedule D1.

9 Metering information to be archived electronically or in accordance with codes of practice

The **participant** responsible for a **metering installation** will ensure that:

9.1 Manner in which metering installations to be read

All the **metering installation's** meters are read electronically or in accordance with the **codes of practice** and the data is transferred and stored in such a manner that it cannot be altered without leaving a detailed audit trail; and

9.2 Raw meter data to be kept

A copy of the **raw meter data** is kept for a minimum period of two years and six months and is made available to the **reconciliation manager** or its agent on request.

10 When metering installations are to be tested

Each **participant** will, at its cost, test in accordance with the **metering testing requirements** the **metering installations** for which it is responsible:

10.1 On installation

Upon the installation of the **metering installation**;

10.2 Upon completion of repairs or modifications

Upon completing repairs or modifications to a **metering installation**; and

10.3 Codes of practice

When required by any **code of practice**,

and a certificate certifying as to the completion of the test and that the test complies with the **metering testing requirements** will be held by the **participant** and will be made available on written request from any other **participant**.

11 Requests for metering installation tests

Any **participant** likely to be affected by a defective **metering installation** may, upon giving reasonable notice to the **participant** responsible under the **rules** for providing the **metering installation**, request a test of the **metering installation**. If any requested test indicates that the **metering installation** is inaccurate with respect to the metering standards set out in schedule D1, the cost of the test will be borne by the **participant** responsible for the inaccurate **metering installation**. If any requested test indicates that the **metering installation** is not inaccurate with respect to the metering standards set out in schedule D1, the cost of the test will be borne by the **participant** requesting the test to be performed.

12 Who conducts tests

The test, if carried out in accordance with rule 9, will be conducted by an **approved test house** appointed by the **participant** responsible for the **metering installation**. If the test is conducted pursuant to rule 10, the **approved test house** carrying out the test will be appointed by the **participant** requesting the test and be approved by the **participant** responsible for the

metering installation. If the **members** in question cannot agree on the test house, the **market administrator** will nominate an **approved test house** which is to conduct the test.

13 Adjustment of defective metering installation

Any **metering installation** found to be inaccurate will, once the **participants** involved (if more than one) have agreed, be adjusted, repaired or replaced as necessary. If the **participants** concerned cannot agree, any adjustment, repair or replacement will be only as directed by the **reconciliation manager**. Following the adjustment, repair or replacement a test will be completed in accordance with rule 9.

14 Reconciliation manager will determine inaccuracies

If a **metering installation** should cease to operate (temporarily or permanently) or be proven to be inaccurate, the quantity of **electricity** conveyed or consumed during the period of in operation or inaccuracy will be that measured or determined by the **reconciliation manager** as follows:

14.1 Reconciliation manager to use back up metering installations

By any additional **metering installation** used for backup (if any) by the **member** responsible for supplying the **metering installation** or if such backup **metering installation** should be proven to be inaccurate; or, if no such backup **metering installation** exists, then

14.2 Reconciliation manager to use check metering installations

By any **metering installation** of any other **member** or if such check **metering installation** should be proven to be inaccurate; or if no such check **metering installation** exists, then

14.3 Reconciliation manager to use such other means as agreed

By such other means as the **reconciliation manager** will agree with all **participants** concerned or, failing agreement, as determined by the **Rulings Panel**.

15 Participants will notify reconciliation manager of inaccuracies

Where a **participant** ascertains or believes a **metering installation** is or may be inaccurate, that **participant** will forthwith notify the **reconciliation manager** which, as soon as practicable after receipt of such notice, will advise all **participants** that are likely to be materially affected by such an inaccuracy.

16 Information to be included with reconciliation manager's notice

The information or advice to be given by the **reconciliation manager** pursuant to rule 14 will include:

16.1 Point of measurement's location

The location of the **point of measurement**;

16.2 Participant responsible for metering installation

The **participant** responsible under the **rules** for the **metering installation**; and

16.3 Details of any intended test

Whether a test will be held and if so, the time and place of the test.

17 Reconciliation manager will distribute further information

Upon the information concerning an inaccuracy becoming available (and to the extent it is available) the **reconciliation manager** will give to the persons it believes are entitled to receive such advice or information a description of the means of ascertaining the inaccuracy and, to the extent possible:

17.1 The commencement of inaccuracy

The time and date of the commencement of the inaccuracy;

17.2 The time of correction

The date and time the inaccuracy was corrected in accordance with rule 12;

17.3 The level of inaccuracy

The amount of the inaccuracy for each **half hour** during the period of inaccuracy; and

17.4 Statement setting out correct reconciliation information

A statement setting out a correction of the **reconciliation information** during the period of inaccuracy for the transactions to which the person receiving the information was a **purchaser** or **generator**.

18 If conflicted, reconciliation manager will appoint an independent person

If the person responsible for the **metering installation** being tested under rule 9 or rule 10 is the **reconciliation manager** (or a **related person** to the **reconciliation manager**), upon the request of any **participant**, the **reconciliation manager** will appoint an **independent** person to carry out its duties under rules 12 and 13 in respect of that **metering installation**.

Schedule D1- The Codes Of Practice

1 Codes of practice will be issued

Codes of practice specifying the technical requirements for **metering installations**, **metering information** and **metering testing requirements** will be issued and amended in accordance with the rules in section IV of part A.

2 Total metering installation accuracy

Unless certified in accordance with the Selected Component Installation option of **code of practice** 3, or in accordance with **code of practice** 6, **metering installations** will have the maximum permitted percentage of error specified in the following table:

Metering Installation Category	Voltage* & Current	Measuring Transformers	Maximum Permitted Error (Including Uncertainty)
1	1Ø & 3 Ø, V ≤ 400V I ≤ 100A	None (Whole current metering)	± 2.5%
2	3Ø, V≤ 400V I ≤ 500A	CT	± 2.5%
3	3Ø, V ≤ 400V I ≤ 1200A 3Ø, 400V < V ≤ 11kV I ≤ 100A	CT VT & CT	± 1.25%
4	3Ø, V ≤ 400V I ≤ 2000A 3Ø, 400V < V ≤ 11kV I ≤ 200A	CT VT & CT	± 1.25%
5	3Ø, 400V < V ≤ 11kV I ≤ 300A	VT & CT	± 0.75%
6	3Ø, 400V< V ≤ 11kV I ≥ 300A; 3Ø, V > 11kV	VT & CT	± 0.75%

* Voltages referred to are nominal Ø- Ø, where Ø is used to denote phase.

2.1 Error Calculation

The error calculation will include an assessment of uncertainty in measurement. The measured error plus the uncertainty will be no greater than the maximum permitted error specified above. Uncertainty figures will have a 95% level of confidence. Refer to **code of practice** 3 for guidance.

The percentage error of a **metering installation** will be calculated using appropriate mathematical methods, taking account of all sources of measurement error, and will apply to the total throughput over an annual period or such other period, not exceeding 12 months, as will be reasonably expected for the specific installation.

2.2 Half-hour metering installations to be in place

All metering installations that fall within categories 3, 4, 5 or 6 (as defined in rule 2 of this schedule) will be **half-hour** (or sub multiple of) **metering installations**.

Code Of Practice 2 - Requirements for approved test houses

Contents

Code Of Practice 2 - Requirements for approved test houses

1 Scope

This **code of practice** is issued pursuant to the provisions of schedule D1 and will be read in conjunction with all other such **codes of practice**. It covers the requirements for obtaining **Class A** or **Class B approved test house** status, **calibration** of components of **metering installations**, and testing and maintaining of records of **metering installations** and equipment.

In order to maintain consistency throughout this document, IEC Standards have been used. All references shall be deemed to be to the latest version of any Standard or, where a Standard has been superseded, to the replacement Standard. Equipment may optionally comply with the IEC Standards in force when originally certified. Alternative Standards shall be acceptable provided they are certified in writing by an **approved calibration laboratory** as being equivalent to or better than the specified IEC Standard.

2 Definitions

Terms which appear in bold type throughout this **code of practice** will have the meanings assigned to them in annexure A to the **rules**.

3 Class A approved test houses

3.1 Permitted Activities

Class A approved test houses are approved to carry out all or any of the following:

3.1.1 Calibration

Calibration of working standards, metering equipment and metering installations, and issuing of calibration reports;

3.1.2 Installation

Installation of metering equipment;

3.1.3 Commissioning and certifying

Commissioning and **certifying** all categories of **metering installations** under the provisions of the **rules** and associated **codes of practice**, and issuing of **certification reports**.

Individual **Class A approved test houses** may carry out any or all of the above functions to varying degrees, dependent upon any limitations that may be specified in the **Class A approved test house's** ISO 17025 (formerly ISO Guide 25) Accreditation. (Refer rule 3.2 below).

Where such an **approved test house** considers site conditions are appropriate, metering equipment may be **calibrated** in-situ, following appropriate procedures.

3.2 ISO Accreditation

All **Class A approved test houses** will be accredited to ISO 17025 (formerly ISO Guide 25) "General requirements for the competence of calibration and testing laboratories."

While the appropriate accreditation is a pre-requisite for approval, the possession of such accreditation will not imply an assurance that approval will be granted.

4 Class B approved test houses

4.1 Permitted Activities

Class B approved test houses are approved to carry out all or any of the following:

4.1.1 Calibration

Calibration of Class 1 and Class 2 **meters** and Class 0.5 CTs provided these activities are carried out under the relevant provisions of ISO 17025 (formerly ISO Guide 25), and issuing of resulting **calibration reports**;

4.1.2 Installation

Installation of metering equipment;

4.1.3 Commissioning and certifying

Commissioning and **certifying** category 1 - 3 **metering installations** under the provisions of the **rules** and associated **codes of practice**.

Metering equipment **calibrated** by a **Class B approved test house** in accordance with rule 4.1.1 will be used only in **metering installations certified** under the provisions of rule 6 of **code of practice** 3 and as described in rule 4.1.1. **Working standards** used for such **calibrations** will comply with rule 6.1 of this **code of practice**.

Where such an **approved test house** considers site conditions are appropriate, metering equipment may be **calibrated** in-situ, following appropriate procedures.

4.2 ISO Accreditation

Class B approved test houses will be certified to ISO 9002 "Quality Systems for Production and Installation" or ISO 9001 "Quality Systems for Design/Development, Production, Installation and Servicing".

While the appropriate certification is a pre-requisite for approval, the possession of such certification will not imply an assurance that approval will be granted.

5 General requirements for approval

5.1 General

An organisation seeking approval as a **Class A** or **Class B approved test house** will be able to demonstrate to the satisfaction of the **market administrator** that it has the facilities and procedures to meet consistently the requirements of the **codes of practice** for the activities for which it is seeking approval.

5.2 Organisation and Management

Class B approved test houses will be organised in such a way that confidence in their independence of judgement and integrity is maintained at all times. Managerial staff will have the authority and resources needed to discharge their duties. The responsibilities, authority and functional relationships of all relevant personnel will be specified and documented.

Each **Class B approved test house** will appoint a technical manager (however named) with overall responsibility for technical operations. The technical manager would normally be expected to hold appropriate qualifications. There will also be a quality manager (however named) with responsibility for the quality system and its implementation.

Each **Class B approved test house** will ensure that all staff who perform or supervise work are technically competent and appropriately qualified and trained for the functions they perform.

Class A approved test houses will comply with any requirements which may be specified in the **Class A approved test house's** ISO 17025 (formerly ISO Guide 25) Accreditation.

5.3 Quality System

The **approved test house** will establish, implement and maintain a documented quality management system. In addition to the requirements of the ISO Standard or Guide appropriate to the class of **approved test house**, the quality management system will cover all the relevant requirements of the **rules** and associated **codes of practice**.

5.4 Seals

Approved test houses will have documented systems for applying seals to **metering installations** to monitor the **metering installations**' continued integrity and to enable the **members** with a commercial interest in them to be alerted to any unauthorised access.

5.5 Accommodation and Environment

Subject to rule 4.1 of this **code of practice**, the environment in which **Class B approved test house** activities are undertaken will not invalidate test results or adversely affect the required accuracy of measurement. Particular care will be taken when such activities are undertaken on sites other than the permanent **Class B approved test house** laboratory premises. Access to the testing facilities and records will be controlled. Environmental conditions within the laboratory will comply with the specific requirements for temperature, humidity, dust and electromagnetic interference for the **calibrations** or tests being carried out.

The **certification** of **metering installations** requires work outside the laboratory. In all cases, relevant conditions will meet statutory requirements and will be monitored and recorded.

Subject to rule 3.1 of this **Code of Practice**, **Class A approved test houses** will comply with any requirements which may be specified in the **Class A approved test house's** ISO 17025 (formerly ISO Guide 25) Accreditation.

5.6 Equipment

The **approved test house** will be furnished with all items of equipment required for the correct performance of the **calibrations** and tests it undertakes. This code does not prescribe the specific equipment required.

All equipment will be maintained in accordance with the manufacturers recommendations, and records of each item of equipment will be kept, including:

5.6.1 Maintenance

Details of maintenance;

5.6.2 Calibration

Calibration records and records of in-service checks;

5.6.3 History

History of damage, malfunction, modification or repair.

Class A approved test houses will comply with any requirements which may be specified in the **Class A approved test house's** ISO 17025 (formerly ISO Guide 25) Accreditation.

5.7 Measurement Trace ability and Calibration

The **approved test house** will establish and maintain a system that ensures that, whenever a test or measurement is undertaken, the equipment utilised will have been previously **calibrated** within an appropriate period of time, and that sufficient records are kept that would enable the test or measurement to be replicated in every respect should the need arise.

5.8 Commissioning Reports

Commissioning reports are required as part of the input to **certification reports** for Category 1, 2 and 3 **metering installations certified** under the provisions of rule 6 of **code of practice** 3. **Commissioning reports** will contain details of all tests carried out to **commission** the **metering installation**. All test results will be recorded accurately, clearly, unambiguously and objectively.

5.9 Documentation and Records – General Requirements

The **approved test house** will maintain a record system which will ensure that all requirements for record keeping specified in these **codes of practice** are followed. All records pertaining to the quality system, **calibration**, **commissioning** and test equipment, certificates and reports will be stored safely and made available at all reasonable times upon request from the **auditor**, or other **member** with a legitimate requirement. Such requests and any subsequent supply of information will satisfy the confidentiality requirements of part A.

Records will be retained for not less than six months beyond the period specified in rule 11.2 of section II of part D.

6 Additional requirements for class A approved test houses

6.1 Reference and Working Standards

Reference standards will be **calibrated** by an **approved calibration laboratory**. **Working standards** will be **calibrated** by either an **approved calibration laboratory** or by a **Class A approved test house**. In all cases, **calibration** is required at intervals not greater than those given in Table 1, and results must be available as **calibration reports**:

Table 1: - Calibration intervals

Standard		Basic Calibration Interval (months)	Maximum Calibration Interval (months)
Reference	Measuring transformers	36	60
	Comparator bridges	36	60
	Meters	12	24
	Power factor, voltage and current meters	12	24
Working	All	2	12

Before a **reference** or **working standard** is put into service, it will be **calibrated**. Thereafter, it will be **calibrated** at intervals no greater than the Basic Calibration Interval, unless the **approved calibration laboratory** or **Class A approved test house** (for **working standards**) responsible for the **calibration** chooses a longer Calibration Interval up to the maximum specified in the above table. The choice of any Calibration Interval longer than the Basic Calibration Interval requires evidence in the form of **calibration reports** showing that differences between **calibrations** are either negligible or predictable. During periods of use (i.e. between **calibrations** at **Approved Calibration Laboratories**), procedures will be carried out and the results recorded to substantiate the stability of **reference standards**.

Calibration of a **working standard** by a **Class A approved test house** will normally be carried out against a **reference standard**. However, the **calibration** may be carried out against another **working standard** immediately after return of this second **working standard** from **calibration** at an **approved calibration laboratory** and prior to its use for any other purpose. A measurement assurance programme can also provide the **reference standard** where an **approved calibration laboratory** controls a **reference standard** that is transported around a group of **Class A approved test houses**. In all cases, the **uncertainties** given in the **calibration reports** must be acceptably small.

The cost and difficulty of **calibrating working standards** intended for use on systems operating at voltages greater than a nominal 33kV between active conductors is recognised. Consequently, the above Calibration Intervals and other relevant requirements for **reference standards** may also be applied to these **working standards**.

Where **adjustment** of **reference** and **working standards** is required, **calibration reports** will include both before and after **adjustment** results.

When a **reference** or **working standard** is **calibrated** and is found to be outside the manufacturer's specification for that apparatus, the reason for failure will be investigated. Following this investigation, and without evidence to the contrary, all **meters calibrated** since the previous **calibration** will be considered as

calibrated with faulty apparatus. Remedial action will be taken in accordance with rules 12 to 20 of section II of part D.

Reference standards, other than standard measuring transformers, will be maintained at the appropriate reference conditions set out in the relevant IEC Standards or equivalents.

6.2 Meter Testing Systems

A **calibrated** complete **meter** testing system (test bench) may be used as an alternative to separately **calibrated** energy standards and associated measuring transformers. In such situations, the **meter** Calibration Intervals specified in the above table will apply to the overall system. After commissioning such a system, an **overall accuracy** test will be carried out using approved **reference standards**. When **meter** testing systems are found to be outside the maximum overall **uncertainty** limits specified in Appendix 1, the energy standard and measuring transformers will be separately **calibrated**.

6.3 Calibration Methods

Components of **metering installations** will be **calibrated** and **adjusted** under the appropriate physical and electrical **reference conditions** detailed in the relevant IEC Standards or equivalents, or under conditions which will permit the calculation of the results and their **uncertainty** at the **reference conditions**. The individual test points will be as described in the relevant IEC standards specified in Appendix 2 of **code of practice** 3, or at points sufficient to ensure that the **calibration** is within the prescribed limits for the whole of the operating range. The **calibration** procedures will be referenced to these documents and included as part of the formal procedures of the **Class A approved test house**.

The **uncertainty** of measurement during the **calibration** of **active meters, reactive meters** and measuring transformers will not exceed the limits stated in Appendix 1 for the class and type of component.

The **Class A approved test house** will have documented instructions on the use and operation of all relevant equipment. Documented **calibration** procedures will be available to staff carrying out **calibrations**.

The overall **uncertainty** of measurement shown on the **meter** record will be determined using all **uncertainties** in the chain of **calibration** from the SI Unit to the **meter** under test.

Components of a **metering installation** may be **calibrated** on site in their normal working environment only if the effects of departures from the **reference conditions** specified in the relevant IEC Standards can be calculated. This will require measurement on site of all influence variables, and inclusion of their effects in the **uncertainty** calculation. For example, if the temperature coefficients of a component and **calibration** apparatus have been previously determined, a correction can be applied to give the value at the reference temperature. However, the overall **uncertainty** may be greater because of contributions from both the temperature and temperature coefficient measurements. The standards of accuracy and **uncertainty** laid down in Appendix 1 must be met after taking into account all influence variables.

Meters will be **calibrated**, and if necessary **adjusted**, or **error compensation** applied, such that the **overall accuracy** is within the percentage error limits as defined in Table 1 of Appendix 1 (for **active meters**) and Table 2 (for **reactive meters**). It is expected that actual **meter** errors over a group of **meters** will exhibit a pattern approaching a normal distribution with a mean error of zero at the specified load. An error pattern over a group of **meters** showing a consistent bias towards the extremes of error band may need to be justified.

Following any internal adjustments, appropriate seals will be applied.

Calculations and data transfers will be subject to appropriate checks.

Where computers or automated equipment are used for the capture, processing, manipulation, recording, reporting, storage or retrieval of **calibration** data, the **approved test house** will ensure that:

6.3.1 Codes are complied with

The requirements of this and other relevant **codes of practice** are complied with;

6.3.2 Software is documented

Computer software is documented and adequate for use;

6.3.3 Procedures for protection of data

Procedures are established and implemented for protecting the integrity of data entry, storage, transmission and processing;

6.3.4 Maintenance of computers

Computer and automated equipment is maintained to ensure proper functioning;

6.3.5 Procedures for maintenance of security

Procedures are established for the maintenance of security of data including the prevention of unauthorised access to and amendment of computer records.

The **approved test house** will have a documented system for uniquely identifying the items to be **calibrated**. All observations and calculations will be recorded in a permanent manner. Original **calibration** records will be uniquely identifiable and **traceable** to the items to which they refer and to any reports based on them. **Calibration** records will contain sufficient information to permit identification of possible sources of error and to permit satisfactory repetition of the **calibration** under original conditions. **Calibration** records will identify the person(s) responsible for their generation and for the checking of data transcriptions and calculations.

6.4 Calibration Reports

Calibration reports are required as part of the input to **certification reports** for **metering installations** and will include all information required to confirm compliance with **code of practice** 3.

7 Procedures for approval

7.1 Application for Approval

Organisations seeking approval will complete the relevant application form and submit it, together with any fee which may be payable, to the **market administrator,** which may seek whatever advice it considers necessary. When an organisation is approved and has paid its first annual subscription, it will be placed on the Register of **approved test houses** held and maintained by the **market administrator,** and a Certificate of Approval issued.

A copy of the organisation's quality assurance manual will accompany all applications.

7.2 Annual Renewal

Approval will be given on an annual basis. Renewal of approval is required annually. Approval will be granted only where the **approved test house** can demonstrate that it continues to meet the required standards for its class of approval. The **market administrator** will review each **approved test house**. Information from the **approved test house** register, held by the **market administrator**, will be confirmed with the **approved test house**. Where the information supplied in the review is considered to be incomplete or unsatisfactory, the **market administrator** will advise the **approved test house** of its concerns and may, after giving the **approved test house** reasonable opportunity to address those concerns, carry out an **audit** of the **approved test house** as set out in rule 7.3 of this **code of practice**. Approval will be withdrawn for those activities for which the **approved test house** no longer meets the relevant criteria.

Where the **market administrator** is satisfied that an **approved test house** continues to satisfy the criteria for approval, approval will be renewed for a further twelve months, and a Certificate of Approval issued.

7.3 Audits

The **market administrator** will have the right to carry out without prior notice at any time within normal working hours **audits** of the records and procedures of an **approved test house**. The **approved test house** will afford the **auditor** appointed by the **Board** for this purpose full access to all relevant facilities, personnel, records and manuals and will provide to the **auditor** any additional information which the **auditor** considers is necessary to enable an assessment of whether or not the **approved test house** continues to meet the criteria for approval.

Unless information from the **approved test house**, the **reconciliation manager**, or any other party, indicates cause for concern that an **approved test house** may no longer meet the relevant criteria for approval for any or all of its activities, **audits** will be carried out at intervals no greater than three years for **Class A approved test houses**, and two years for **Class B approved test houses**, or at shorter intervals at the request of the **approved test house**.

7.4 Cancellation of Approval

If an **approved test house** fails to renew its approval by the due date, or fails an entire **audit**, the **market administrator** will cancel the approval of the organisation, remove its name from the Register of **approved test houses**, and request return of the Certificate of Approval. Where an **approved test house** fails only part of an **audit**, its approval to carry out those activities affected by the areas that fail the **audit** will be withdrawn, the details recorded on the Register will be appropriately amended, and an amended Certificate of Approval issued. The original Certificate of Approval will be returned to the **market administrator**. Approvals will remain cancelled until a subsequent **audit** indicates that the **Test House** again meets the criteria for approval. The **market administrator** will notify such withdrawal of approval by "Public Notice".

8 Sub-Contracting

8.1 Sub-Contracting of Activities

An **approved test house** may subcontract any of its activities to any other party, but will retain full responsibility for ensuring that all activities are carried out in accordance with the **rules**. **Class B approved test house** will establish and maintain procedures for the procurement of sub-contract services which will ensure that this requirement is met, and that only suitably competent and qualified organisations and personnel carry out any such activities, as well as ensuring that **certification** and all **commissioning** and **calibration** tests required by any **code of practice** are carried out by organisations approved to do so.

Class A approved test houses will comply with all requirements specified in the **Class A approved test house's** ISO 17025 (formerly ISO Guide 25) Accreditation.

8.2 Purchases

Class B approved test houses will establish and maintain procedures for the purchase of test equipment and consumables. Each **Class B approved test house** will ensure that purchased equipment or consumables will not be used until inspected or otherwise verified as conforming to specified requirements.

Class A approved test houses will comply with all requirements specified in the **Class A approved test house's** ISO 17025 (formerly ISO Guide 25) accreditation.

9 Complaints

The **approved test house** will have documented policies and procedures for the resolution of complaints received from clients or other persons about the **approved test house's** activities. Records will be kept of all complaints and of relevant actions taken by the **approved test house**.

Where the complaint raises doubts concerning the **approved test house's** compliance with the requirements of the **codes of practice** issued pursuant to schedule D1, and the complainant is not satisfied with the response of the **approved test house**, the complainant may notify the **market administrator** of the complaint and the response of the **approved test house** to the complaint. The **market administrator** will decide if any further action is required.

APPENDIX 1: Tables

Table 1: Standards of accuracy and overall uncertainty for test house calibration and testing of active meters

Notes: (i) Caution should be used when applying information from the following tables to 2 element metering for three phase systems.

(ii) Current values in this table are modelled on the relevant IEC Standard. The percentage values of current are relative to the meter's base or rated current (I_b or I_n) as appropriate, and it is assumed that this current would be selected at a level appropriate to the specific site where the meter is to be installed.

Class of Meter 2.0 and 2.0S

Value of Current %	Power Factor	Maximum Overall Uncertainty %	Percentage Error Limits of Meter Including Uncertainty
5 to 120	1	±0.4	±1.9
10 to 120	0.5 lagging	±0.6	±1.9
10 to 120	0.8 leading	±0.6	±1.9

Class of Meter 1.0 and 1.0S

Value of Current %	Power Factor	Maximum Overall Uncertainty %	Percentage Error Limits of Meter Including Uncertainty
5 to 120	1	±0.2	±0.9
10 to 120	0.5 lagging	±0.25	±0.9
10 to 120	0.8 leading	±0.25	±0.9

Class of Meter 0.5 and 0.5S

Value of Current %	Power Factor	Maximum Overall Uncertainty %	Percentage Error Limits of Meter Including Uncertainty
5 to 120	1	±0.1	±0.5
10 to 120	0.5 lagging	±0.12	±0.6
10 to 120	0.8 leading	±0.12	±0.6

Class of Meter 0.2S

Value of Current %	Power Factor	Maximum Overall Uncertainty %	Percentage Error Limits of Meter Including Uncertainty
5 to 120	1	±0.06	±0.2
10 to 120	0.5 lagging	±0.09	±0.3
10 to 120	0.8 leading	±0.09	±0.3

Table 2: Standards of accuracy and overall uncertainty for test house calibration and testing of reactive meters (Where Required)

Notes: (i) Caution should be used when applying information from the following tables to 2 element metering for three phase systems.

(ii) Current values in this table are modelled on the relevant IEC Standard. The percentage values of current are relative to the meter's base current (I_b or I_n), and it is assumed that the base current would be selected at a level appropriate to the specific site where the meter is to be installed.

Class of Meter 3.0

Value of Current %	Power Factor	Maximum Overall Uncertainty %	Percentage Error Limits of Meter Including Uncertainty
20 to 120	Zero	±1.0	±3.0
20 to 120	0.8 lead	±1.5	±3.5
20 to 120	0.8 lag	±1.5	±3.5

Class of Meter 2.0

Value of Current %	Power Factor	Maximum Overall Uncertainty %	Percentage Error Limits of Meter Including Uncertainty
20 to 120	Zero	±0.5	±2.0
20 to 120	0.8 lead	±1.0	±2.5
20 to 120	0.8 lag	±1.0	±2.5

Table 3: Voltage and current balance

Polyphase Meters	Class of Meter			
	0.2 & 0.5	1.0	2.0	3.0
Each of the voltages between line and neutral or between any two lines will not differ from the average corresponding voltage by more than	±0.1%	±1.0%	±1.0%	±1.0%
Each of the currents in the conductors will not differ from the average current by more than	±1.0%	±2.0%	±2.0%	±2.0%
The phase displacements of each of these currents from the corresponding line-to-neutral voltage, irrespective of the power factor, will not differ from each other by more than	2°	2°	2°	2°

Code Of Practice 3 - Requirements of metering installations

Contents

Code Of Practice 3 - Requirements of metering installations

1 Scope

This **code of practice** is issued pursuant to the provisions of schedule D1 and will be read in conjunction with all other such **codes of practice**. It covers new and existing **metering installations** which are to be used for energy trading purposes under the **rules**, and applies to all measuring transformers, **test facilities**, wiring/cabling, metering panel construction, **active** and **reactive meters**, and **data loggers**. It details requirements for the initial **certification** that a **metering installation** meets the requirements of the **rules**, including confirmation that any **data logger** is **certified** for use in a **metering installation**, and that it records the energy transferred in accordance with the requirements of the **rules**.

Also described are procedures to ensure that the **metering installation** continues to meet the requirements, and steps which must be taken to reconfirm **certification** following any modifications to the **metering installation** or when **certification** has expired for any reason. The **responsible party** will retain responsibility for ensuring that these requirements are met.

Note that where there is multiple ownership of equipment at any site, the respective owners will ensure that their individual responsibilities under this **code of practice** are defined in their relevant agreements.

This **code of practice** does not attempt to cover all possible variations in **metering installations**. Where features additional or alternative to those covered in this document are present, they will be appropriately tested and/or inspected to confirm the integrity of the overall **metering installation**.

In order to maintain consistency throughout this document, IEC Standards have been used. All references shall be deemed to be to the latest version of any Standard or, where a Standard has been superseded, to the replacement Standard. Equipment may optionally comply with the IEC Standards in force when originally certified. Alternative Standards shall be acceptable provided they are certified in writing by an **approved calibration laboratory** as being equivalent to or better than the specified IEC Standard.

2 Definitions

Terms which appear in bold type throughout this **code of practice** will have the meanings assigned to them in Annexure A.

3 Metering equipment

3.1 General

Metering equipment shall be installed to meet the requirements of schedule D1. Except as otherwise provided for in this **code of practice**, only employees or subcontractors of **approved test houses** shall be permitted to carry out any work on or make direct connections to components of a **metering installation**, or to take any action which may have any effect on any such components. This requirement shall not include the visual inspections of category 1 and 2 **metering installations** referred to in the note to Table 8 of rule 7.1 of this **code of practice**.

3.2 Measuring Transformer Secondary Circuits

Any measuring transformer secondary circuit which is earthed will be earthed at no more than one point.

3.3 Wiring/Cabling

The wiring and cabling will be run as directly as practicable and will, wherever practicable, be without intermediate terminations for all measuring transformer circuits. Where intermediate terminations are unavoidable, they will be sealable.

3.4 Data Logger

Certification that any **data logger** complies with **code of practice** 4 will be required for both new **metering installations** and where a **data logger** is added to an existing **metering installation**. **Data loggers** will be installed in such a way that on-site **interrogation** is possible without the need to interfere with **approved test house** seals. Unless they are integral with one another, **meters** and **data loggers** and associated equipment will each have a dedicated power supply.

Where a **metering installation** requires the monitoring of multiple channels of data and more than one **data logger** is used, their time clocks will be automatically synchronised. A single multi-channel **data logger** is preferred to this arrangement.

The design of the metering installation, data logger, and interrogation system, shall ensure that the smallest possible increment in the energy value of the metering data is consistent with the required maximum limits of error. IEC 60338 illustrates one way of dealing with this issue.

3.5 Measuring Transformers

References to measuring transformers in this **code of practice** do not preclude the use of other measuring techniques which meet the required standards of accuracy.

Where measuring transformers are located within a switchboard, they shall, where practicable, be securely mounted within an enclosure that can be sealed against interference and unauthorised access. Where measuring transformers are not housed within a defined enclosure, where sealing of an enclosure is not practicable, or where access to the enclosure is required by any person, other than an employee, or subcontractor, of an **approved test house**, alternative sealing arrangements such as the use of terminal studs drilled in such a way that sealing wire can be passed through the holes to secure the connections, or the use of sealing paint applied to terminal screws, shall be acceptable provided their use is covered by appropriate **approved test house** documentation. A label shall be attached in a prominent position inside the enclosure, warning of the presence of sealed metering equipment within the enclosure and requesting that care be taken not to disturb connections to such equipment. This label shall be attached to every new such **metering installation**, and to existing such **metering installations** at the time of **recertification**.

Measuring transformers will preferably be dedicated to the **metering installation**, but where this is not the case, any additional burdens will not be added or modified without the prior approval of the **responsible party** for the **metering installation** (See also Table 5) who will seek comment from the certifying or other **approved test house** before giving such approval. The total burden (magnitude & phase angle where appropriate) on any measuring transformer will not exceed its name plate rating or any alternative rating specified by the metering designer. The certifying **approved test house** will be notified of any changes.

The measuring transformer burden will not be changed without the **metering installation** being **calibrated** for the change in burden, except that the burden on VTs rated at 30VA or above may change by up to 1VA from the burden which existed at the last **calibration** without further **calibration** being required. For VTs rated at less than 30VA, this permitted burden change will be proportionately less. Where voltage selection is necessary, the permitted burden changes will apply to the principal VT.

Where **meter** voltage supplies are derived externally to the **meter**, they will be adequately protected by appropriate fuses or circuit breakers dedicated to the metering circuit. Where considered desirable,

additional fuses or circuit breakers of lower rating may be installed in the metering enclosure. All fuses and circuit breakers will be sealed or located within sealed enclosures. Where an enclosure also contains fuses or circuit breakers supplying other circuits, those supplying metering circuits will be individually sealed.

3.6 Enclosures

Metering equipment will be housed in enclosures which the **approved test house** is satisfied are appropriate to the environment in which they are located. In both indoor and outdoor situations, unauthorised access to wiring terminals and equipment will be restricted.

3.7 Test Facilities

All **metering installations** using measuring transformers will be fitted with **test facilities**, which will be installed close to the **meter**(s).

3.8 Control Devices

Where a load or **meter** control device has malfunctioned, it may be bridged out by a person who is not an employee or subcontractor of an **approved test house**, provided that the **retailer** and the **metering equipment owner** have in place appropriate procedures for ensuring that such activities are carried out only by persons so authorised by the **retailer** and **metering equipment owner**. Such procedures shall also ensure that notification to the **retailer** and remedial work by an **approved test house** are handled in a timely manner.

4 Certification & recertification of metering installations

4.1 General

Subject to the provisions of rule 4.8 of this **code of practice**, every **metering installation** to be used for energy trading under the **rules** will be **certified** by an **approved test house** as complying with the requirements of the **rules**. Every **metering installation** will comply with the requirements of Regulation 54 of the electricity Regulations 1997.

4.2 Method of Certification

New **metering installation** Categories 1, 2 and 3 as defined in schedule D1, and installations of any other category which consume less than 0.5GWh per annum, may be **certified** by complying with the requirements of either rule 5 or rule 6 of this **code of practice**. All other new sites will be **certified** in accordance with the requirements of rule 5. Where CT metering is installed, the categories will generally be decided by the primary current rating of the CT, but where the actual loading makes it more appropriate, a **metering installation** may be certified as a lower category. In such circumstances, and when the 0.5GWh annual consumption limit has been applied as described above, the **retailer** will be responsible for monitoring the **metering installation** maximum loading or consumption, as appropriate. Where the limit is exceeded for the category for which it is **certified**, the **retailer** will initiate the immediate **recertification** of the **metering installation** in its appropriate category.

Existing metering installations will be certified either as described above (i.e. full certification), or as described in rule 4.8 below (i.e. interim certification).

4.3 Departure From Requirements

In some cases, it may not always be possible or appropriate to require a **metering installation** or item of metering equipment to comply strictly with the engineering requirements of the **rules** and the **codes of practice**. Where the variance from the requirements is minor and best accuracy and integrity of the metering installation or equipment can be demonstrably maintained, the **approved test house** may use its discretion to **certify** the **metering installation** or equipment despite such variance. All such cases will be documented and a copy of the information forwarded to the **market administrator** for **audit** by the **market administrator** and possible publication as a case study. Where the **market administrator** has concerns that acceptance of the variance from requirements was inappropriate, it may recommend further action, which may include reversal of the decision by the **approved test house**. In publishing any material, the **market administrator** shall ensure that information of a commercial nature is not released. Information shall be published on the website of the **market administrator**, with comment as an ongoing guideline to **approved test houses**.

4.4 Certification Confirmation

When a complete **metering installation** has been fully **certified** or **recertified** under the appropriate provisions of this **code of practice**, this **certification** will be confirmed by the attachment by the **approved test house** to a suitable part of the **metering installation** of a **certification sticker**, or use of an equivalent procedure as described in rule 5.2 for individual components. The **certification sticker** or equivalent will show the **metering installation** category and the expiry date of the **certification**.

4.5 Records

Records of all metering installation commissioning and certification tests carried out under the provisions of this **code of practice** will be kept in accordance with rule 8.

4.6 Failure of Tests

If the **metering installation** fails the on-site **commissioning**, **certification** or **recertification** tests specified in this **code of practice**, any faulty component or components will be identified and replaced with equivalents which comply with the requirements specified in the relevant part of this **code of practice**, other relevant codes and schedule D1. All tests necessary to confirm that the faulty component or components have been eliminated will then be carried out.

4.7 Test Results

A **metering installation** or any of its components will not be deemed to be **certified** until the **certification** or **recertification** test results have been formally accepted by an **approved test house** and distributed to the affected **member** within a reasonable timeframe. Where a **metering installation** fails its **recertification** tests, the **reconciliation manager** will be advised, and the affected **members** will agree on the action to be taken. No **adjustments** or replacements of any component of the **metering installation** will be carried out until all affected **members** have agreed to such action, in accordance with rule 15 of section II of part D. Where the affected **member** cannot agree on the action to be taken, the procedure described in rule 15 of section II of part D will be followed. (See also rule 10 of this **code of practice** for Emergency Exemptions.).

4.8 Existing Metering Installations

Existing **metering installations** of any type or category which do not comply fully with the requirements for full **certification** under the provisions of this **code of practice** will be deemed to be **certified** on an interim basis. This interim **certification** will expire on the dates given in Table 1:

Table 1: Expiry of interim certification

Metering Installation Category	Expiry Date
1	1/4/2015
2	1/4/2010
3	1/10/2002

For **meters** of accuracy class 2.0, the above dates may be extended provided the **approved test house** responsible for the **metering installation** applies a satisfactory programme of statistical sampling as described in rule 5.3.

The **metering equipment owner(s)** will ensure that a programme of inspection, testing and equipment replacement (as appropriate) is implemented which will ensure full **certification** by the above dates of all **metering installations** in accordance with rule 5 or 6 of this **code of practice**, as appropriate. Any metering equipment used to derive **half-hour metering** data but not **certified** by the relevant date will not be permitted to be used for **half hour** trading.

Where any item(s) of metering equipment is replaced prior to full **certification** of the **metering installation**, the replacement item(s) will comply with the requirements of this **code of practice**. Where such replacement is sufficient to enable full **certification** of the **metering installation**, such **certification** will be carried out and **metering installation** records amended accordingly.

The interim **certification** provided for in this rule will cancel and replace all agreements under the provisions of **code of practice** 6 entered into before the **rules** took effect. Where there are valid technical reasons why a particular **metering installation** cannot be fully **certified** by the date specified in Table 1 above, the provisions of **code of practice** 6 will apply after that date.

Any interim **certification** granted under code of practice 3 of **MARIA** and that was current when these **rules** took effect will be deemed to have been granted under this **code of practice** 3.

5 Full certification - fully calibrated installations

5.1 Design

A Design Report will be prepared by the metering designer both for a new **metering installation** and where an existing **metering installation** is to be modified.

The report will be accompanied by a drawing of the system for use by **certification** personnel. Both Design Report and drawing will identify and be signed by the person who carried out the design. The Design Report and drawing will be checked to ensure that the proposed **metering installation** will function correctly and complies with the requirements of the **rules** and the **codes of practice**. The person carrying out these checks will sign the Design Report and drawing to confirm that the checks have been carried out.

Loss compensation arrangements will be documented and will be included in the maximum permitted percentage error calculations.

If the metering installation is not at the same physical point as the point of measurement, it will be acceptable for the quantity of electricity to be derived by a mathematical process provided this does not compromise the accuracy of the quantity of electricity at the point of measurement. (See rule 7 of section II of part D) The time error in any **trading period** will not exceed that in Table 2:

Table 2: - Maximum permitted time errors

Metering Installation Category	Maximum Time Error of Data Logger Clock (seconds)	Maximum Time Error in Commencement of any Trading Period (seconds)	Maximum Time Error in Interrogation & Processing Systems (seconds)	Maximum Time Error for Automatic Adjustment (seconds)
1	±10	±10	±5	±10
2	±10	±10	±5	±10
3	±10	±10	±5	±10
4	±10	±10	±5	±10
5	±5	±5	±5	±5
6	±5	±5	±5	±5

The maximum percentage of **uncertainty** for any **metering installation** will not exceed the values listed in Table 3 and will have a confidence level of 95%.

Table 3: - Maximum permitted uncertainties

Metering Installation Category	Max % Uncertainty
1	± 0.6
2	± 0.6
3	± 0.3
4	± 0.3
5	± 0.2
6	± 0.2

It is expected that actual meter installation errors, over a group of metering installations, will exhibit a pattern approaching a normal distribution, with a mean error of zero, at the specified load. An error pattern over a group of metering installations, showing a consistent bias towards the extremes of the error band, may need to be justified.

5.2 Certification of Components

New or replacement components of a **metering installation** which is or is to be **certified** under the provisions of rule 5 of this **code of practice** will be individually **certified** by a **Class A approved test house** prior to their installation, except where otherwise specified below. Each **certification report** will, where relevant, include a **calibration report** which will comply with the requirements of **code of practice** 2 and will confirm that components comply with the requirements of their accuracy class and/or relevant **code of practice**. Copies of the **certification reports** will be held by the **Class A approved test house** carrying out the **certification**. **Certification** of a component will be indicated by the attachment to the component of a **certification sticker** bearing the date of **certification**, the date upon which the **certification** validity period expires (see Table 4 below), the name of the **Class A approved test house** which carried out the **certification**, the reference number of the **certification report**, and the initials of the person who carried out the **certification**. Where the application of a sticker is not practicable, the **Class A approved test house** will devise and operate an alternative means of providing information equivalent to that provided by the sticker system. Such a system will be properly documented and maintained.

Any component found to be outside the accuracy limits will be replaced, or appropriate **error compensation** measures applied to the **metering installation**.

Recalibration of components will require the same full laboratory tests as if they were new components. In situ testing will be acceptable for this purpose where the requirements of **code of practice** 2, rules 3.1 and 5.5, are complied with. Note that where it considers such action appropriate, the **Class A approved test house** may **certify** a component for shorter period than those specified.

Table 4: - Certification validity member

Measuring Transformers	Meter				Data Logger
	Cl 0.2	Cl 0.5	Cl 1.0	Cl 2.0	
10 yr	3 yr	5 yr	10 yr	15 yr	see note (iv)

Notes:

(i) Class designations with suffix "S" are included in the above

(ii) Note that care should be exercised when certifying epoxy insulated CTs as their characteristics may change significantly with age, temperature or batch.

(iii) For **meters** of accuracy class 2.0, the above interval may be extended provided the **approved test house** applies a satisfactory programme of statistical sampling. See rule 5.3.

(iv) **Data loggers** do not require recalibration. However, regular maintenance, such as battery monitoring, in accordance with the manufacturer's recommendations will be carried out and fully documented.

The **certification reports** will detail the **calibration** and other relevant standards for each component as follows:

5.2.1 Measuring Transformers

Measuring transformers will meet the standards specified in Appendix 1 of this **code of practice** and will be suitably rated for the intended installation. Where multi-tap CTs are used, the tap setting will be appropriate for the maximum demand.

Measuring transformers will be of an accuracy class appropriate for the required **overall accuracy** of the **metering installation** as specified in schedule D1. **Calibration reports** from an **approved test house** will indicate the measuring transformer's error at a range of primary values at their rated burdens, and at their in-service burdens. Multi-tap CTs will be **certified** only for the ratios that have been **calibrated**.

Where the condition and/or accuracy class of existing measuring transformers are unknown and the cost of replacing them is substantial (particularly if it would require replacement switchgear), the **approved test house** will inspect whatever manufacturers' test certificates or other records may be available, and will carry out whatever tests it considers necessary to satisfy itself that the measuring transformers are suitable for the particular application, and that the **metering installation** meets the **overall accuracy** requirements of the **rules**. Where the **approved test house** is unable to satisfy itself that the **overall accuracy** requirements can be met, or the accuracies of the measuring transformers are known to be lower than required to meet the necessary **overall accuracy**, an agreement may be entered into under the provisions of **code of practice** 6 to exempt the **metering installation** from any particular requirements of this **code of practice**. Any exemption so agreed will be valid for a maximum of ten years. An **approved test house** may grant interim **certification** to the **metering installation** for a maximum period of three months while the agreement for exemption is being established.

5.2.2 Meters

All **meters** will comply with the Standards specified in Appendix 1 of this **code of practice**, and will have **approved test house calibration reports**.

5.2.3 Test Facilities

Test facilities will meet appropriate standards.

5.2.4 Data Logger

Any **data logger** will comply with the requirements of **code of practice** 4 and will (as part of the Design Report) have been confirmed by the designer of the **metering installation** to be compatible with the **meter** and communications network to which it is connected, and suitable for the electrical and environmental site conditions in which it will be installed.

5.2.5 Modems

Modems will be approved for connection to the communications networks on which they will operate.

5.3 Statistical Sampling

Note (iii) to Table 4 permits the extension of the **certification** period for Class 2 **meters** where an **approved test house** adopts a statistical sampling process to ascertain whether an acceptable proportion of the population of installed **meters** remains within its class accuracy. Where this option is adopted, random samples of like **meters** will be subjected to **calibration** tests. The population of like **meters** from which each sample is chosen will be selected on the basis of a manufacturer's batch, or on some other appropriate basis, such as year of purchase. An acceptable statistical sampling methodology is included in Appendix 3. Alternative methodologies which give the same results will also be acceptable. A Limiting Quality Level (LQL) value of 2% will be applied.

It will be the responsibility of the **approved test house** to ensure the credibility of the sampling process and the actions taken in response to it. The procedures to be followed will be documented, and detailed records of every step in the process will be kept. Actions to be taken as a result of the **calibration** tests will be in accordance with documented procedures. Typically, such procedures will describe actions which will result when stated numbers of the sample **meters** are found to be outside the specified accuracy limits for the types of **meters**.

5.4 Certification of Metering Installations

Certification of the **metering installation** will be valid as long as the **certifications** of all components of the **metering installation** remain current (refer Table 4). Note that where it considers such action appropriate, the **approved test house** may **certify** a **metering installation** for shorter periods than those specified in Table 4.

5.4.1 Initial Certification Requirements

For a new **metering installation**, the design will be checked to ensure functionality and compliance with the **rules**. Where required under the provisions of rule 5.2 above, an **approved test house** will first individually certify components. Table 5 lists various checks and tests which must be carried out on a new **metering installation** prior to its being used for energy trading under the **rules**, and on an existing **metering installation** in the same situation or when it has been modified in any way, to ensure that the **metering installation** meets or continues to meet the requirements of the **rules**.

Note also that as each component of an existing **metering installation** (other than the measuring transformers where permitted) is required to be individually **certified**, it would be expected that the **meters** and **data logger**s in an existing **metering installation** would be replaced by **certified** components. Tests and checks (b), (c) and (f) listed in the table for existing **metering installations** would therefore be required for the initial **certification** of an existing **metering installation**. Tests and checks (d) and (e) would apply only when the measuring transformers, or the CT ratio were changed at any time.

5.4.2 Recertification of a Metering Installation

Before the **certification** of a **metering installation**, or of any of its components, has expired, the **metering installation** will require **recertification**. Note that **certification** of the overall **metering installation** expires when the individual **certification** of any one of its components expires. Any such component would be **recertified** by removal and test, testing in situ, or replacement, as appropriate. The tests and checks listed in the appropriate row of Table 5 for replacement components will be required for the **metering installation** to be **recertified**.

Table 5 specifies the minimum requirements. Any other tests and checks required to confirm the integrity of a specific **metering installation** will also be carried out. Where **recertification** involves **meter recalibration** in-situ, or where the meter is being replaced with a new or refurbished fully-**calibrated meter**, it shall be necessary for the **approved test house** to carry out only those **calibration** tests which it considers are appropriate for the particular **metering installation**. The reasons for carrying out limited testing shall be documented and shall be subject to audit. The records for the **metering installation** shall describe the actual tests carried out.

Other than where covered by the provisions of rule 3.5 of this **code of practice**, if any part of the wiring of the **metering installation** is modified, or if additional components are connected to the **metering installation** (other than testing or monitoring equipment temporarily connected, or to cater for emergencies, via the **test facility**), the **certification** of the **metering installation** will be deemed to be cancelled until the relevant tests and checks have been satisfactorily carried out.

Where an **approved test house** considers site conditions are appropriate, metering equipment may be **calibrated** in-situ, following appropriate procedures.

Table 5: - Tests & checks for compliance

Premises	Design	CT/VT Certification	Meter Certification	Wiring Check	Primary Inj to Meter	Working Standard at Prevailing Load	Multiplier Checks	Data Logger Performance	Review Compensation Arrangements	Output to Host
New Premises: (All new eqpt)	✓	✓	✓	✓	**O**	✓	✓	✓	-	✓
Existing Premises:										
(a) In Compliance (trader change)	✓	-	-	-	-	-	-	-	-	**O**
(b) **Meter** Change	✓	-	✓	✓	**O**	✓	✓	✓	-	✓
(c) Logger Change	✓	-	-	✓	**O**	-	✓	✓	-	✓
(d) CT Change, Ratio Change	✓	✓	-	✓	**O**	✓	✓	**O**	✓	✓
(e) VT Change	✓	✓	-	✓	**O**	✓	-✓	**O**	✓	✓
(f) Additional Eqpt, Wiring Mods	✓	-	**O**	✓	**O**	✓	-	✓	✓	**O**
(g) No measuring transformer compliance	✓	**N**	✓	✓	**N**	✓	✓	✓	-	✓

Key: ✓ = Mandatory O = Optional N = Within prescribed timeframe

6 Full certification - selected component installations

6.1 General Requirements

New and existing **metering installation** Categories 1, 2 and 3 may be fully **certified** by compliance with the following:

6.1.1 Certificate as to class based on type-testing

Meters and measuring transformers will have a certificate from an **approved calibration laboratory** or an **approved test laboratory** attesting to the device's type-testing to the appropriate class.

6.1.2 Certificate based on manufacturing sample testing

Meters and measuring transformers will also have a certificate from an **approved calibration laboratory**, **approved test laboratory**, or **approved test house** attesting to the particular device's manufacture to the appropriate class, based on appropriate sample testing of manufacturing runs of product. Where the approved organisation has satisfied itself that a manufacturer's own batch testing facility is of an acceptable standard, batch test certificates from the manufacturer will be acceptable and testing need not be repeated.

Where a **meter** or measuring transformer has been previously in service, it will be **recalibrated** by an **approved test house** in accordance with this **code of practice** before being reinstalled in any **metering installation**. Where **certification** or **recertification** involves **meter recalibration** in-situ, or where the **meter** is being replaced with a new or refurbished fully-**calibrated meter**, it shall be necessary for the **approved test house** to carry out only those **calibration** tests which it considers are appropriate for the particular **metering installation**. The reasons for carrying out limited testing shall be documented and shall be subject to **audit**. The records for the **metering installation** shall describe the actual tests carried out.

Suggested minimum **meter** test requirements are given in Appendix 2 to this code.

6.1.3 Distance from the meter

Measuring transformers will not be of such a distance from the **meter** that rated burdens are exceeded.

6.1.4 Condition or class unknown

Where the condition and/or accuracy class of existing measuring transformers are unknown and cannot be ascertained, they will be deemed to have an accuracy not lower than the minimum appropriate for the **metering installation**.

6.2 Design

Standard master designs and drawings may be used for **metering installation** Categories 1, 2 and 3. A Design Report will be prepared for each master design, and the reports and drawings will identify and be signed by the person who carried out the designs. The master design reports and drawings will be checked to ensure that the proposed **metering installations** will function correctly and comply with the requirements of the **rules** and the **codes of practice**. The person carrying out these checks will sign the master Design Reports and drawings to confirm that the checks have been carried out.

A copy of the master design document may be used by **certification** personnel and will form a part of the site records. The document may have included in it relevant details such as metering equipment model and serial numbers as well as sealing information. Any peculiarities of the site and variations from the design may also be noted on the design document.

Metering equipment will be selected from the combinations in Table 6:

Table 6: - Permitted equipment combinations

Metering Installation Category	Meter Class	CT Class	Data Logger (where fitted)
1	2.0	N/A	Complies with the requirements of **code of practice** 4
2	2.0	1.0	As Above
3	1.0	0.5	As Above

The use of **meters** and measuring transformers of a higher accuracy will be acceptable.

6.3 Installation

Installation of the metering equipment will be in accordance with appropriate parts of rule 3 of this **code of practice.**

6.4 Commissioning

The **commissioning** of **metering installations** will include checks that the installation is correctly wired, and sufficient testing to verify the correct operation and expected accuracy of the installation as far as this can be determined without full **calibration** tests. A **commissioning report** will be completed by the **commissioning Class A** or **Class B approved test house**. This report will include the results of all **commissioning** tests.

6.5 Certification

When the **Class A** or **Class B approved test house** is satisfied that the **metering installation** has been installed and is functioning as designed, the relevant information will be assembled into a **certification report** and the procedure described in rule 4.4 will be followed.

6.6 Recertification

Certification of the **metering installation** will be valid for the period shown in Table 7:

Table 7: - Certification validity member

Metering Installation Category	Certification Validity Period
1	15 yr
2	15 yr

Metering Installation Category	Certification Validity Period
3	10 yr

On the expiry of the **certification** Validity Period, the **meters** will be replaced with items which comply with rule 6.1.2 above. Full **commissioning** tests will then be carried out on the **metering installation**, including functional checks to confirm the correct operation of any **data loggers**.

For Class 2 meters, the above interval can be extended to a maximum of 25 years provided the **approved test house** applies a satisfactory programme of statistical sampling as described in rule 5.3.

Where an **approved test house** considers site conditions are appropriate, metering equipment may be **calibrated** in-situ, following appropriate procedures.

7 Inspection requirements

7.1 General

All **metering installations** will be subject to non-invasive inspections by a suitably qualified person appointed by the **responsible party**. A copy of the signed inspection report, which will confirm that the **metering installations** continue to comply with the requirements of the **rules,** will be kept with the **certification** records.

Metering installations will undergo inspections at least as often as specified in Table 8:

Table 8: - Maximum intervals between inspections

Metering Installation Category	Inspection Interval In Years
1	10
2	10
3	5
4	1
5	1
6	1

Inspections will include the activities outlined in the following rules.

For categories 1 and 2, the inspection interval may be extended to 15 years where a low-level visual check of the **metering installation** is carried out by a suitably-trained person at least once per year, and the check is recorded by the **retailer** or their agent. It is not necessary for such checks to be carried out by **approved test house** personnel or their subcontractors. The **retailer** shall be responsible for ensuring that appropriate training of those carrying out the visual inspections is carried out by suitably competent persons. Details of such training shall be recorded, along with an assessment of the resulting competence of those receiving the training.

7.2 Certification Validity Confirmation

Where a **metering installation** has been fully **certified** under the provisions of rule 5 of this **code of practice**, each inspection will include confirmation that each component of the **metering installation** carries a current **certification sticker** or equivalent. Where the **certification sticker** or equivalent on any component is not readily visible, **certification** will be confirmed by inspection of the **metering installation** records held by the **approved test house** which carried out the **certification**. The only exceptions will be where measuring transformers were existing when the **metering installation** was originally established and do not yet require **certification** (see rule 5.2.1) The due date of **recertification** or **certification** of each component will be recorded. If any component of the **metering installation** is found to be overdue for **certification** or **recertification**, the **metering installation** will be deemed to be no longer **certified** under the **rules**, and all **members** with an interest in the **metering installation** will be notified immediately. Steps will be taken to **recertify** the component and the **metering installation** in accordance with rule 5.4.2 above. If such **recertification** is not carried out within ten business days of the discovery of the expired **certification**, the **metering installation** will be deemed unacceptable for energy trading under the provisions of the **rules**, except with the express approval of the **reconciliation manager**. The **reconciliation manager** will consult with all relevant **members** before ruling on any requests for such approval.

Where a **metering installation** has been fully **certified** under the provisions of rule 6 of this **code of practice**, the **certification sticker** or equivalent will be inspected to ensure that it is still current.

7.3 Metering Installation

If the **metering installation** is found to have current **certification**, each inspection will include the following:

7.3.1 Meter

The **meter** will be read and monitored in such a way that its correct operation can be demonstrated. The responsible party will document the general process for this.

7.3.2 Measuring Transformers

Where it can be done without breaking seals, all measuring transformers will be visually inspected. The inspection will note any deterioration of the measuring transformer, confirm the measuring transformer tap position and (where appropriate), confirm that there has been no change to equipment connected to the measuring transformers. The measuring transformer tap position will also be checked to ensure that it is still appropriate for the expected maximum demand of the **metering installation** over the period until the next inspection.

7.3.3 Voltage Check

The presence of appropriate voltages will be confirmed at the meter or test facility, and the correct operation of any voltage circuit alarms and/or fault indicators confirmed.

7.3.4 Data Logger

Where fitted, the **data logger** will be confirmed to be operational.

7.3.5 Batteries

The life of each battery will be determined and confirmed to exceed the period until the next scheduled maintenance inspection.

7.3.6 Seals

All equipment and enclosures will be examined to ensure that all security seals are intact and secure. If any seals are found to have been removed or broken, an investigation will be carried out to ascertain who broke the seal and for what reason, and the procedures described in rule 10 of this **code of practice** will be followed. If there is any doubt regarding the continued integrity of the component or **metering installation**, it will be **recertified** and the **reconciliation manager** notified.

7.3.7 Equipment Changes

A check will be made to ensure that no equipment has been added to or removed from the **metering installation** since the last inspection without the change having been documented and **certification** requirements satisfied.

7.3.8 Damage/Tampering

All seals, enclosures, components and wiring of the **metering installation** will be visually inspected for evidence of damage or tampering. Where such evidence is found, the procedures described in rule 10 will be followed.

8 Record keeping and documentation

8.1 General

The **responsible party** will ensure that appropriate records are kept of:

8.1.1 Equipment

All equipment, including serial numbers and manufacturers' details

8.1.2 Test Certificates

Manufacturers' test certificates for all components

8.1.3 Category

Metering installation category.

8.1.4 Reports

Approved test house certification reports, **calibration reports** and **commissioning reports** showing dates tested, tests carried out, test results etc

8.1.5 Contractor details

Metering equipment installation contractor details, including personnel carrying out installation

8.1.6 Certification report

Copy of the initial **certification report** issued for the **metering installation**

8.1.7 Certification sticker

Copy of the **certification sticker**, or equivalent, details for each component of a **metering installation** which is **certified** under the provisions of rule 5 of this **code of practice**.

8.1.8 Seal

Seal identification information

8.1.9 Compensation arrangements

Details of any **loss compensation/error compensation** arrangements.

Records will be retained for not less than six months beyond the life of the **metering installation**.

8.2 Test Records

Each test record will be identified by a unique serial number. In each situation, all relevant test records, both for individual components and the overall **metering installation,** will be retained by the **approved test house** carrying out the tests. All records will be sufficiently detailed to ensure that test conditions, specific test equipment used, personnel carrying out the tests, etc are recorded to ensure complete **traceability** of all aspects of the tests in accordance with modern Quality Assurance procedures. Copies of all records will be forwarded to the **responsible party** where requested.

8.3 Transfer of Records

If the **responsible party** changes the **approved test house** which it contracted for a **metering installation**, copies of all relevant records held by the first **approved test house** will be handed to the new **approved test house**. Such transfer will not relieve the first **approved test house** of its obligation to keep original records.

9 Sealing

When all tests required for **commissioning**, **calibration**, **certification** or **recertification** have been satisfactorily completed, all **meters**, **data loggers**, **test facilities**, terminal block covers, fuses and any other components which could influence the functioning of the **metering installation**, will be sealed by the person carrying out the tests, and will be resealed following any subsequent work which requires removal of the seals. Each **approved test house** will use a sealing system which will be uniquely identifiable.

10 Reporting of defects, tampering & incidents (emergencies)

If any defects, evidence of tampering, or incidents of any kind which could affect the integrity of the **metering installation** are found, the **responsible party** will immediately notify the **reconciliation manager.** The **responsible party** will prepare, or arrange for the preparation of, a detailed statement of the situation and will ensure that it is forwarded to the **reconciliation manager**. The statement will include full details of what was found, the cause (if known), the effects of the problem, and the remedial action proposed. The **reconciliation manager** will forward this statement to all affected **members** and the **Board** and will seek their agreement to the proposed action. If any **member** objects to the proposed course of action, their objection will be lodged with the **reconciliation manager** by the end of the business day following the day on which the statement was received by them. The **reconciliation manager** will consider any objections received and will decide on the actions to be taken to resolve the

situation. Where the remedial action includes testing of the **metering installation**, the procedures laid down in rules 14 and 15 of section II of part D will be followed. When the situation has been remedied, the **reconciliation manager** will advise all affected **members** of the actions that were taken.

All affected **members** and **approved test houses** will have an equal obligation to report any incident to the **responsible party** as soon as they become aware of it.

Emergency replacement of metering components is permissible provided that this is followed up by the required checking and documentation procedures as soon as practicable thereafter. Care must be taken to preserve/record the evidence of any defect.

11 Complaints and disputes

Any complaints or disputes in relation to these **codes of practice** will be resolved in accordance with section V of part A.

APPENDIX 1: Tables

Table 1: Standards for electricity meters

Equipment	Standards
Class 1 and 2 induction watt-hour meters	IEC 60521
Class 1 and 2 induction watt-hour meters of the demand type	IEC 60521
Class 1S and Class 2S electronic watt-hour meters	IEC 61036
Class 0.2S and Class 0.5S electronic watt-hour meters	IEC 60687 Note: Mechanical tests for rack mounted meters not covered by this standard
Class 3 induction var-hour meters	IEC 60145
Class 2S and Class 3S electronic var-hour meters	IEC 61268
Ripple control receivers for tariff and load control	IEC 61037
Time clocks for use in meters	IEC 61038

Table 2: Measuring transformers

Measuring transformers will be designed and manufactured generally to the following Standards and will be tested to the relevant part of those Standards. The **approved test house** will inspect manufacturer's test certificates and carry out whatever additional tests it considers necessary to satisfy itself that the measuring transformers and **metering installation** meet the accuracy requirements of the **rules**.

Equipment	Standards
Current transformers	IEC 60044-1
Inductive voltage transformers	IEC 60044-2
Combined Transformers	IEC 60044-3
Capacitor voltage transformers	IEC 60186 & 60358

Note: (i) Alternative Standards will be acceptable provided they are certified in writing by an **approved calibration laboratory** as being equivalent to or better than the above.

(ii) Evidence of a component's compliance with the above requirements will be made available, upon request, to an **auditor**.

APPENDIX 2: Statistical sampling methodology for recalibration

1 Purpose

The purpose of this appendix is to provide a method of recalibration of meters based on statistical sampling. The statistical sampling method is an alternative or complimentary method to fixed interval recalibration that:

- Provides information about a population and guidelines for recalibration without having to test the entire population;
- Provides a level of confidence on the information obtained.

2 Scope

The sampling plan provided in this appendix is based on *attribute* inspection. That is, a meter is simply classified as conforming or nonconforming with respect to all the requirements of **code of practice** 3.

3 Definitions

Attribute = The presence or absence of a property or characteristic in a unit of product. The term is used here to define the type of sampling plan that has been employed. Whether a meter conforms or does not conform to the **code of practice** is an attribute. Since the proposed plan uses the attribute of 'conformance to the **code of practice**' as a criteria for acceptability of a meter, the plan is an attribute sampling plan.

Population = The collection of all meters under the responsibility of one party.

Batch = A collection of like meters forming a portion of the overall meter population of one party. (Also known as 'lot'.)

Sample = A selection of meters from the population. The size of the sample is less than the size of the population. For the proposed plan, samples will be taken from each batch of meters. (see rule 5.3 *Random sampling*.)

Screen = The act of inspecting and replacing an entire batch (100%) of meters that has been rejected. In other words, a batch that has been rejected will need to be 100% inspected for repair or replacement.

Nonconforming Meter = A meter that does not meet the criteria of acceptance as set out in **code of practice** 3.

Acceptance Sampling Plan =A plan that states the sample size to be used and the associated acceptance or rejection criteria for individual batches.

4 Reference documents

Schilling, Edward G., A Lot Sensitive Sampling Plan for Compliance Testing and Acceptance Inspection. *Journal of Quality Technology*, Vol. 10, No. 2, 1978 (April) pp 47-51.

5 Sampling theory

When inspection is for the purpose of acceptance or rejection based on adherence to a standard, the type of inspection procedure employed is acceptance sampling. Acceptance sampling requires the selection of random samples from a batch of units. The disposition of the entire batch is determined by the information (the number of nonconforming units) contained in the samples. The actual sampling plan is a statement of the sample size to be used and the associated acceptance or rejection criteria for individual batches.

5.1 Rectifying Inspection

Acceptance sampling procedures require corrective action when batches are rejected. This usually takes the form of 100% inspection, or screening, of rejected batches with all defective units replaced or fixed. This is called rectifying inspection because the final quality of the population is affected by the screening activity. This is illustrated in Figure 1.

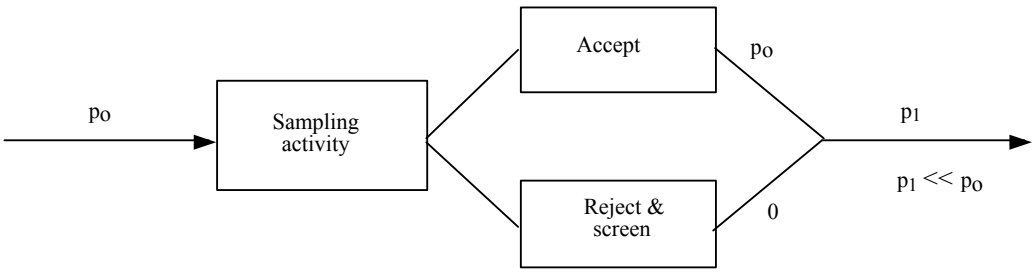


Figure 1. Rectifying inspection

The p_o on the left side of Figure 1 represents the current overall proportion of nonconforming meters in a population. The rejected batches will be screened and their final proportion of nonconforming meters will be zero. The accepted batches are not screened and will retain the proportion of nonconforming p_o. As a result, the population is now a mixture of batches that collectively have an average proportion of nonconforming p_1, which is less than p_o. Thus, the quality of the population has been improved.

The concept of acceptance sampling applied to meters is further represented in Figure 2.

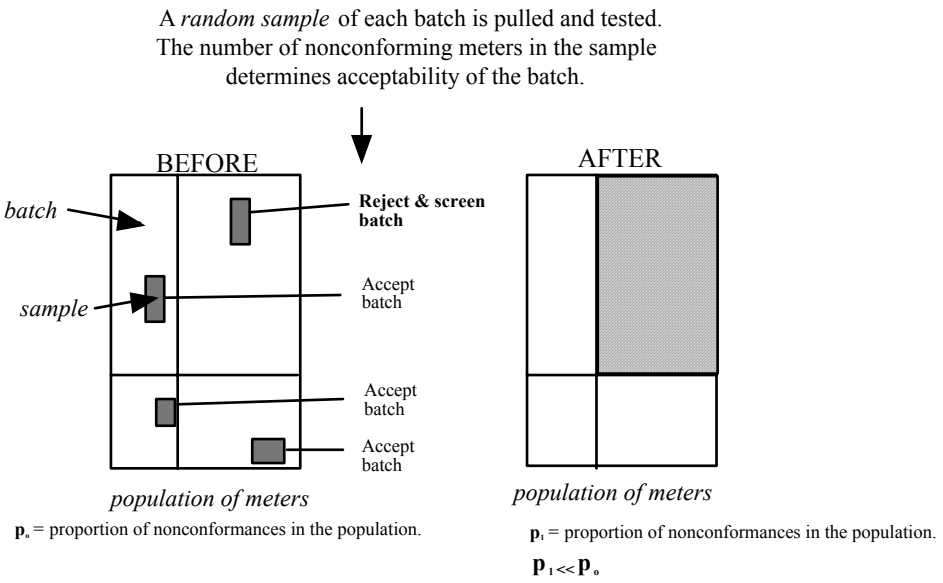


Figure 2. Sampling applied to meter recalibration

In this diagram (Figure 2) the entire population of meters is represented as a collection of batches from which samples are drawn. The samples are inspected/tested for conformance to the **code of practice**. If a sample does not meet the acceptability criteria (or samples because the suggested plan is a 3-stage plan - see rule 6.6), the entire batch of meters from which the sample was drawn is rejected and screened (all meters tested and all nonconforming meters fixed or replaced, including the meters in the sample!). The result is a population that has a different "look" - rejected batches have a proportion nonconforming of zero resulting in a new estimate of the population proportion nonconforming. Over time, as batches are sampled and inspected, the proportion of nonconforming in the population of meters is decreasing (under the assumption that no new meters have been installed).

5.2 Batch Formation

The collection of meters designated as a batch for this sampling plan may differ from a collection of meters designated as a batch for other purposes (e.g. customer type). Each inspection batch should, as far as is practicable, consist of meters of the same age, type, brand, etc. The formation of an inspection batch is generally expected to ensure homogeneity of the meters. More details are provided in rule 6.3.

Two methods to consider when forming batches are stratification and clustering.

Stratification means to divide the population up into different groups, or strata, based on certain characteristics. As stated above, characteristics such as age, type and brand are a good place to start. It is most probable that as you sample and gain more information about the meter population that the original form of the batches may change. Stratification may be helpful if you discover a large, bad batch and believe only a certain portion is suspect. For this situation, further divide the batch and form multiple batches from the one.

If you are confident that your meter batch is homogeneous, it is quite feasible to divide your batch into clusters - groups of meters with a common characteristic that is not related to performance of the meter. Location is the best example. Collectively, these clusters still comprise one batch but aid in the sampling activity. You can take a sample of clusters (or one cluster) and test all the meters within the sampled clusters. This, of course, will depend on the sample size required for the batch and the size of the clusters. To use clustering, you must be confident that the clusters are representative of all the meters in the batch.

5.3 Random Sampling

The units for inspection from the batch should be chosen at random and they should be representative of the all the units in the batch. The random sampling concept is extremely important in acceptance sampling. There are various techniques to random sampling that can be employed - the use of a random number table, stratification or clustering. If units are not randomly sampled, estimates of proportion nonconforming will be wrong leading to incorrect decisions.

5.3.1 Random Number Table

A random number table is simply a list of numbers generated in random order. Many hand-held calculators and software packages have the ability to create random numbers. To use this method, first number all the units in your batch. If your sample size is 20, you would look at your random number table and select 20 random numbers. You would then sample the units that have the corresponding numbers from your batch.

5.4 Advantages & Disadvantages of Statistical Sampling

Advantages:

- Can be considerably less expensive and time consuming than 100% inspection (fixed interval);
- Provides a statistically based estimate of the population proportion of nonconforming meters.

Disadvantages:

- There are risks of accepting “bad” batches and of rejecting “good” batches;
- Requires planning and documentation of the sampling procedure.

6 Sampling method

The sampling procedure or method is represented by the flowchart in Figure 3.

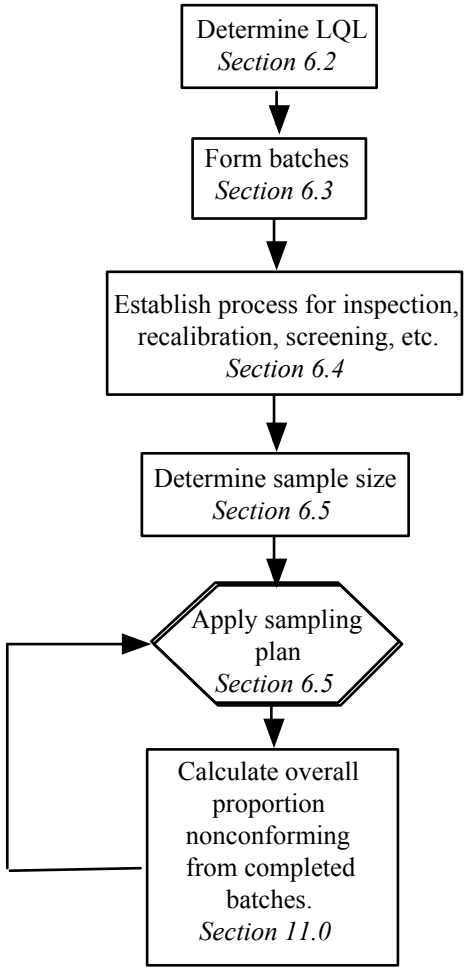


Figure 3. Sampling method

6.1 Level of Protection

A sampling plan states the number of units from each batch which are to be inspected and the criteria for the acceptability of the batch.

The type of sampling plan proposed is a special purpose plan tailored for this **code of practice**. It is based on a consumer-oriented, lot sensitive plan (Schilling 1978). This plan provides for rejection of a batch if any nonconforming units are found in the sample, a well-defined relationship between the sampling plan and size of the batch being inspected, and simplicity and clarity of use.

It is consumer-oriented because the plan uses a specified level of protection for individual batches of poor quality. This level of protection is the poorest level of quality that the consumer is willing to accept in an individual batch. In other words, this level of protection is in terms of a minimum unacceptable level of quality in an individual batch that the consumer will in variably be wanting to reject. Since the objectives of the Metering **code of practice** are to provide a quality assurance system for users of electricity, a plan that factors consumer protection is desirable.

6.2 The Limiting Quality Level (LQL)

The level of protection discussed in the last rule is called the limiting quality level (LQL). The LQL is the minimum value for the proportion of nonconforming meters that is considered unsatisfactory. Hence, the LQL is the level of quality that is least acceptable.

Batches of LQL or poorer quality will be rejected at least 99% of the time by the proposed sampling plan. For example, a value of 2% for LQL means that a batch having 2% or more nonconforming meters will be rejected at least 99% of the time by the sampling plan.

The selection of the LQL will be determined by the guidelines set out in the **code of practice**.

6.3 Batch Formation For Inspection

A population of meters will need to be classified into inspection batches.

In the sampling plan the term batch means "inspection batch"- a collection of meters from which a sample (or samples) is to be drawn and inspected to determine the conformance based on the acceptability criteria. Each inspection batch will need to, as far as is practicable, consist of meters of the same age, type, manufacturer, etc. The formation of an inspection batch is generally expected to ensure homogeneity of meters.

Batch formation will require a significant amount of background information on your meter population. The characteristics age, type and manufacturer are the three main ones to be considered for batch formation but any additional characteristic or feature may be employed. For any new meters purchased, batch formation should occur before the meters are installed.

There are advantages in making meters in batches as alike as possible:

- It is less likely that inadequate types of meters will be missed;
- It is less likely that the whole batch is ruled to need replacing when only meters of some particular type are faulty.

Batch formation will be dynamic; it will invariably change over time. In cases where a batch is rejected and screened, the repaired/replaced meters will have a longer life expectancy than their un-repaired counterparts. This will lead to new meters being treated as a new batch.

6.4 Process for Recalibration, Inspection, etc.

It is recommended that processes be established for the sampling, inspection, and recalibration of meters that include sampling results and reporting. Consumer records for meters must show a batch identification to enable annotation with results of sampling.

Having these processes in place before commencing sampling will help to expedite the testing of sampled meters as well as the screening of rejected batches.

6.5 Sample Size Determination

The next step in the sampling method is to determine the size of the sample to be drawn from each batch. Sample sizes have been calculated and tabled for a comprehensive range of LQLs and batch sizes. See Table 1 below.

Table 1: Values of fraction to be sampled
{See rule 11.0 for the derivation of the table.}

f	0	0.005	0.01	0.015	0.02	0.025	0.03	0.035	0.04	0.045	0.05	0.055	0.06	0.065	0.07	0.075	0.08	0.085	0.09	0.095
0	*	1137	567	377	282	225	187	160	140	124	111	101	92	85	79	73	68	64	60	57
0.1	54	51	49	47	45	43	41	39	38	36	35	34	33	32	31	30	29	28	27	26
0.2	26	25	24	24	23	22	22	21	21	20	19.8	19.4	18.9	18.5	18.1	17.7	17.4	17.0	16.6	16.3
0.3	16.0	15.7	15.4	15.1	14.8	14.5	14.2	14.0	13.7	13.5	13.2	13.0	12.8	12.6	12.3	12.1	11.9	11.7	11.5	11.3
0.4	11.2	11.0	10.8	10.6	10.5	10.3	10.1	10.0	9.8	9.7	9.5	9.4	9.3	9.1	9.0	8.9	8.7	8.6	8.5	8.3

The following procedure derives the sample size:

1. Decide the batch size (N).

2. Compute the product of batch size and the LQL ($\mathrm{N} \times \mathrm{LQL}$).

3. Enter the body of Table 1 at the nearest value less than or equal to the product computed in Step 2 ($\mathrm{N} \times \mathrm{LQL}$) and read the corresponding value of the fraction to be sampled, called f, as the sum of the associated row and column headings.

4. The sample size (n) is the product of the batch size and the fraction to be sampled ($\mathrm{N} \times \mathrm{f}$).

Example 1. *For a given batch size of 1000 and LQL of 2%, the sample size is found as follows:*

Batch size = N = 1000

1. *LQL = 0.02 (in fractions)*
2. $\mathrm{N} \times \mathrm{LQL}$ *= 1000(0.02) = 20*
3. *f = 0.245 (from Table 1; closest value less than or equal to 20)*
4. *Sample size =* $\mathrm{N} \times \mathrm{f}$ *= 1000(0.245) = 245*

For large batch sizes ("large" will vary by the choice of LQL), only a small fraction needs to be sampled (less than 1% of the batch size) which will be independent of the batch size. This explains why sampling, as distinct from 100% inspection, can markedly reduce costs of compliance with the code. In such cases, use of Table 1 is not necessary. If the product $N \times LQL$ from step 3 is significantly greater than 1137 (the largest value in the table), simply divide the number 5.7 by the fixed LQL to obtain the sample size.

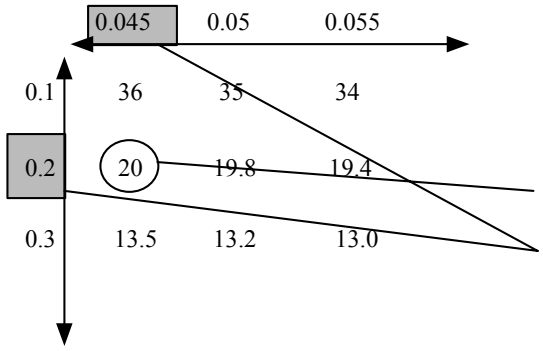
Example 2. *To obtain the sample size for large batches using an LQL of 2%, divide 5.7 by 0.02 and fix the sample size as 285. This is the largest sample size used in the given plan with an LQL of 2%.*

Note:

Because Table 1 does not account for all possible values of NxLQL (recall that step 3 above requires the user to look for the "...nearest value less than or equal to the product computed in Step 2 ($N \times LQL$)") and the value 5.7 is derived from a theoretical approximation, it is possible that calculated sample sizes will be more than 5.7/LQL for batches that have a value of NxLQL close to the maximum allowed on the table. In these cases, use 5.7/LQL as the sample size.

For small batch sizes, the product of $N \times LQL$ will be smaller than 8.3 (the smallest value in the table). For such batches it is recommended that a *minimum* of 50% of the batch be sampled with the optimum being 100% of the batch.

Additional examples are given in Figure 4 to illustrate the use of Table 1.



1. Batch size = 1000
2. NxLQL = 1000 x 0.02 = 20
3. Find 20 in body of Table 1.
4. Read the corresponding value of "f" as the sum the associated row and column headings:

   0.2 + 0.045 = 0.245 = f
5. Sample size = Nxf = 1000 x 0.245 = 245

LQL = 2%

Batch size	N x LQL	f	n	
20	0.4	*1.000*	20	small batch sizes - sample 50-100%
50	1	*1.000*	50	
200	4	*0.500*	100	
500	10	0.435	218	
700	14	0.335	235	
1000	20	0.245	245	
2000	40	0.135	270	
5000	100	0.06	*300*	see NOTE under section 6.5
60000	1200	*	285	

**** = 5.7/LQL = 285***

Figure 4: Examples of sample size calculations using Table 1

6.6 Sampling Plan

The type of sampling plan adopted is a special purpose plan tailored for this code. The sample size of the plan is fixed for a given limiting quality level (LQL) and batch size. A batch is **accepted if all the sampled meters conform to the specifications**. In other words, no nonconforming units are tolerated for the purpose of acceptance of a batch. If one or more nonconforming meters are found, a new random sample of the same size is drawn. The batch is then accepted if all the meters conform. Otherwise, a third random sample of the same size is drawn and the batch is finally accepted if no nonconforming meters are found. A batch, which is given three chances to pass the acceptance criteria and fails, will be screened whereby all meters in the batch are inspected and non-complying meters recalibrated or replaced.

Intuitively, the amount of sampling and testing will depend on the quality of the given batch. Batches with acceptable quality levels will be sampled much less than those with potentially unacceptable quality because of the three stages. As batch quality improves the amount of sampling required from the batch will decrease.

The operation of the plan is depicted in Figure 4.

7 Expression of nonconformance

The expression of nonconformance is in terms of a proportion nonconforming. The proportion nonconforming of a batch, or a part of the metering population, is one hundred times the number of nonconforming meters divided by the total number of meters. That is:

$$\text{Proportion Nonconforming} = \frac{\text{number of nonconforming meters}}{\text{total number of meters}} \times 100$$

8 Estimation of proportion nonconforming

8.1 Initial Estimation of Proportion Nonconforming

To simplify the theory behind calculation of proportion nonconforming over all batches, it is essential to start with an initial estimate and then update accordingly as batches are sampled and screened.

The initial estimate of proportion nonconforming will be calculated from a single random sample of meters from the population **before batching has occurred**. The size of the sample will be the largest sample size possible with the given sampling plan and the prescribed LQL (for an LQL = 2%, this sample size is 285). Refer to the description of sample size calculation for large batch sizes in rule 6.5.

From this random sample, calculate the **initial proportion nonconforming** as the number of nonconforming meters found in the sample divided by the number of meters sampled.

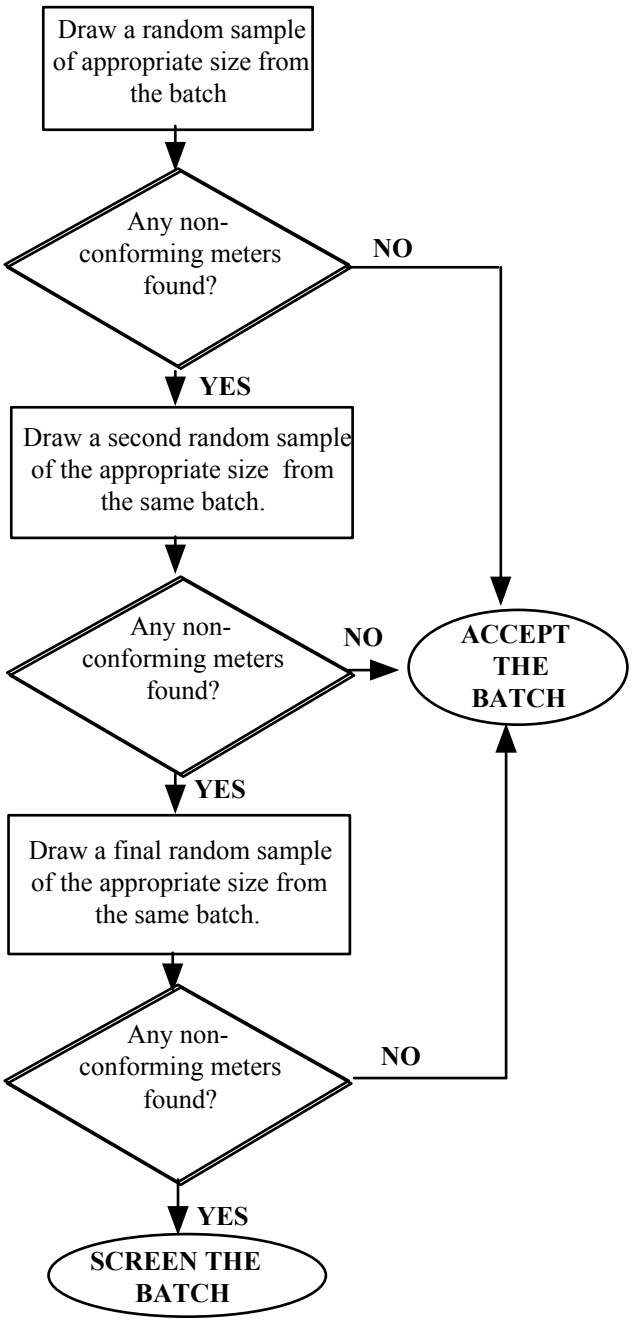


Figure 5. Sampling Plan

Once the population has been batched, it may be possible to calculate preliminary estimates of proportion nonconforming for certain batches from the meters in this initial sample. This initial sample of meters will be (should be) spread across the population and hence across batches. Therefore, *some* batches will contain meters from this initial sample. For any batch that contains meters from this initial sample and if any of these meters are nonconforming, calculate a **preliminary batch estimate of proportion nonconforming** by dividing the number of nonconforming meters (from the initial sample) by the number of meters from the initial sample in the batch.

The initial proportion nonconforming is a only starting point for further calculations.

8.2 Estimate of Proportion Nonconforming for the Population

Acceptance of a batch can occur at any one of the three stages in the sampling plan. If a batch is accepted at the first stage, this indicates that no meters were found to be non-conforming in the sample

taken. If a batch is accepted at either the second or third stage of sampling, some nonconforming meters will have been found in the sample(s).

To obtain the estimate of proportion nonconforming for accepted batches, divide the number of nonconforming meters found in the first and second stages of sampling by the total number of units sampled over all three stages. The fraction nonconforming for rejected batches after screening will, of course, be zero. For batches accepted at the first stage, the proportion nonconforming is estimated to be zero (even though the batch may contain non-sampled, nonconforming meters).

Example 3.

Below is a table generated for a population of 63,403 meters using an LQL of 2%. An initial estimate of proportion nonconforming was calculated by randomly sampling 285 meters. Out of this sample of 285, seven meters were found to be nonconforming. The initial population estimate of % nonconforming is therefore 7/285 = 2.5%.

The population was then divided into 14 batches. At the point in time represented in the example, 12 of the batches have been sampled and any rejected batches have been screened. The table in Example 3 attempts to capture a variety of the sampling scenarios that could occur and the resulting values of % nonconforming. The example highlights some key points:

- For all batches rejected and screened, the % nonconforming after screening will be zero (see batches 3, 4, 11, 12);
- For all batches accepted at the first stage of sampling, the estimate of % non-conforming is zero (see batches 7 and 10);
- Batches that have been accepted at the second and third stage of sampling may have a % nonconforming larger than the expected LQL. (see batches 1 and 6);
- For batches that have a sample size greater than 5.7/LQL, use the value 5.7/LQL for the sample size (see batches 1, 4, 12);
- For accepted batches where nonconformances were found during sampling, it is assumed that these nonconformances will be repaired/replaced. The estimate of batch % nonconforming is still based on the number of nonconformances found. In the case of batches 5 and 9, the entire batch was sampled and the nonconforming meters found were repaired/replaced, hence the resulting % nonconforming is zero;
- Batch 13 is an example of a batch that has not been sampled. As stated in rule 8.2, the initial proportion nonconforming is used as the batch estimate. This does not mean that the batch should not be sampled;
- Batch 14 is an example of a batch that has not been sampled but which contained some of the meters taken as the original sample to obtain the initial estimate of proportion nonconforming. Batch 14 contains 19 of this original sample, of which one is a nonconforming meter (out of the 7 found). Therefore, a preliminary batch estimate can be determined. This again does not mean that the batch should not be sampled!
- There were 5,364 meters sampled which equals 8.5% of the population.

Population consists of 14 batches

LQL = 2%

Initial estimate of proportion nonconforming = 7/285 = 2.5%

5.7/LQL = 5.7/0.02 = 285 maximum sample size

			# nonconforming:				***estimated % nonconforming:***	
Batch ID	**Batch Size**	**Sample Size LQL = 2%**	**1st Stage**	**2nd Stage**	**3rd Stage**	**Decision**	**Before Screening**	**After Screening**
1	10,000	285 (300)	10	10	0	ACCEPT	2.3% (20/855)	2.3% *
2	3000	270	3	0	-	ACCEPT	0.6% (3/540)	0.6% *
3	500	218	3	1	1	REJECT SCREEN	1.0% (5/500)	0% 3rd sample is remaining 64 meters, so entire batch has been screened.
4	11,000	285 (330)	8	5	8	REJECT SCREEN	2.5% (21/855)	0%
5	100	50	5	0	-	ACCEPT	5% (5/100)	0% The entire batch of 100 has been sampled - replace / repair nonconforming.
6	450	212	3	6	0	ACCEPT	2.1% (9/424)	2.1% *
7	2,000	270	0	-	-	ACCEPT	0% (0/270)	0
8	578	226	5	0		ACCEPT	1.1% (5/452)	1.1% *
9	225	113	1	0		ACCEPT	0.4% (1/225)	0% The entire batch of 100 has been sampled - replace / repair nonconforming.
10	800	240	0			ACCEPT	0% (0/240)	0%
11	50	50	2	-	-	REJECT	4.0% (2/50)	0%
12	33,300	285 (333)	6	2	10	REJECT SCREEN	2.1% (18/855)	0%
13	400	not sampled					2.5% Initial estimate	2.5% Initial estimate
14	1,000	not sampled					5.3% (1/19) Preliminary batch estimate	5.3% (1/19) Preliminary batch estimate
				Total	*63,403*			

* *For batches that are accepted during the second and third stages, it is intuitive that the failed meters found during the sampling will be replaced or repaired. This does not change the estimate calculated for the batch from the sample.*

The pooled estimate of the fraction nonconforming meters over all batches can then be obtained with the batch sizes as weights. Such an estimate may be obtained before and after the screening of rejected batches. For any batch that has yet to be sampled, use the initial estimate of the population proportion nonconforming or the preliminary batch estimate of proportion nonconforming calculated in rule 8.1 (see batches 13 and 14).

Estimated Percent nonconforming over all batches **before screening**:

$$= \frac{\sum(\text{batch size} \times \%\text{nonconforming before screening})}{\sum \text{batch size}}$$

$$= \frac{(10,000 \times 0.023) + (3,000 \times 0.006) + (500 \times 0.01) + ... + (1,000 \times 0.053)}{63,403}$$

$$= \frac{1314}{63,403} = 2.07\%$$

Estimated Percent nonconforming over all batches **after screening**:

$$= \frac{\sum(\text{batch size} \times \%\text{nonconforming after screening})}{\sum \text{batch size}}$$

$$= \frac{(10,000 \times 0.023) + (3,000 \times 0.006) + (500 \times 0) + ... + (1,000 \times 0.053)}{63,403}$$

$$= \frac{327}{63,403} = 0.52\%$$

These estimates should be updated every time a batch is sampled and then again when rejected batches are screened.

These estimates can be used to develop a sampling schedule (rule 9.0). The accepted batches with a high proportion of non-conforming meters should be sampled more frequently as a measure to potentially decrease the overall estimate of proportion nonconforming.

8.3 Population Parameters

The following formulae will give an estimate for the proportion nonconforming and the variance of the estimated proportion nonconforming.

Given L batches and a sample of n_l from N_l with an estimated proportion $\hat{p}_l$ defective in batch l. Then the proportion nonconforming over all batches, $\hat{p}$, is

$$\hat{p} = \frac{1}{N}\sum_{l=1}^{L} N_l \hat{p}_l \qquad \text{where} \quad N = \sum_{l=1}^{L} N_l$$

{Notation format of the equation used in rule 8.2.}

The variance of the estimate of proportion nonconforming, $\text{var}(\hat{p})$, is

$$\text{var}(\hat{p}) = \frac{1}{N^2}\sum \frac{N_l^2}{N_l - 1}\left(\frac{N_l - n_l}{N_l}\right) s_l^{\,2} \quad \text{with} \quad s_l^{\,2} = \frac{\hat{p}_l(1-\hat{p}_l)}{n_l} \ .$$

9 Frequency and interval of sampling

Once all meters have been batched, sampled and the appropriate actions taken regarding acceptance or rejection, the next consideration is the frequency of sampling. That is, how often do you sample the batches after the transition plan?

The frequency of sampling should be determined by each party individually. A starting recommendation is to sample all batches every 5 years **on average**. The frequency of sampling any one batch should be determined by two factors:

- Age of the meters in the batch, and
- Known performance of the meters in the batch.

A batch of new meters that historically perform well need not be sampled as often as a batch of existing meters in the field whose performance is either unknown or known to be questionable.

Table 2 below gives a suggested guideline for the frequency of sampling based on % nonconforming. Note that the maximum interval is 10 years.

Table 2: Frequency based on % nonconforming

% nonconforming of batch ($\hat{p}$)	Frequency (years)
≤0.5	10
1	7
2	5
5	3
10	2
> 10	1

A product of the initial sampling of your population of meters should be a comprehensive database on the meters including the estimates of proportion nonconforming. Based on this data, a schedule for sampling should be developed and maintained for each batch.

In conjunction with the frequency of sampling, there is also the question of ensuring all batches are sampled over some fixed interval. Initially, the transition plan forces all batches to be sampled within a ten year period. A starting recommendation is to ensure that all batches are sampled at least once in subsequent ten year intervals. (It would be appropriate to review this part of the methodology in three or four years time once the results have been collected and analysed more systematically than is possible at present).

10 Alternative sampling plans

There are a variety of sampling plans that can be derived for use in meter recalibration. For situations involving compliance sampling or acceptance based on a standard, it is established in the literature that limiting quality level is the quality index to be used to fix the sample size.

Note:

Alternate names in the literature for limiting quality level (LQL) are the *lot tolerance percent defective* (LTPD) and *rejectable quality level* (RQL).

Adaptations to the plan are acceptable. The plan presented is a three stage plan with an acceptance number c = 0. The number of stages of the plan can be increased with a reduction in sample size, or the number of stages can be decreased with a marked increase in the sample size. The acceptance criteria can also be adjusted but will remove the "simple and easy to use" characteristic of the given plan.

It is not the intent of this appendix to provide a detailed description of the various sampling plans that can be derived. The plan proposed meets the given customer requirements and the needs of a diverse meter population. Users who wish to explore other sampling options are directed to the multitude of resources on acceptance sampling.

11 Details for the derivation of values in Table 1

Let: p = lot fraction nonconforming

3.1.1 N = lot size

3.1.2 n = sample size

$P_A(p)$ = overall probability of acceptance under the three stage plan

$P_a(p)$ = probability of acceptance under the zero acceptance number plan

The proposed plan has three stages, and rejection can occur in any of the three stages. The probability of rejection in a stage is $1- P_a(p)$. This suggests that

$$P_A(p) = 1-[1- P_a(p)]^3.$$

Let p_t stand for the LQL fixed for a consumer's risk of b = 0.01. Hence,

$$P_A(p_t) = 0.01=1-[1- P_a(p_t)]^3.$$

$$\text{or} \quad [1- P_a(p_t)]^3 = 0.99$$

$$\text{or} \quad 1- P_a(p_t) = 0.99^{(1/3)}$$

$$\text{or} \quad P_a(p_t) = 1-0.99^{(1/3)}.$$

Following Schilling (1978), we write, $P_a(p_t) = (1-f)^D$ where $D = Np_t$ and $f = n/N$.

The formula for D is therefore

$$D = \log [P_a(p_t)] \ / \ \log(1-f) = \log\{ [1-0.99^{(1/3)}]\} \ / \log(1-f)$$

$$= -2.47566795/\log_{10}(1-f)$$

For assumed values of f, the values of D are obtained and are tabulated in Table 1.

For large lot sizes, P_a is approximated as e^{-np} giving

$P_A(p_t) = 1-(1-e^{-np_t})^3$ = 0.01 giving np_t = 5.7.

Code Of Practice 4 - Data Logger Minimum Functional Requirements

Contents

Code of Practice 4: Data Logger Minimum Functional Requirements

1 Scope

This **code of practice** is issued pursuant to the provisions of schedule D1 and will be read in conjunction with all other such **codes of practice**. It covers **data loggers** which are incorporated in **metering installations** to store information related to energy consumption, as measured by a **meter**. This information is then transferred to a remote host computer.

Code of practice 3 describes the requirements which **metering installations** must meet in order to be **certified** for energy trading under the provisions of the **rules**. This part of **code of practice** 4 describes the requirements with which **data loggers,** and **meters** fitted with integral **data loggers,** must comply for them to be used in a **metering installation**.

In order to maintain consistency throughout this document, IEC Standards have been used. All references shall be deemed to be to the latest version of any Standard or, where a Standard has been superseded, to the replacement Standard. Equipment may optionally comply with the IEC Standards in force when originally certified. Alternative Standards shall be acceptable provided they are certified in writing by an **approved calibration laboratory** as being equivalent to or better than the specified IEC Standard.

2 Definitions

Terms which appear in bold type throughout this **code of practice** will have the meanings assigned to them in Annexure A.

3 Certification

Each type (model) of **data logger** used in a **metering installation** will be **type-tested** by an **approved test laboratory** to confirm its specific characteristics and to prove that it complies with the requirements of **code of practice** 4.

When the **approved test laboratory** is satisfied that the **data logger** can consistently meet the requirements of **code of practice** 4, it will **certify** that particular type of **data logger** as meeting those requirements.

A **data logger** may be **certified** as complying with the **rules** under qualified circumstances. For example, a **data logger** may be deemed to comply only when used in situations where **interrogation** is carried out on a maximum of 10 day cycles. (The frequency of **interrogation** may be determined by the memory available and the number of channels being used).

Further information on the **certification** process is given in **code of practice** 3.

If at any time there are any modifications to the specification, hardware or resident (ROM) software of a particular type and model of **data logger**, it will be regarded as a new model and will require repeat **type-tests** to be satisfactorily carried out before it will be considered to be **certified**. Where the modifications affect only part of the device, it may be sufficient to perform only limited tests on the characteristics affected by the modifications. The extent of such tests will be decided by the **approved test laboratory** carrying out the tests.

Designers of a **metering installation,** and the **approved test house** carrying out final **certification** of a **metering installation,** will ensure that only **certified data loggers** are used in the **metering installation**, in accordance with **code of practice** 3. The **responsible party** will have the overall responsibility of ensuring that only **certified data loggers** are used in the **metering installation**.

4 Data logger requirements

4.1 General Requirements

Data loggers shall be suitable for the conditions in which they will operate and shall generally comply with the relevant parts of the IEC standard applicable to a **meter** that would be used in the same location. These parts are not restricted to but would include the following:

- Environmental Characteristics
- Mechanical Characteristics
- Electrical Characteristics
- Electromagnetic Compatibility
- Radio Frequency Interference

Where the **approved test house** considers that any such requirements are unreasonably stringent for the particular circumstances in which a **data logger** will be used, and has satisfied itself that the **data logger** can be used in such a situation without in any way compromising the **overall accuracy** of the **metering installation**, the **approved test house** may certify the **data logger** for use in that **metering installation**. In such situations, the **approved test house** shall include in the records for the **metering installation** the reasons for dispensing with the particular requirements of the relevant standard.

4.2 Outputs and Inputs

All outputs/inputs will be suitably isolated and rated for the purpose. Outputs will not interfere with the operation of the device.

4.3 Data Monitoring Characteristics

The requirements detailed below will apply equally to Import and Export energy and may include information other than kWh, such as kvarh. The **data logger** will retain all data pertaining to energy and events for a minimum period of the interrogation cycle plus 5 business days.

4.3.1 Energy Consumption Data

The **data logger** will record the metered energy consumption as pulse counts or in engineering units.

Each period of data will be identifiable, or deducible, by both date and time on **interrogation**.

The **data logger** will record the time and date of all relevant event/fault conditions. Recorded events will be downloaded to the host collection system during **data logger interrogation**.

4.3.2 Events

The **data logger** will record the following events:

4.3.2.1 Loss of power

The period(s) in which a loss of the power supply to the **data logger** exceeding 60 seconds duration has occurred.

4.3.2.2 Changes to software, status or time setting

For sites certified to provide **half-hour metering** data, the **trading period(s)** in which there have been any software configuration, status or time setting changes, other than time synchronisation in accordance with **code of practice** 5.

4.3.2.3 Alarms

Critical internal alarms such as memory integrity checking.

The **data logger** will be able to record and store a minimum of 50 events between **interrogations**.

4.3.3 Data Loss Protection

Data loggers will include data loss protection for all data for a period of up to the **interrogation** cycle plus 5 business days from the onset of power supply loss. Electronic watchdog mechanisms will be provided to maintain error indication. **Data loggers** will carry out routine checking of memory integrity.

Data loggers will be designed to ensure continued clock and memory operation when the power supply to the **data logger** is lost. When supply is restored, the time and date will remain within the site design specification.

4.4 Communications

4.4.1 Media

Communications with the **data logger** may be via direct connection on site or via recognised media for remote communications.

Where on site access is required for **interrogation**, the direct connection to the local **interrogation** port will be able to be made without breaking any of the seals placed by the **approved test house**.

4.4.2 Communications Media Compatibility

Where the **data logger** incorporates remote communications as part of its functionality, the communicating device must satisfy the compatibility and connection requirements of the communications network operator.

4.5 Time Keeping Requirements

The **data logger** clock will have a time keeping accuracy of better than 60 seconds per month.

Data loggers will have provision for time synchronisation which adjusts time, forwards or backwards, in response to an instruction from the **interrogation** system. All information logged will be referenced to New Zealand Standard Time.

Maximum time errors will not exceed those specified in Table 1:

Table 1: - Maximum permitted time errors

Metering Installation Category Group	Maximum Time Error of Data Logger Clock (seconds)	Maximum Time Error in Commencement of any Trading Period (seconds)	Maximum Time Error in Interrogation & Processing Systems (seconds)	Maximum Time Error for Automatic Adjustment (seconds)
1	±10	±10	±5	±10
2	±10	±10	±5	±10
3	±10	±10	±5	±10
4	±10	±10	±5	±10
5	±5	±5	±5	±5
6	±5	±5	±5	±5

4.6 Security Requirements

4.6.1 Access Codes

Access codes shall be employed in such a manner that the password or identifier offered shall determine the level of access to the information or software within the **data logger**.

There will be a minimum of two access codes to permit access at the following levels:

Level 1: Required for **interrogation** only. This level may also allow synchronisation of time clocks where time errors are within the allowable specified in Table 1 of this **code of practice**.

Level 2: Required for all functions including program parameter changes. This level may also allow synchronisation of time clocks where time errors are outside the allowable limits specified in Table 1 of this **code of practice**. The access code shall consist of a string, or series of strings, of elements, where the number of possible combinations of elements overall equals or exceeds $15x10^6$.

Where access codes can be entered on a keypad integral with the **data logger**, neither the password nor the number of characters will be displayed on a screen.

4.6.2 Sealing

With the exception of a port for on-site reading only which is not capable of any other function, all parts and connections, and all components of the **data logger** will be contained within, or attached to, the case of the **data logger** in such a way that unauthorised access may be monitored by the application of a seal or seals, or by other means.

4.7 Trading Periods

For sites certified to provide **half-hour metering** data, the **trading period** duration, normally 30 minutes, will be within ±0.1% (± 2 seconds). **Trading periods** will be contiguous.

4.8 Quantisation Error

The design of the **metering installation**, **data logger**, and **interrogation** system, will ensure that the smallest possible increment in the energy value of the metering data is consistent with the required maximum limits of error. IEC 60338 illustrates one way of dealing with this issue.

Code of Practice 5: Data Administrator Requirements

Contents

Code of Practice 5: Data Administrator Requirements

1 Scope

This **code of practice** is issued pursuant to the provisions of schedule D1 and will be read in conjunction with all other such **codes of practice.** It covers the roles and responsibilities for **data administrators.**

2 Definitions

Terms which appear in bold type throughout this **code of practice** will have the meanings assigned to them in Annexure A - Definitions.

3 Departure from requirements

The **market administrator** will have the discretion to approve situations which depart from the requirements of this **code of practice** where it is satisfied that such departure will have minimal adverse effect on any **member**.

4 Appointment of data administrator

Each **retailer** will appoint a **data administrator** for each **ICP** it notifies to the **registry**. A **retailer** may be a **data administrator**.

5 Applications for approval

Any person wishing to be approved for appointment as a **data administrator** will apply in writing to the **market administrator** in the form specified from time to time by the **market administrator**. At the time of application, the applicant will pay to the **market administrator** any application fee and any annual fee that may be set by the **market administrator** from time to time.

6 Approval process

6.1 Requirements for Approval

The **market administrator** will approve an application in accordance with rule 5 of this **code of practice** provided that the applicant can demonstrate to the satisfaction of the **market administrator** that it has the facilities and procedures to consistently meet the requirements for the activities for which it is seeking approval. Such facilities and procedures may include the maintenance by the **data administrator** of:

6.1.1 Relevant AS/NZS certification

The relevant AS/NZS ISO 9002:1994 series Quality Certification; or

6.1.2 Equivalent

An international Quality Certification that the **market administrator** deems to be equivalent to the AS/NZS ISO 9002:1994 series Quality Certification.

The mere possession by an applicant of such certification will not imply an assurance that approval will be granted by the **market administrator.**

6.2 Consultation

In assessing whether to grant an application, the **market administrator** may consult an **auditor**. The **auditor** may request such additional information and carry out such inspections of the applicant and **audits** of its procedures as the **auditor** may consider necessary to enable it to process the application and make recommendations to the **market administrator**. The **market administrator** will pay for obtaining such advice.

6.3 Register of data administrators

When a **data administrator** is approved by the **market administrator** and has paid the relevant fees, it will be placed on the register of **data administrators** held and maintained by the **market administrator,** and a certificate of approval will be issued by the **market administrator**. The **market administrator** will notify the **reconciliation manager** of all changes to the register of **data administrators**, and provide all **members** with reasonable access to it.

6.4 Duration of Approval

Approval as a **data administrator** will be valid for a period of twelve months from the date the **market administrator** gives approval.**.** At the end of this period, the **data administrator** will, if it wishes to be approved for a further twelve month period, make a further application under rule 5 of this **code of practice**, although no application fee will be payable for any such re-application.

6.5 Audits

The **Board** will have the right to carry out without prior notice at any time within normal working hours **audits** of the records and procedures of a **data administrator**. The **data administrator** will:

6.5.1 Access

Afford any **auditor** appointed by the **market administrator** for this purpose full access to all relevant facilities, personnel, records and manuals; and

6.5.2 Information

Provide to the **auditor** any additional information which the **auditor** considers necessary to enable an assessment of whether or not the **data administrator** continues to meet the criteria for approval.

6.5.3 Intervals

Unless information from the **data administrator**, the **registry**, the **reconciliation manager**, or any other **participant** indicates cause for concern that a **data administrator** may no longer

meet the relevant criteria for any or all of its activities, **audits** will be carried out at intervals of no more than three years, or at shorter intervals as may be requested by the **data administrator**. The **data administrator** will pay for the costs of a regular **audit**. The costs of any **audit** requested by the **reconciliation manager**, the **registry** or any other **participant** will be paid in accordance with rule 6.6.

6.6 Who pays audit costs

6.6.1 If data administrator has not performed its obligations

If an **audit** establishes that a **data administrator** has not performed its obligations under the **rules**, then that **data administrator will** pay for the **audit**. Where the **auditor** believes the non-performance of a **data administrator's** obligations is trivial the **auditor** may, in his or her discretion, make an assessment regarding the proportion of the costs of the **audit** that are to be borne by the **data administrator** and the requesting **participant**.

6.6.2 If data administrator has performed its obligations

If an **audit** establishes that the **data administrator** has performed its obligations under the **rules**, then the requesting **participant** will pay for the **audit**.

6.6.3 If data administrator has performed some obligations

If an **audit** establishes that, in respect of some (but not all) matters investigated by the **auditor**, a **data administrator** is at fault, then the **auditor** will make an assessment regarding the proportion of the costs of the **audit** that are to be borne by the **data administrator** and the requesting **participant**.

6.7 Removal From the Register

If a **data administrator** fails to renew its approval by the due date, or fails an entire **audit**, the **Board** will cancel the approval of the **data administrator** and remove its name from the register. Where a **data administrator** fails only part of an **audit**, its approval to carry out those activities affected by the areas that fail the **audit** may, at the discretion of the **market administrator**, be withdrawn, and the **Board** will amend the details recorded on the register accordingly. Approvals will remain cancelled until a subsequent **audit** indicates that the **data administrator** meets the criteria for approval. The **market administrator** will notify all **members** of the removal of a **data administrator** from the register.

7 Collection of metering data and associated information

7.1 Data Interrogation

Data for all **half-hour metering** will be read (downloaded) electronically. This may be carried out through the use of portable devices, or remotely via a recognised communications medium.

Data for all non **half-hour metering** will be collected by a suitably qualified **data collector** in a manner agreed between the **data administrator** and each **retailer** that it represents.

Interrogation methods should take account of the possible future introduction of reconciliation on a weekly or daily basis.

7.1.1 Data to be Downloaded

Data downloaded on **interrogation** of **half-hour metering** will consist of the following as a minimum:

7.1.1.1 ID

The **data logger** ID.

7.1.1.2 Time

The time from the **data logger** at the commencement of the download unless the time is within specification and the **Interrogation** Log records the time of **interrogation**.

7.1.1.3 Half hour data

The **half hour** data. This may be limited to the data accumulated since the last **interrogation** and download.

7.1.1.4 Events Log

The Events Log. This may be limited to the events information accumulated since the last interrogation and download. The Events Log will contain as a minimum the events listed in rule 4.3.2 of **code of practice** 4.

Data collected during **interrogation** of non **half-hour metering** will consist of the following as a minimum:

7.1.1.5 ICP identifier

The **ICP** identifier.

7.1.1.6 Data collector identifier

The **data collector** identifier.

7.1.1.7 Date and Time

The date and time of the meter read.

The non **half-hour metering** data, which is the **ICP** consumption data as reflected on the register(s) connected to that meter point.

7.1.2 Meter Readings Provided by consumers

Meter readings that are provided directly from **consumers** will be accepted as actual consumption data to be inputted into the reconciliation process. However, the **data administrator** will ensure that a suitably qualified **data collector** interrogates a non **half-hour meter**:

7.1.2.1 Once during period of supply

at least once during the period of supply by a **retailer** to a particular **consumer** and this may take the form of a final **meter** interrogation; and

7.1.2.2 Once every four months for 90% of ICPs

at least once every 4 months on a rolling basis for 90% of the **non half hour metering** ICP's at a **grid exit point**, provided that the remaining 10% that are not interrogated do not contain ICP's with an annual usage of 20,000 kWh or greater.

Every **ICP** is to be read at least once annually. More frequent meter reading may be required for particular **profiles**.

7.1.3 Communication and Data Integrity

All transmissions of metering data will employ techniques to ensure the integrity of the data transmitted and received.

7.1.4 Archiving of Metering Information

All **metering information** downloaded or collected will be archived in accordance with rule 10.2 of part D. This rule requires that the information is stored in such a manner that it cannot be altered without leaving a detailed **audit** trail, and that a copy of the **raw meter data** is kept by the **data administrator** for the minimum period prescribed by that rule. This **raw meter data** will be available to the **reconciliation manager** or its agent, or an **auditor**, on request.

The **data administrator** will ensure that procedures are in place to minimise the possibility of **raw meter data** being accessed by unauthorised personnel, and to ensure that under no circumstances can the **raw meter data** be modified in any way. The means of storage of the **raw meter data** will be such that any access to it is recorded.

7.1.5 Interrogation Log

For all **half-hour metering** data, an **interrogation** log will be generated by the **interrogation** software to record details of all **interrogations**. This log will form part of the **interrogation audit** trail and will contain the following:

7.1.5.1 Date

Date of **interrogation**.

7.1.5.2 Time

Time of commencement of **interrogation**.

7.1.5.3 Operator ID

Operator ID (where appropriate).

7.1.5.4 Data Logger ID

Data logger ID.

7.1.5.5 Clock errors

Clock errors outside the range specified in rule 7.1.6.

7.1.5.6 Interrogation method

Method of **interrogation** (e.g. automatically, handheld, etc.).

7.1.5.7 Handheld computer ID

ID of handheld computer used for **interrogation** (where applicable).

The **interrogation** log will also be perused by the process operator and appropriate action taken where problems are apparent. Alternatively, this process may be an automated software function which flags exceptions.

For all non **half-hour metering** data, an **interrogation** log will be generated by the **data collector**. This log will form part of the **interrogation audit** trail and will contain the following:

7.1.5.8 Date

Date of interrogation.

7.1.5.9 Time

Time of interrogation.

7.1.5.10 Data collector ID

Data collector ID.

7.1.5.11 ICP Identifier

ICP *identifier.*

7.1.5.12 Interrogation method

Method of **interrogation** (e.g. handheld, etc.).

7.1.5.13 Handheld computer ID

ID of handheld computer used for **interrogation** (where applicable).

Note that while a **data collector** records both the date and time of a **meter interrogation**, only the date is used during the reconciliation process. The time of the **interrogation** is recorded for **audit** trail purposes only.

7.1.6 Data Logger Clock Synchronisation for Half-Hour Meters

Data logger clock synchronisation relates to **half-hour metering** only.

Interrogation and processing system(s) will have their internal clock(s) **calibrated** electronically against a time source with a traceable standard on a regular basis, at intervals no greater than one week and prior to the commencement of any individual **interrogation** or

interrogation cycle, or at such greater frequency as will ensure the internal clock is within 5 seconds of true time.

During **interrogation**, the internal clock of the **data logger** will be compared with the **calibrated** clock in the **interrogation** device. Should the time error be no greater than that listed in Table 1, the **interrogation** device may automatically update (synchronise) the clock in the **data logger** in accordance with **code of practice** 4.

Where a time error greater than that listed in Table 1 is detected, no change will be made to the **data logger** clock time. The error will be recorded in the Events Log and downloaded as part of the **interrogation**. The process operator will provide full details of the situation, including the magnitude of the discrepancy, to the **reconciliation manager** who will, in accordance with rules 15 to 19 of section II of part D, decide on the action to be taken.

Table 1: - Maximum permitted time errors

Metering Installation Category Group	Maximum Time Error of Data Logger Clock (seconds)	Maximum Time Error in Commencement of any Trading Period (seconds)	Maximum Time Error in Interrogation & Processing Systems (seconds)	Maximum Time Error for Automatic Adjustment (seconds)
1	±10	±10	±5	±10
2	±10	±10	±5	±10
3	±10	±10	±5	±10
4	±10	±10	±5	±10
5	±5	±5	±5	±5
6	±5	±5	±5	±5

7.1.7 Trading Period

The **trading period** duration, normally 30 minutes, will be within ±0.1% (± 2 seconds).

7.1.8 Quantisation Error

The design of the **interrogation** system will ensure that the requirements of rule 3.4 of **code of practice** 3 are complied with.

7.2 Data Validation

All **raw meter data** will be checked for validity after each **interrogation** cycle.

7.2.1 Half-Hour Metering Data

For **half-hour metering** data, the **raw meter data** will be checked at a frequency that will allow a further **interrogation** of the **data logger** before the data is overwritten within the **data logger** and before this data can be used for any purpose.

All **data logger** data will be verified for accuracy against **half-hour metering** readings during inspections, in accordance with **code of practice** 3, rule 7.3. For **half-hour metering** data, the **raw meter data** will be checked at a frequency that will allow a further **interrogation** of the **data logger** before the data is overwritten within the **data logger** and before this data can be used for any purpose.

As a minimum, each validity check for **half-hour metering** data will include the following:

7.2.1.1 Missing Data

Checks for missing data.

7.2.1.2 Invalid dates and times

Checks for invalid dates and times.

7.2.1.3 Zero throughput levels

Checks of zero throughput levels. The **data administrator** will be responsible for verifying the validity, or otherwise, of any period of zero throughput. Where the data shows periods of zero throughput while there was energy transferred, this will be repaired by an acceptable methodology, and the number and magnitude of errors reported monthly to the **Board**. Repairs to metering data errors of a significant magnitude will require the consent of the affected **member**.

7.2.1.4 Comparison of flow patterns

Comparison with standard or previous flow patterns. (Refer rule 7.2.3).

7.2.1.5 Comparison of registers

Comparisons with **meter** and **data logger** registers.

7.2.2 Non Half-Hour Metering Data

As a minimum, each validity check for **non half-hour metering** data will include the following:

7.2.2.1 Missing data

Checks for missing data.

7.2.2.2 Invalid dates and times

Checks for invalid dates and times.

7.2.2.3 Comparison of flow patterns

Comparison with standard or previous flow patterns. (Refer rule 7.2.3).

7.2.3 Metering Data Trend Reports

The **data administrator** will document and prepare metering trend reports, based on both **half-hour** and non **half-hour metering** data, to ensure the integrity of the data collected.

The **data administrator** will make available to the **auditor** details of the trend reporting it is undertaking to ensure the integrity of its data.

7.3 Error Handling

Errors in **raw meter data** will be corrected in a manner acceptable to the **reconciliation manager** in accordance with rule 18 of part D.

7.3.1 Raw Meter Data Integrity

In correcting any working data, the **raw meter data** will not be overwritten. If the **raw meter data** and the working data files are one and the same, an automatic secure backup of the affected data will be made and archived by the processing or data correction application.

7.3.2 Journals

In all cases where data is corrected or altered, a journal will be generated and archived with the **raw meter data** file. The journal will contain the following as a minimum requirement:

7.3.2.1 Date

The date of the correction/alteration.

7.3.2.2 Time

The time of the correction/alteration.

7.3.2.3 Operator ID

The operator ID.

7.3.2.4 Data corrected

The identification of the **half-hour metering** data and/or the non **half-hour metering** data corrected/altered.

7.3.2.5 Technique used

The technique used to arrive at the corrected data.

7.3.2.6 Reason

The reason for the correction or alteration.

7.3.3 Error Compensation and Loss Compensation

Error and **loss compensation** may be carried out as part of the process of arriving at corrected data. Whatever methodology is used, the process will be documented and will comply with **audit** trail requirements.

7.4 Data Transmission

7.4.1 General

Transmissions and transfers of **metering information** between **members** and their agents, such as **data administrators**, for the purposes of the rules, will be carried out electronically. Except where they are communicating with the **reconciliation manager** or the **registry**, **members** will agree the format and structure of transmitted files in writing before any communication takes place. All transfers involving the **reconciliation manager** will be as reasonably specified from time to time by the **reconciliation manager**.

Recognised and secure transmission media will be used. Floppy disks will be used only in emergency situations.

7.4.2 Decimals

In reporting **metering information**, the number of decimal places will be no greater than two. Any stored metering information containing more than two decimal places will be reported back to the nearest two decimal places, with the mid-point being rounded up - i.e. if the digit to the right of the second decimal place is greater than or equal to 5, the second digit is rounded up, and if the digit to the right of the second decimal place is less than 5, the second digit is rounded down.

In preparing the files for the **reconciliation manager**, the method of dealing with decimals will be as follows:

7.4.2.1 Periods 1 - 47

For each day, in each of the **half hour** period 1 through 47, the decimal part of the resultant value will be carried over and added to the next **half hour** period.

7.4.2.2 Period 48

In the 48th or final period, the decimal part of the resultant value will be truncated.

7.5 Non-Metering Information

The **data administrator** will ensure that all relevant non-**metering information**, such as external control equipment operation logs, used in the determination of **profile** data is collected, and is archived in accordance with rule 10 of section II of part D.

7.6 Audit Trails

7.6.1 General Requirements

A complete **audit** trail will exist for all data gathering, validation and processing functions. The **audit** trail will include details of the passing of information between the **registry**, between the **reconciliation manager** and between **members** and their agents. This **audit** trail will apply to all archived data in accordance with rule 10 of section II of part D.

7.6.2 Logs

Logs of communications and processing activities will form part of the **audit** trail. This will apply most particularly where automated processes are in operation. Logs will include the following as a minimum:

7.6.2.1 Activity identifier

An activity identifier.

7.6.2.2 Date and time

The date and time of the activity.

7.6.2.3 Operator identifier

The operator identifier.

Logs may be printed and filed as hard copy or maintained as data files, in a secure form, along with other archived information

Code of Practice 6: Variation Of Requirements

Contents

Code of Practice 6: Variation of Requirements

1 Scope

This **code of practice** is issued pursuant to the provisions of schedule D1 and will be read in conjunction with all other such **codes of practice**. It covers situations where it is considered necessary or desirable to depart from the requirements of **codes of practice** 2 - 4 inclusive, or schedule D1.

2 Definitions

Terms which appear in bold type throughout this **code of practice** will have the meanings assigned to them in Annexure A - Definitions.

3 Variation of metering requirements

3.1 Consumer metering installations

Any requirements for an existing **metering installation**, as prescribed in any **code of practice**, may be varied by agreement between the **incumbent retailers** and **independent retailers**, subject to the following conditions:

3.1.1 Not detrimental to timeliness

The agreement is not detrimental to the timeliness of information supplied to the **reconciliation manager** or the requirements of schedule D1, and

3.1.2 Details recorded

Details of the proposed arrangements, including any consents thereto and the agreement termination date, will be recorded against the **metering installation** records, and copies provided to the **consumer**, **distributor**, **incumbent retailer** and **independent retailer**, and

3.1.3 Does not permit non-compliance

Except where approved specifically by the review panel, the agreement will not permit the use of any **meter** or **data logger** which does not comply fully with the requirements of **code of practice** 3 or **code of practice** 4 as appropriate.

3.2 Point of connection and generator metering installations

Requirements for a **metering installation** at a **grid exit point** or a **generator**, as prescribed in any **code of practice**, may be varied only in accordance with the following:

3.2.1 Approved by Review Panel

The **Board** will appoint a review panel to approve every application for exemptions from any requirement of this **code of practice**.

3.2.2 Panel of 5 persons

The review panel will be made up of five persons, drawn from the industry's technical base, who will represent the industry.

3.2.3 Supporting documentation

Each application for exemption under this **code of practice** will be supported by documentation detailing the reason for the application and the effects on the accuracy of the resultant **metering information**.

3.2.4 Result notified in 20 business days

Each application will be considered within 20 **business days** and the result notified to all **participants**.

3.2.5 Objections

Any objections to any exemption or application for exemption will be reviewed by the review panel and will be supported by evidence that the exemption materially affects the objecting party. The review panel will then decide on the action to be taken as a result of this review.

4 Effective date of exemption

Any agreement entered into or exemption granted under the provisions of this **code of practice** will take effect from a date agreed by the **consumer**, **distributor**, **incumbent retailer** and the **independent retailer** for **consumer metering installations**, or from a date specified by the review panel for **point of connection** and **generator metering installations**.

5 Master agreement

Where an agreement can be reached between a **distributor**, **incumbent retailer** and **independent retailer** that covers a number of commonly described sites, this may act as a master agreement. It will then be necessary only to refer to this agreement and record proof of the **consumer's** consent in the **metering installation** records.

6 Expiry of exemption

6.1 Consumer metering installations

No agreement will remain in force for more than ten years without approval by the review panel. If the parties to an agreement decide to terminate that agreement prior to any expiry date which may be specified therein, the **responsible party** will ensure that the **consumer**, **distributor, incumbent retailer** and **independent retailer** have been notified of the date upon which that agreement will terminate.

6.2 Point of connection and generator metering installations

If the original applicants for an exemption under the provisions of this **code of practice** decide to terminate that exemption prior to any expiry date which may have been agreed or imposed by the review panel at the time the exemption was granted, they will apply to the review panel to have the exemption

terminated. The review panel will consider the application and will notify the original applicants and all other **members** of its decision.

If, as a result of a review or for any other reason, the review panel wishes to terminate any exemption, the original applicants for the exemption will be advised. The review panel will consider any responses from the original applicants, and if it decides to terminate the exemption, it will notify the original applicants and all other **members**.

6.3 Agreements existing prior to 1 April, 1999

All agreements entered into prior to 1 April 1999, will be deemed to have expired on that date and replaced by the provisions of **code of practice** 3, rule 4.8.

Any variation that was granted under the **MARIA** code of practice 6 and that was current when these **rules** took effect will be deemed to have been made under the equivalent provision of these **rules.**

Code of Practice 7: Profile Administration

Contents

Code of Practice 7 – Profile Administration

1 Scope

This **code of practice** is issued pursuant to the provisions of schedule D1 and will be read in conjunction with all other such **codes of practice**. It covers new and existing **metering installations** which are to be used for energy trading purposes under the **rules**. It details the requirements for the production of **profiles** to be used for energy trading where a **metering installation** meets the eligibility criteria described herein.

2 Definitions

Terms which appear in bold type throughout this **code of practice** will have the meanings assigned to them in Annexure A - Definitions.

3 Departure from requirements

The **market administrator** will have the discretion to approve situations which depart from the requirements of this **code of practice** where it is satisfied that such departure will have minimal adverse effect on any **member**.

4 General

Where load switching information is required from the operation log of an external control system, such as a SCADA or ripple injection control system, it will be the responsibility of the **retailer** to ensure that this data is available to the **data administrator** on or before the second business day of each month.

The **data administrator** will ensure that all non-metering information, such as external control equipment operation logs, used in the determination of **profile** data is archived in accordance with rule 13 of part D.

Each **retailer** who uses a **profile** will keep a current **profile population** list for each month the **profile** is in use. This will form a part of the **audit** trail of how **profiles** are applied.

Each **profile owner** will keep a full copy of all of the details of each **profile** approved for use. These details will be kept in accordance with rule 10 of section II of part D for **audit** purposes.

Where a **metering installation** has multiple **meters** or **meters** with multiple registers, a **retailer** may choose to have each **meter** or **meter** register treated as one of the **profiles** described in Appendix 1.

New **profiles** will be developed in accordance with the **rules** contained in this **code of practice**.

External or internal clocks used for switching of **meter** registers will have a time-keeping accuracy of better than 60 seconds per month. The current time indicated by each clock will be checked for accuracy at least once per year, and corrected as necessary.

Where a **metering installation** includes subtractive metering, the **data administrator** (or, where applicable, **data administrators** in collaboration) will derive the appropriate net consumptions.

5 Approved profiles

Profiles which have been approved by the **market administrator** are described in Appendix 1.

6 NSP-derived profiles

The **market administrator** will approve the **NSP**-derived **profiles** described in Table 1 of Appendix 1. Where a **member** wishes to apply any other **profile** to any **consumer** or grouping of **consumers**, the procedures described in rule 7 will be followed. All **profiles** approved by the **market administrator** in accordance with this **code of practice** will be listed in Appendix 1.

7 New profiles

7.1 Technical Requirements

New **profiles** will be based on a process of statistical sampling carried out in accordance with the guidelines contained in this **code of practice**, or derived using recognised engineering principles, or derived from **NSP profiles**.

7.2 Applications

Any application to introduce a new **profile** will be submitted to the **market administrator**, who will either advise the **profile applicant** of further actions, or will approve or reject the application no later than 15 business days after its receipt. Each application will contain:

7.2.1 Profile description

Profile description;

7.2.2 Profile class

Profile class (refer Appendix 2);

7.2.3 Size and identifier of profile population

The size of the **profile population** and a list that uniquely identifies each member of the **profile population**;

7.2.4 Eligibility criteria

The eligibility criteria for **consumers** to be included in the **profile**. These criteria will be assessed under the provisions of Appendix 3;

7.2.5 Methodology

Description of methodology for arriving at a monthly file for the **reconciliation manager,** including any accruals etc;

7.2.6 Metering installation

Details of dynamics derived from sources external to the **metering installation** (SCADA, ripple control etc) if appropriate;

7.2.7 Half-hour metering

Details of any **half-hour metering** as a control or source of input data to the **profile**, and

7.2.8 Statistical or engineering data

Statistical or engineering data which supports the proposed **profile** shape.

In general, the **market administrator** will not perform any analyses required as part of the application. The **profile applicant** will be responsible for supplying any analytical information relating to the application in the format required by the **market administrator**.

7.3 Assessment

The **market administrator** must be satisfied that:

7.3.1 Eligibility criteria

The eligibility criteria satisfy the requirements of Appendix 3 of this **code of practice**;

7.3.2 Audit trail

There is a clear **audit** trail for the eligibility criteria of **consumers**;

7.3.3 Methodology

The methodology of arriving at a monthly file for the **reconciliation manager** has no apparent fault;

7.3.4 Profile

The **reconciliation manager** is able to incorporate the **profile** into reconciliation, and

7.3.5 No profile variance

The proposed **profile** is not at variance with existing **profiles** for like populations.

7.4 Sampling Requirements

Statistical samples will be drawn using the methodology described in Appendix 4. Sampling information will be taken from fully **certified metering installations**. **Metering installations** with interim **certification** under the provisions of **code of practice** 3 will not be used for this purpose.

7.4.1 Preliminary Sample

For **profiles** that require statistical sampling, the **market administrator** will either specify the **preliminary sample size** and draw a **preliminary sample** of **consumers** from the **profile population** list, or will accept appropriate sampling performed by the **profile applicant**. **Half-**

hour research **meters** will be, or will have been, installed and operated by the **profile applicant** for this **preliminary sample**. The **market administrator** will require a minimum sampling period of 60 calendar days, and not more than 12 months. The **market administrator** will have the discretion to withdraw **consumers** from the **profile population** list if it can be shown by the **profile applicant** that those **consumers** are in sites that are difficult to meter.

The average **unit cost** and standard deviation of the **unit cost** will be calculated using the 60 days or more of data obtained as described above. If the sample **coefficient of variation** is less than or equal to the **profile acceptance limit** specified in Appendix 4, the size of the **profile sample** will be the **profile sample size**. The **market administrator** will provide a standard set of synthetic price scenarios to determine the variability of **unit costs**.

If the sample **coefficient of variation** is more than the **profile acceptance limit**, the **market administrator** can reject the application, or can require the **profile applicant** to supply additional information until the **market administrator** is satisfied that there is no clear evidence to suggest the population **coefficient of variation** exceeds the **profile acceptance limit**.

7.4.2 Profile Sample

If the **preliminary sample size** is less than the **profile sample size**, the **market administrator** will draw an additional random sample. The size of the additional random sample will equal the shortfall.

If the **profile sample size** is less than the **preliminary sample size**, the **preliminary sample** will become the **profile sample**.

7.5 Ownership

For the purposes of this **code of practice**, the **profile applicant** will become the **profile owner** once the application is approved. If the **profile applicant** is not a legal entity, a legal entity will be nominated to be the **profile owner**.

7.6 Withdrawal of Applications

If an application is withdrawn by the **profile applicant** at any time following the **declaration date**, but prior to approval, the **market administrator** will advise all **members**.

7.7 Rejected Applications

If an application is rejected, the **market administrator** will provide to the **profile applicant** a detailed explanation of why the application was rejected, together with actions required for a reconsideration of the application.

Where a **profile** application is rejected because the **coefficient of variation** is found to be too large, the **profile applicant** will be permitted to resubmit the application with a refined **profile population**. The refined **profile population** will be a subset of the original population and will be made up of **consumers** who are more homogenous in their **unit costs** than those in the original **profile population**. Data collected from **half-hour metering** in the original **preliminary sample** may be re-used to constitute the refined **preliminary sample** as long as the data was collected from **consumers** who belong to the refined **profile population**. The **market administrator** will determine if additional **consumers** are required to make up the refined **preliminary sample**.

Appeals against any rejection will be handled in accordance with rule 11 of this **code of practice**.

7.8 Use of Approved Profiles

A **profile** will not be used for reconciliation until the **market administrator** approves it. The use of a **profile** will be effective from a date decided by the **market administrator**, but not earlier than the first day of the month following the **declaration date**. If an approved **profile** is used for reconciliation, every **consumer** on the **profile population list** will be reconciled under that **profile**.

A **retailer** who wishes to reconcile its eligible **consumers** using an existing **profile** will first gain the approval of the **profile owner**. **Consumers** not already on the **profile population list** will be added to the list before the **profile** can be applied.

7.9 Profile Maintenance

The **profile sample** will be representative of the **profile population**. The **profile owner** will be responsible for maintaining a valid statistical sample which takes into account changes in the **profile population**.

7.9.1 Profile Population List

The **profile owner** will maintain a current **profile population list**. The **profile owner** will be responsible for informing the **market administrator** when an update is necessary (refer rule 7.9.2). The **profile population list** will be subject to random **audit** by the **market administrator** or its appointed **audit** agent.

7.9.2 Updates

The **profile sample** will be updated when membership of the **profile population** has changed by more than 20% since the **sample date**. The **profile owner** will notify the **market administrator** of the changes in the **profile population** list. The **market administrator** will then determine any required modifications to the **profile sample**. The **profile owner** will then have 1 month to ensure that **certified half-hour meters** are installed in the **metering installations** of these **consumers**, and that the **metering installations** are fully **certified**.

When more than 5% of the **profile sample** has been lost or removed, the **profile owner** will submit to the **market administrator** a list of **consumers** in the current **profile sample** who have been lost or removed from the **profile population** list. The **market administrator** will then draw **consumers** from the **profile population list** to replace those who are lost or removed from the **profile sample**. The **profile owner** will then have 1 month to ensure that **certified half-hour meters** are installed in the **metering installations** of these **consumers**, and that the **metering installations** are fully **certified**.

The addition or removal of **consumers** to or from the **profile sample** will follow the procedures contained in Appendix 4 of this **code of practice**.

There will be a minimum period of 3 months between updates.

7.10 Exceptions

The **Board** will have the discretion to allow different sampling methodologies that are not described in this **code of practice** provided that:

7.10.1 Methodology

The methodology can produce sample data that meets the precision standards specified under Appendix 4 of this **code of practice**, and

7.10.2 Audit

The **Board** or its **audit** agent is satisfied that the methodology can be **audited** to the same degree of rigour as the sampling methodology outlined in Appendix 4 of this **code of practice**.

7.11 Disclosure

Following the **declaration date** but prior to approval, details of the shape of the proposed **profile** will be provided by the **profile owner** on a monthly basis to all **members** trading on the affected **NSP(s)**. Use of such **profile** information will be subject to the requirements of rule 7.8 of this **code of practice**. Following approval, such details will be provided to all **members** by the **reconciliation manager**.

8 Audits

Any **member** may request the selective **audit** of any **participant's** compliance with this **code of practice** and the application and use of any **profile(s)**. The application of all **profiles** will be examined in a random order at least once in every 2 years by application of a selection process maintained by the **market administrator** and monitored by the **market administrator**.

As a minimum, a **profile audit** will cover the following:

8.1.1 Rules

The documentation detailing the rules of the **profile**;

8.1.2 Elements

The application of dynamic and estimated elements of the **profile**;

8.1.3 Consumers

The **consumers** on the **profile population** list.

9 Reviews

The **market administrator** will review the structure of every approved **profile administrator** at least every three years. Each review will determine whether:

- the criteria for **profile** definition are still appropriate; and
- where applicable, the existing sample needs to be redrawn.

10 Removal of profiles

The **market administrator** will immediately remove any **profiles** that fails the **audit** procedures from the list of approved **profiles** in Appendix 1. All breaches will be reported to the **Rulings Panel** who will decide the remedies and/or penalties to be applied.

Any **profile** may also be removed at the request of the **member** that introduced it, or for such other reasons as may be decided by the **market administrator**. Requests for the removal of a **profile** will be notified to the **market administrator**, and will be effective from the following settlement period.

Whenever a **profile** is removed, the **market administrator** will decide on the actions to be taken with respect to the **consumers** to whom the removed **profile** applied.

11 Dispute resolution

Any complaints or disputes relating to this **code of practice** will be resolved in accordance with section V of part A.

APPENDIX 1: Approved profiles

The **profiles** detailed below are approved under the **rules**. As new **profiles** are approved, the **market administrator** will add them to the list**,** and updated listings will be distributed to **members**. The terms used are as follows:

Profile Reference:	The unique reference under which the **profile** is stored by the **reconciliation manager**	
Profile Class:	Refer to Appendix 2	
Characteristics:	Type(s) of **meter(s)**:	A – None
		B – Single Register
		C – Multi-Register
	Type(s) of Load(s):	D – Controlled
		E – Uncontrolled
Description:	A brief description of the type of consumer to whom the **profile** applies	

Examples of typical entries are given at the end of this Appendix.

Table 1. NSP-derived profiles

Profile Reference	Profile Class	**Metering Installation Characteristics**	Description	Profile Owner
	1.1	B&D, C&D, C&E	Time of use - definite switching times	
	1.2	B&D, C&D	Controlled load only	
	1.3	B&D/E, C&D/E	Whole installation, part controlled	
	1.4	B&E	Uncontrolled 24hr	

Table 2. Sampled/deemed profiles

Profile Reference	Profile Class	**Metering Installation Characteristics**	Description	Profile Owner
	2.1	A&D, A&E	Unmetered	
	2.2	Any	100% sampled	

APPENDIX 2: Generic descriptions of metering installations

This Appendix contains generic descriptions of **metering installations** to which particular **profile classes** may be assigned. Note that more descriptions may be added as they arise.

1 NSP-derived profiles

1.1 Profile Class 1.1 Interval Time of Use Meter(s)

Typical **meters** in this classification include the following:

1. Day-Night Two Rate **meter**
2. Night Only **meter**
3. Night Only plus Afternoon Boost **meter**
4. Five Rate Time of Use **meter**.

Where register-switching is triggered by an external signal, such as a ripple relay, rather than by the **meter's** internal clock, data from the operation log of the equipment controlling the external signal will be used to provide the **profile** time period.

1.2 Profile Class 1.2 Separately Metered Controlled Load

Typical **meters** in this classification include a separate **meter** for a ripple controlled water heater, which may be switched on and off at variable times of the day. The entire load recorded on this register will be available for control.

Information from the operation logs of equipment controlling the connection of controllable loads will be used to determine the time period relating to them. Where the controllable load component is not static, a calculation of the diveristy of the load will be documented and applied.

Other **meters** in the **metering installation** will be applied as per **profile class** 1.1 or 1.4, as appropriate.

1.3 Profile Class 1.3 Non Separately Metered Controlled Load

Typical installations include a ripple controlled water heater but with only one **meter** measuring the whole installation including the water heater. The controlled load may be switched on and off at variable times of the day.

In this case a proportion of the profile (kWh) will be applied as per **profile class** 1.2 with the remaining kWh applied as per **profile class** 1.1 or 1.4, as appropriate.

1.4 Profile Class 1.4 Uncontrolled Load 24-Hour Meters

The **profile** from these meters will follow the **NSP** residual **profile**.

The **NSP** residual **profile** will be calculated as follows:

Step 1: Deduct from the **NSP half-hour metering** data, where **half-hour metering** is installed at the **NSP**, all **half-hour metering** data submitted from **certified metering installation** categories 3 - 6.

Step 2: Once the remaining **profile** data has been converted into "allocated monthly data" it will be deducted in a manner decided by the **reconciliation manager**.

2 Sampled / deemed profiles

2.1 Profile Class 2.1 Unmetered Loads

Profiles may be applied to the following types of unmetered loads:

(i) Estimated loads whose characteristics are reasonably predictable using time and other observable values applied between fixed time periods (static);

(ii) Estimated loads whose characteristics are reasonably predictable and which apply over varying but known time periods (dynamic).

The elements making up each load type will be documented. The documentation will include a description of the methodology, formulae, and the results of any calculations for any estimated data.

For static **profiles**, the time period over which the load will be applied will also be included.

For dynamic **profiles**, the source and method of arriving at the variable time period will be described.

2.2 Profile Class 2.2 Half-Hour Data, Metering Installations With Interim Certification

Half-hour data from **metering installations** that have been granted interim **certification** under the provisions of **code of practice** 3 may be either:

(i) Regarded as a 100% sampled **profile** until the expiry of the interim **certification** validity period for those **metering installations**, as specified in **code of practice** 3. From that date, if the **metering installation** has not been fully **certified** in accordance with **code of practice** 3, the **metering installation** will be assigned to **profile class** 1.4,

or

(ii) Treated as if it was derived from fully **certified metering installations** until the expiry of the interim **certification** validity period for those **metering installations**, as specified in **code of practice** 3. For the avoidance of doubt, the **half-hour** data must be derived from an **interrogation** of the **metering installation** and must be submitted to the **reconciliation manager** in accordance with schedule G4.

For a 100% sampled **profile**, a method of calculating forward estimates will be adopted in accordance with rule 4.3 of schedule E1. A **profile** shape for the reconciliation period will be submitted to the **reconciliation manager** with the estimated data.

Where the gathering, validation and repair of **metering information** from a **metering installation** with interim **certification** is carried out by a **data administrator** in a manner which is not in accordance with **code of practice** 5, these processes must be fully documented in the quality procedures of the **data administrator**.

APPENDIX 3: Guidelines for profile production

1 Basic principles

The two basic principles for classifying **consumers** into a **profile** are:

(i) All **consumers** within that **profile** will have similar **consumption patterns** and/or **unit costs**.

(ii) The classification criteria will be readily verifiable.

2 Considerations

Similarity in **consumption pattern** will be regarded as a more stringent requirement than similarity in **unit cost**, since a wide variation in **consumption pattern** during periods of low prices does not necessarily imply a wide variation in **unit cost**.

In addition, given that similarity in **unit cost** is difficult to establish in advance, **consumption pattern** provides a more practicable guideline to determine if the defining criteria are acceptable.

Hence, in determining if the **profile** classification criteria are acceptable, the **Board** will consider the similarity of **consumers' consumption patterns** in the first instance. If the application fails the **consumption pattern** consideration, the **Board** will then consider the similarity in **unit cost**, requiring further information or supporting materials from the **profile applicant**.

3 General guidelines

As general guidelines, the **Board** will take into consideration the following examples of discernible characteristics:

(i) commercial **consumers** in the same line of business;

(ii) hours of operations;

(iii) pricing structure;

(iv) alternative fuel;

(v) domestic **consumers** with the same pricing structure;

(vi) consumption level;

(vii) metering arrangements.

Although this will be determined as part of the application, the **market administrator** will inform the **profile applicant** of the risk of incurring sampling costs and having the application rejected.

APPENDIX 4: Preliminary methodology – with no apriori information on profile population structure

1 Basic sampling scheme

The method of **simple random sampling without replacement** will be used in drawing statistical samples whenever such samples are required for **profiles** under the **rules**.

2 Preliminary sample

Unless the **profile applicant** has better information available which is acceptable to the **Board,** the size of the **preliminary sample** will be determined by the following **preliminary sample size** formula:

$$n_1 = (z_\alpha^2 \times C_A^2)/ r^2$$

If n_1/N is greater than 0.1, it will be modified to account for the finite population correction factor and is calculated as:

$$n_1' = n_1 / (1 + n_1/N)$$

If either n_1 or n_1' is less than 20, the **preliminary sample size** will be 20.

In the above formulae:

N = size of the **profile population,**

α = confidence level,

z_α = value of the standard normal distribution which gives α probability outside the tails,

C_A = **assumed coefficient of variation** of the **unit cost,**

r = **relative standard error** of the **unit cost.**

The following parameter values are to be used:

Assumed coefficient of variation (C_A): 0.1

Relative standard error (r): 0.05

Confidence level (α): 0.99

The **profile acceptance limit** will be 0.2.

These values will be subject to review in accordance with rule 5 of this Appendix.

The **profile applicant** will collect **half-hour** data from the **preliminary sample** over a period of at least 60 calendar days. The data, in its processed form, will be submitted to the **Board** for consideration. The

data processing will include calculations of **unit costs**, and of mean and standard deviation of **unit costs**, over the sample period.

3 Profile sample

The size of the **profile sample** will be determined by the following **profile sample size** formula:

$$n = (S_0^2/Y_0^2) \times (z_\alpha^2/ r^2) \times \{1 + 8 \times (r^2/z_\alpha^2) \times [S_0^2/(n_1 \times Y_0^2)] + 2/n_1\}$$

Again, if n/N is greater than 0.1, it will be modified to account for the finite **profile population** correction factor and is calculated as:

$$n' = n/(1+n/N)$$

If either n or n' is less than n_1, the **preliminary sample** will become the **profile sample**.

In the above formulae:

S_0 = estimated standard deviation of **unit costs** from the **preliminary sample**, or from the existing **profile sample** in the case of updates,

Y_0 = estimated mean of **unit costs** from the **preliminary sample**, or from the existing **profile sample** in the case of updates,

α = confidence level,

z_α = value of the standard normal distribution which gives α probability outside the tails,

n_1 = size of the **preliminary sample**, or the existing **profile sample** in the case of updates,

r = **relative standard error** of the **unit cost**.

The **relative standard error** (r) and the confidence level (α) will be the same as those specified in rule 2.

If the size of the **profile sample** is larger than the size of the **preliminary sample**, additional **consumers** from the **profile population** will be drawn to increase the sample size to the required level.

Data from the **profile sample** will be used to form the basis for future updates.

4 Sample updates

When an update is required because of a change in the **profile population**, the following procedures will be followed:

If the size of the updated **profile sample** is larger than the size of the existing **profile sample**, additional **consumers** will be drawn from new members of the **profile population** to increase the sample size to the required level.

If the size of the updated **profile sample** is smaller than the size of the existing **profile sample**, **consumers** from the existing **profile sample** will be removed to decrease the sample size to the required

level, unless the **profile applicant** decides to nominate the existing **profile sample** as the **profile sample**.

For the purposes of updates, data from the existing **profile sample** will be used (instead of data from the **preliminary sample**) in all **profile sample size** calculations.

5 Reviews

The statistical parameters will be monitored by the **market administrator** and reviewed when considered appropriate. Modifications of these parameters are expected as the industry gains experience in the use of statistical **profiles**. Industry participants will be consulted as part of the review process.

Each year the **market administrator** will review data gathered during the year for each **profile sample**, and will re-examine the **coefficient of variation** and the sample size. A **relative standard error** of 5% and a confidence level of 99% will be applied initially. A figure of 2% for the **relative standard error** is expected to be adopted by the **market administrator** following the first twelve-monthly review and may thereafter be reviewed from time to time.

Reviews of existing standards will take place in the sixth month and the twelfth month during the first year of **profile** introduction.

Schedule D2- Points of Connection