ANNEX 7 TO THE PRIVATE NETWORK CFD AGREEMENT

PRIVATE NETWORK TECHNICAL SYSTEM REQUIREMENTS

Version 2

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CONTENTS

ACRONYMS

BS EN: British Standard European Norm

CT: Current Transformer

HHU: Hand-held Interrogation Unit

ID: Identifier

IEC: International Electrotechnical Commission

IU: Interrogation Unit

kW: Kilowatt

kWh: Kilowatt hours

MVA: Megavolt ampere

MWh: Megawatt hours

UTC: Co-ordinated Universal Time

VT: Voltage Transformer

1. INTERPRETATION

1.1.1 In these TSRs:

(a) in relation to any Metering System, the requirements set out in this document shall be construed as requirements in relation to all of the Metering Equipment comprised or required to be comprised in that Metering System;

(b) references to a Metering System include a Metering System which is to comprise Metering Equipment which a third party is or will be required to calibrate, install, commission, prove, operate, maintain or test;

(c) references to Metering Equipment in the context of a Metering System or the Generator are to all of the Metering Equipment which is or is to be comprised in such Metering System (except that references to Metering Equipment shall not include references to Metering Equipment which comprises a Boundary Point Metering System, and references to a Metering System shall not include a Boundary Point Metering System); and

(d) where the Facility is a Dual Scheme Facility, other than in paragraph 2.1.1 of these TSRs, references to Metered Volume shall not include Imported Input Electricity.

2. METERED VOLUME

2.1 Required measurements

2.1.1 The following electricity measurements are required in relation to each Settlement Unit for the purposes of calculating Metered Volume:

(a) all output electricity generated by the Facility;

(b) if the Facility is not a Dual Scheme Facility, all input electricity comprising parasitic and site load used by the Facility; and

(c) if the Facility is a Dual Scheme Facility, all input electricity comprising the parasitic load used by the Facility and the Imported Input Electricity,

in each case, all such values to be converted to kWh and expressed to three (3) decimal places.

2.1.2 The Meters must be capable of recording the relevant measurements described in 2.1.1(a), 2.1.1(b) and 2.1.1(c) above (other than Imported Input Electricity, which shall be measured by Metering Equipment comprising a Boundary Point Metering System and which is outside the scope of these TSRs) for each Settlement Unit.

2.2 Accuracy requirements

The overall accuracy of the electricity measurements in respect of each Meter must be within the following limits of error at all times:

Metering Type 1 (Metering of circuits rated greater than 100MVA)

Condition	Limits of error at stated system power factor	
Current expressed as a percentage of Rated Measuring Current	Power Factor	Limits of Error
120% to 10% inclusive Below 10% to 5% Below 5% to 1% 120% to 10% inclusive	1 1 1 0.5 lag and 0.8 lead	± 0.5% ± 0.7% ± 1.5% ± 1.0%

Metering Type 2 (Metering of circuits not exceeding 100MVA)

Condition	Limits of error at stated system power factor	
Current expressed as a percentage of Rated Measuring Current	Power Factor	Limits of Error
120% to 10% inclusive Below 10% to 5% Below 5% to 1% 120% to 10% inclusive	1 1 1 0.5 lag and 0.8 lead	± 1.0% ± 1.5% ± 2.5% ± 2.0%

Metering Type 3 (Metering of circuits not exceeding 10MVA)

Condition	Limits of error at stated system power factor	
Current expressed as a percentage of Rated Measuring Current	Power Factor	Limits of Error
120% to 10% inclusive Below 10% to 5% 120% to 10% inclusive	1 1 0.5 lag and 0.8 lead	± 1.5% ± 2.0% ± 2.5%

3. METERING EQUIPMENT CRITERIA

3.1 General

3.1.1 Although these TSRs identify separate items of equipment, nothing in them prevents such items being combined to perform the same function, provided the requirements of these TSRs, the MOF and the Contract for Difference are met.

3.1.2 The voltage supply to any Meter, display and Outstation must be connected such that it is normally energised to facilitate reading of the Meter Register(s) and local and remote interrogation of the Outstation.

3.1.3 Facility Metering Equipment (other than outdoor Measurement Transformers) must be accommodated in a clean and dry environment.

3.2 Measurement Transformers

3.2.1 The terms "current transformer" and "voltage transformer" used in paragraphs 3.3 and 3.4 below do not preclude the use of other measuring techniques with a performance equal to that specified for such Measurement Transformers.

3.2.2 For each circuit, current transformers ("**CT**") and voltage transformers ("**VT**") must meet the requirements set out in paragraphs 3.3 and 3.4 below.

3.2.3 Where a combined unit measurement transformer (i.e., VT and CT) is used, the Tests for Accuracy described in clause 8 of IEC Standard 44-3 in relation to mutual influence effects must also be met.

3.2.4 All Measurement Transformers must be of a wound construction.

3.3 Current transformers

3.3.1 All CTs for Type 1, 2 and 3 Meters must meet the following criteria:

Type of Meter	Relevant Standard	Minimum Class Accuracy	No. of sets	Usage
1	IEC 6189-2	0.2s	2	1 set of CTs dedicated to the Main Meter only and 1 set supplying the Check Meters. Check Meter CTs can be used for other purposes provided that such Check Meter CTs comply with the accuracy requirements in paragraph 2.2 of these TSRs.
2	IEC 6189-2	0.2s	1	CTs must be dedicated to the CfD Settlement Activities, supplying both Main Meters and Check Meters. An

Type of Meter	Relevant Standard	Minimum Class Accuracy	No. of sets	Usage
				additional set of CTs may be fitted for the Check Meter which may also be used for other purposes provided that such Check Meters comply with the accuracy requirements in paragraph 2.2 of these TSRs.
3	IEC 185	0.5	1	1 set of CTs for Main Meters and Check Meters' CfD Settlement Activities purposes, but may also have other uses if the overall accuracy requirements in paragraph 2.2 of these TSRs are met.

3.4 Voltage transformers

3.4.1 The primary winding of VTs must be connected to the circuits being measured.

3.4.2 The secondary windings of VTs for Type 1, 2 and 3 Meters must meet the following criteria:

Type of Meter	Relevant Standard	Minimum Class Accuracy	No. of sets	Usage
1	IEC 61869-3	0.2	2 VTs (or 1 VT with two (2) or more secondary windings)	1 VT secondary winding dedicated to the Main Meter for CfD Settlement Activities purposes only. Check Meter VTs can be used for other purposes provided that such Check VT Meters comply with the accuracy requirements in paragraph 2.2 of these TSRs.
2	IEC 61869-3	0.5	1	VT supplying Main Meters and Check Meters for the CfD Settlement Activities only. VT secondary winding must be dedicated to the CfD Settlement Activities, supplying both Main Meters and Check Meters. An additional VT or secondary winding may be used for the Check Meter which may also be used for other purposes provided that such Check Meter complies with the accuracy requirements in paragraph 2.2 of these TSRs.
3	IEC 61869-3	1	1	CfD Settlement Activities purposes, but may also have other uses if overall accuracy requirements in paragraph 2.2 of these TSRs are met

3.5 Fusing and testing facilities

3.5.1 Separate fusing must be provided locally for:

(a) the Main Meter;

(b) the Check Meter; and

(c) any other Facility Metering Equipment burden.

3.5.2 Local fusing must discriminate with the source fusing.

3.5.3 A typical arrangement is illustrated in Appendix 1 of these TSRs.

3.5.4 Where CTs are used on low voltage installations, the voltage supply to the Facility Metering Equipment identified in paragraph 3.5.1 above must be fused as close as practicable to the point of that supply with a set of isolating links, suitably identified, provided locally to that Metering Equipment. If that point of supply is close to the Facility Metering Equipment identified in paragraph 3.5.1, then the isolating links may be omitted.

3.6 Meters

3.6.1 All Meters must be static.

3.6.2 Each Main Meter and Check Meter may be used for a period not exceeding ten (10) years from the later of the date of manufacture and the date of any calibration test carried out in accordance with paragraph 4.1 below.

3.6.3 All Meters must include Outstation functionality.

3.6.4 Meters must be configured so that the number of measuring elements is equal to or one less than the number of primary system conductors. These include the neutral conductor, and/or the earth conductor where system configurations enable the flow of zero sequence energy.

3.6.5 All Meters supplied via Measurement Transformers must be set to the actual primary and secondary ratings of the Measurement Transformers and the ratios must be displayed and downloaded during the interrogation process.

3.6.6 All Meters must include a non-volatile Meter Register of cumulative electricity for each measurement required under paragraph 2.1.1 of these TSRs, other than the Imported Input Electricity where the Facility is a Dual Scheme Facility. The Meter Register(s) must not roll-over more than once within a six (6) month period.

3.6.7 All Meters must comply with the following accuracy standards:

Type of Meter	Minimum Class Accuracy	Relevant Standard
1	0.2s	BS EN 62053-22
2	0.5s	BS EN 62053-22
3	1	BS EN 62053-21

3.7 Displays and facilities for Generator or supplier information

The Main Meter and the Check Meter must display the following primary information (not necessarily simultaneously):

(a) the electricity measurements described in paragraph 2.1.1 of these TSRs;

(b) current time (in accordance with paragraph 3.10.1 of these TSRs) and date; and

(c) the CT and/or VT ratios to which the Meter has been programmed (where appropriate).

3.8 Outstation

3.8.1 The Facility Metering Equipment must include an Outstation System in respect of each Meter to transfer and receive metering data to and from the Instation.

3.8.2 The Outstation must be configured so as to ensure that the metering data is capable of being used by the CfD Counterparty to calculate Metered Output.

3.8.3 A unique Outstation ID must be provided for the purpose of transferring stored metering data from the Outstation to the Instation.

3.8.4 Metering data must be collected by the Instation by way of interrogation of the Outstation at least once during each Billing Period.

3.8.5 Where a separate modem associated with the Outstation System is used, either (i) the modem must be provided with a separately fused supply from a secure supply or a measurement VT; or (ii) a line or battery powered modem must be used.

3.9 Metering data storage

3.9.1 For the purposes of this paragraph 3.9, "**Settlement Unit**" shall mean each half hour period in a day divided into half hour-long periods starting at 00:00 on such day.

3.9.2 Metering data storage facilities must be provided for the metering data. Metering data storage facilities must meet the following requirements:

(a) it must be possible to identify the Settlement Unit for each reading of Metered Volume;

(b) the storage capacity must be:

(i) 48 Settlement Units, starting at 00:00 on each day and running consecutively;

(ii) for a minimum of twenty (20) Billing Periods;

(c) the stored values of metering data must be integer multiples of kWh;

(d) the resolution of the electricity transferred into the demand registers must be within ±0.1% (at full load) of the amount of input and output electricity measured by the associated Meter;

(e) the value of any electricity measured in a Settlement Unit but not stored in that Settlement Unit must be carried forward to the next Settlement Unit;

(f) in the event of an Outstation supply failure, the Outstation must: (i) protect all metering data stored up to the time of the failure; and (ii) maintain the time accuracy in accordance with paragraph 3.10 below;

(g) where, in relation to a Settlement Unit: (i) partial values for Metered Volume are recorded; (ii) zero values for Metered Volume associated with an Outstation supply failure are recorded; or (iii) an Outstation supply failure and/or restoration occurs, the metering data must be marked so that the Instation can identify the relevant Settlement Units and Metered Volumes;

(h) the clock, calendar and all metering data must be supported for a period of twenty (20) days without an external supply connected to cater for continuous supply failures;

(i) any "read" operation must not delete or otherwise alter any stored metering data; and

(j) upon demand by the Instation, the Outstation must provide all of the metering data stored from the start of any specified Billing Period.

3.10 Time keeping

3.10.1 The Outstation time must be set to Co-ordinated Universal Time Clock (UTC). The Outstation time shall not switch to or from British Summer Time (BST).

3.10.2 Time synchronisation of the Outstation may be performed: (i) remotely by the Generator as part of the normal interrogation process; or (ii) locally by an Interrogation Unit ("**IU**").

3.10.3 When time synchronisation occurs, the relevant Settlement Unit must be marked with an alarm indication as described in paragraph 3.11 below.

3.10.4 The overall limits of error for timekeeping, allowing for a failure to communicate with the Outstation for up to twenty (20) days, shall be as follows:

(a) each Settlement Unit must end within ± 20 seconds of UTC; and

(b) the duration of each Settlement Unit must be within ± 1.8 seconds of thirty (30) minutes according to UTC, except where time synchronisation has occurred in a Settlement Unit.

3.11 Monitoring facilities

3.11.1 Monitoring facilities must be provided to record each occurrence of the following:

(a) phase failure of any one or a combination of phases;

(b) (where a supply is fitted) Facility Metering Equipment resets caused other than by a supply failure;

(c) (where a battery is fitted) battery monitoring;

(d) interrogation port access which changes time and/or date;

(e) where different from (d), Settlement Unit(s) which have been truncated or extended by a time synchronisation;

(f) interrogation port access which changes data other than time and/or date;

(g) reverse running (where applicable); and

(h) any other detected error in Facility Metering Equipment functionality.

3.11.2 When an event described in paragraph 3.11.1 above occurs, it must be reported as a separate alarm indication tagged to the relevant Settlement Unit locally by way of an IU or by way of automatic online communication.

3.11.3 Any alarm indications must not be cancelled or deleted by the interrogation process and are to be retained with the metering data until overwritten. The alarm must reset automatically when the relevant occurrence has been cleared.

3.12 Communications

3.12.1 Outstations must provide both local and remote interrogation facilities, from separate ports.

3.12.2 To prevent unauthorised access to the metering data in the Facility Metering Equipment, a security scheme must be incorporated for both local and remote access.

3.12.3 A security scheme must include the following separate security levels:

(a) Level 1: Password for read only of the following metering data, which must be transferable on demand as part of the interrogation process:

(i) Outstation ID;

(ii) input electricity and output electricity for Main Meters and Check Meters;

(iii) cumulative Metered Volumes as described in paragraph 2.1 of these TSRs for Main Meters and Check Meters;

(iv) maximum demand ("**MD**") for kW per programmable charging period i.e., monthly, statistical review period;

(v) multi-rate cumulative electricity as specified by the Generator;

(vi) the Measurement Transformer ratios;

(vii) the Measurement Transformer error correction factor where this is a constant factor applied to the entire dynamic range of the Meter;

(viii) alarm indications; and

(ix) Outstation time and date;

(b) Level 2: Password for:

(i) corrections to the time and/or date; and

(ii) resetting of the MD;

(c) Level 3: Password for programming of:

(i) the displays and facilities as described in paragraph 3.7 of these TSRs;

(ii) the Measurement Transformer ratios;

(iii) the Measurement Transformer error correction where this is a constant factor applied to the entire dynamic range of the Meter; and

(iv) the Passwords for levels 1, 2 and 3.

In addition, it must be possible to read additional information within the Facility Metering Equipment to enable the programmed information to be confirmed.

(d) Level 4: Password or removal of Facility Metering Equipment cover(s) necessitating the breaking of a seal for:

(i) calibration of the Facility Metering Equipment;

(ii) setting the Measurement Transformer ratios;

(iii) programming the Measurement Transformer error correction factor where this is other than a single factor; and

(iv) programming the level 3 Password and the level 4 Password, if appropriate.

3.12.4 Other than in relation to the level 4 Password, each Password must also allow the functions associated with the previous levels to be carried out, i.e.,:

(a) the level 3 Password must allow the level 2 functions to be carried out; and

(b) the level 2 Password must allow the level 1 functions to be carried out.

3.12.5 The Generator must ensure that the communications protocol used in relation to the Facility Metering Equipment requires that access to the metering data within the Facility Metering Equipment is determined by the level of the Password.

3.12.6 A counter logging the number of unauthorised attempts (i.e., Password comparison failures) to access Facility Metering Equipment via the local and remote ports must be incorporated as part of the log-on process. This counter must reset to zero at every hour change (i.e., 01:00, 02:00, etc.). If the counter reaches seven (7), access must be prohibited at all levels until the counter resets at the next hour change.

3.13 Appropriate seals

The Generator must ensure that the Facility Metering Equipment is appropriately sealed so as to provide assurance that:

(a) all standards applicable to the Generator under Electricity Safety, Quality and Continuity Regulations 2002 are being complied with; and

(b) anti-tamper protection is established and maintained in accordance with the Reasonable and Prudent Standard.

3.14 Local interrogation

An interrogation port must be provided for each Outstation.

3.15 Remote interrogation

3.15.1 Remote interrogation facilities must be provided. Such facilities must be capable of checking for errors in the communications between the Outstation System and the Instation.

3.15.2 It must not be possible to disconnect the remote communications connection to or from the Outstation without the breaking of an appropriate seal (as described in paragraph 3.13 of these TSRs).

3.16 Interrogation Unit

3.16.1 An IU, such as a Hand-held Unit ("**HHU**") may be used for programming, commissioning, maintenance, fault finding and the retrieval of stored metering data. The metering data retrieved by the IU should be compatible with the Instation.

3.16.2 The IU must have a built-in security system, such as a password, so that the IU becomes inoperative and non-interrogable if it is lost, stolen or otherwise compromised. Any such password may be applied when the device is turned on or when the IU software application is opened.

3.17 Additional features

Additional features may be incorporated within or associated with the Facility Metering Equipment provided these must not prevent, hamper or otherwise interfere with the CfD Settlement Activities.

4. CALIBRATION

4.1 Meter calibration

4.1.1 Calibration must be carried out to the relevant product standard with tests at the load points specified in Table 1 of these TSRs, in accordance with the accuracy requirements set out in Table 2 and Table 3 of these TSRs.

4.1.2 The relevant product standards are BS EN 62053-22 (Active static Meters of Classes 0.2S and 0.5S), 62053-11 (Active electromechanical Meters of Classes 0.5, 1 and 2), 62053-21 (Active static Meters of Classes 1 and 2), or 62053-23 (Reactive static Meters of Classes 2 and 3)).

4.1.3 Calibration Certificates must include a measurement uncertainty evaluation which shall be determined to a confidence level of 95 per cent. or greater in accordance with the UKAS Directive M3003. Measurement uncertainties for Meters must be within the limits set out in Table 4 of these TSRs.

4.1.4 No compensation shall be applied to any Meter pursuant to these TSRs or the MOF.

4.1.5 Calibration will be conducted using the Meter's metrological test output. However, for at least one load point, it shall also be confirmed that the physical display and the pulse output, where used for purposes of the CfD Settlement Activities, are registering to the necessary standards of accuracy (i.e., all outputs fitted give the same measurement result).

4.2 Measurement Transformer calibration

4.2.1 Calibration of Measurement Transformers must demonstrate compliance with the IEC 61869-2 and/or (as appropriate) IEC 61869-3 accuracy and measurement range requirements, as appropriate for the Measurement Transformer's class index.

4.2.2 Calibration Certificates must include a measurement uncertainty evaluation which shall be determined to a confidence level of 95 per cent. or greater in accordance with the UKAS Directive M3003. In the case of Measurement Transformers for Type 1 and 2 metering the accuracy test result errors including measurement uncertainty shall not exceed 1.5 times the permitted errors in the relevant specifications involved.

4.3 Test points

4.3.1 Meter Calibrations should be performed at the test points (values of currents) outlined in Table 1 below. The measured errors at these test points should not exceed the percentage error limits stated in Table 2 below.

4.3.2 Where a test point is outside the range of the value of current outlined in Table 1 below, the percentage error limit shall be that applicable to the value of current that is closest to the test point value.

4.3.3 It should be noted that "Ib" refers to the basic current of a whole-current Meter, "I_n" refers to the rated current of a transformer-operated Meter and "I_{max}" to the maximum current rating of a Meter.

Table 1: Testing Points for Type 1, 2 and 3 Meters

Test Point	Type of Meter		
Value of current (I)	Power Factor (Cos φ)		
	Unity	0.5 Inductive	0.8 Capacitive*
0.01 I_n	X		
0.02 I_n		X	X
0.05 I_n	X (3), Y		
0.1 I_n		X	X
1.0 I_n	X (2), Y (5)	X (4)	X
1.0 I_{max} or 1.2 I_n or 1.5 I_n or 2.0 I_n**	X (1)	X	X

Notes:

These tests shall be carried out for input electricity and output electricity directions for a given metering point. If the same measuring element is used for both input electricity and output electricity, one additional test point only (at "1.0 I_n", Unity Power Factor, balanced) is required in the reverse direction.

X = all elements combined.
Y = each element on its own.
X,Y = tests should be carried out both on all elements combined, and each element on its own.
* = tests at 0.5 capacitive Power Factor is acceptable.
** = determined by overload capacity of circuit. If unspecified, test at "1.0 I_{max}".

Numbers in brackets identify, for reference only, those tests specified in Statutory Instruments 1998 No. 1566 Schedule 1, Table 2 and Schedule 3, Table 2.

All 1.0 I_n test points are only applicable to Type 3 Meters.

0.05 I_n UPF Y (single phase) are only applicable to Type 1 and 2 Meters.

4.4 Accuracy Tables for Meters

Table 2: Summary of Class accuracy requirements for Type 1, 2 and 3 Meters (Polyphase meters with Balanced Loads [Types 1, 2 and 3] and Single-phase load but balanced polyphase voltages applied to voltage circuits [Type 3 only])

Value of current (I)	**Power factor (Cos φ)**	**Percentage error limits for Types of Meters**		
For transformer-operated Meters		**1** **0.2s**	**2** **0.5s**	**3** **1**
$0.01\ I_n \le I \le 0.05\ I_{max}$	1	± 0.4	± 1.0	N/A
$0.02\ I_n \le I \le 0.05\ I_{max}$	1	N/A	N/A	± 1.5
$0.05\ I_n \le I \le I_{max}$	1	± 0.2	± 0.5	± 1.0
$0.02\ I_n \le I \le 0.1\ I_n$	0.5 inductive 0.8 capacitive	± 0.5 ± 0.5	± 1.0 ± 1.0	N/A N/A
$0.05\ I_n \le I \le 0.1\ I_n$	0.5 inductive 0.8 capacitive	N/A N/A	N/A N/A	± 1.5 ± 1.5
$0.1\ I_n \le I \le I_{max}$	0.5 inductive 0.8 capacitive	± 0.3 ± 0.3	± 0.6 ± 0.6	± 1.0 ± 1.0

Table 3: Summary of Class accuracy requirements for Type 1, 2 and 3 Meters (Polyphase meters carrying a Single-phase load but balanced polyphase voltages applied to voltage circuits [Types 1 and 2 only])

Value of current (I)	**Power factor (Cos φ)**	**Percentage error limits for Types of Meters**	
For transformer-operated Meters		**1** **0.2s**	**2** **0.5s**
$0.05\ I_n \le I \le I_{max}$	1	± 0.3	± 0.6
$0.1\ I_n \le I \le I_{max}$	0.5 inductive	± 0.4	± 1.0

4.5 Measurement uncertainty

Table 4: Measurement uncertainty test for Type 1, 2 and 3 Meters

Maximum overall uncertainty of calibration equipment	Type of Meter under test		
	1	2	3
Measurements at unity power factor	± 0.06%[a]	± 0.1%[b]	± 0.4%
Measurements at other than unity power factor	± 0.12%	± 0.2%	± 0.6%

[a] = means ±0.1% for measurements at load points below 0.05 I_n.

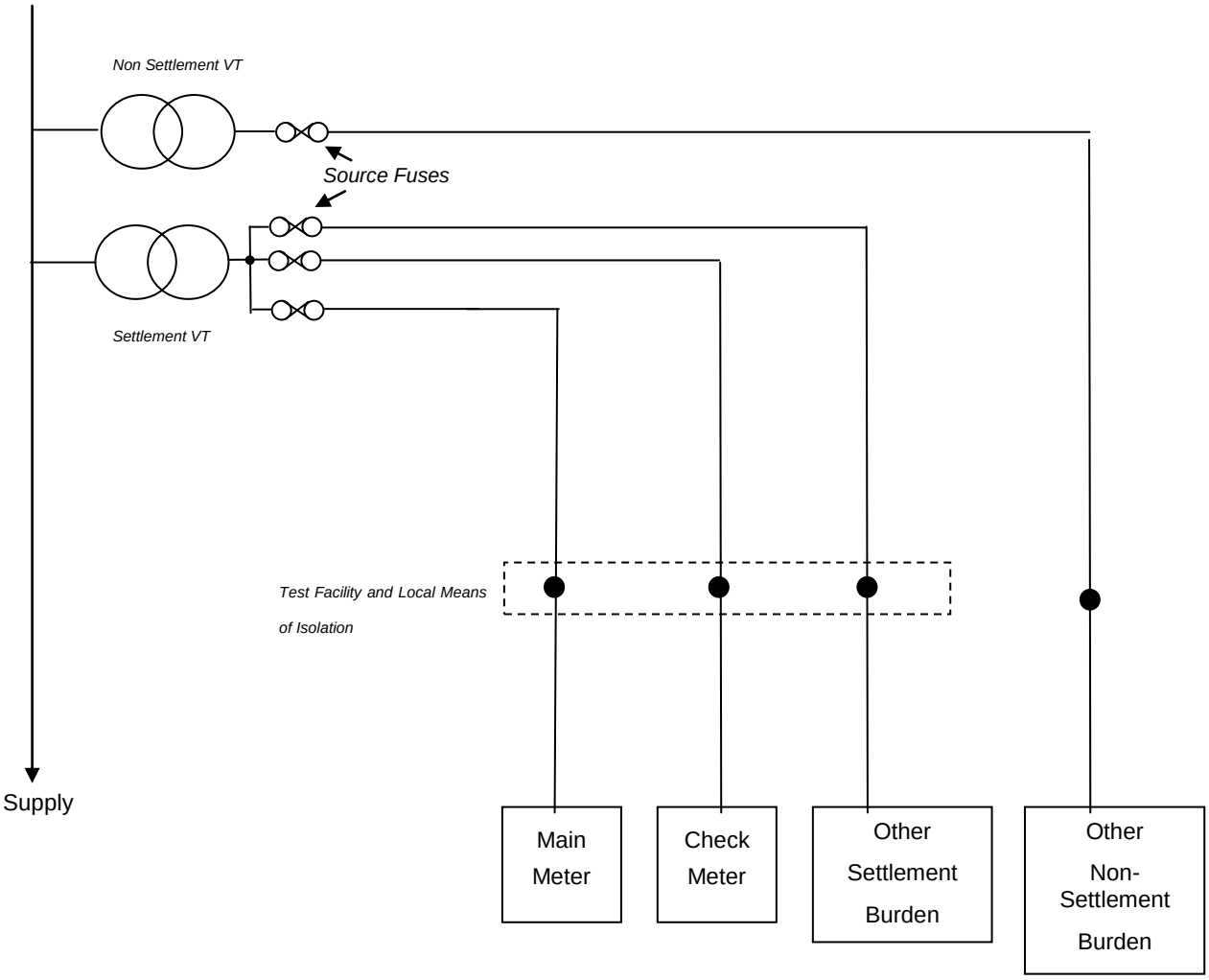
[b] = means ±0.1%b where b is ±0.2% for measurement at load points below 0.05 I_n

The overall uncertainty level shall be calculated to a 95 per cent. confidence level in accordance with UKAS M3003.

Appendix 1
Fusing

The following diagram shows a typical arrangement for the fusing requirements. The diagram is non-exhaustive and is provided for reference only.

Figure 1: Fusing arrangements for cable runs of more than 30 metres distance between source fusing and local means of isolation[1] [2].



[1] Local isolation may be provided by the use of solid links or fuses and may be placed on either side of the test terminal block. Where fuses are to be used, the additional burden shall be accounted for.

[2] Check Meters and other burden may be supplied via an additional secondary winding of the VT.

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