Smart Metering Implementation Programme

Smart Metering Equipment Technical Specifications 2 (SMETS2)

Version 3.1*

8th November 2018

* Note that whilst this document is entitled SMETS2, each version of SMETS is uniquely identifiable by reference only to the version number of the document.

Table of Contents

Note: Sections 1 and 2 of this document are not used.

3 Introduction[1]

The requirement to install and maintain metering equipment in Great Britain which complies with these Smart Metering Equipment Technical Specifications 2 (SMETS2) arises from standard licence conditions 39, 40 and 50.10 of electricity supply licences and standard conditions 33, 34 and 44.10 of gas supply licences.

Whilst this document is entitled 'Smart Metering Equipment Technical Specifications 2 (SMETS2)', each Version of SMETS is uniquely identifiable by reference solely to its version number. In the title of this document, the '2' in SMETS2 does not form part of the version number and is used only to describe the family of SMETS documents to which this document belongs. Any functionality within Data and Communications Company systems which requires the identification of a particular version of SMETS with which a Device complies, will operate by reference solely to the version number.

Section 4 of this document describes the minimum physical, functional, interface, data, testing and certification requirements of Gas Smart Metering Equipment that a gas Supplier is required to install and maintain to comply with standard condition 33 (or 44.10) of its gas supply licence.

Section 5 of this document describes the minimum physical, functional, interface and data, testing and certification requirements of Electricity Smart Metering Equipment that an electricity Supplier is required to install and maintain to comply with standard condition 39 (or 50.10) of its electricity supply licence.

Section 6 of this document constitutes the In-Home Display (IHD) Technical Specifications, which describe the minimum physical, functional, interface, data, testing and certification requirements of an IHD maintained to comply with standard condition 34 of the gas supply licence or standard condition 40 of the electricity supply licence.

Section 7 of this document constitutes the Prepayment Interface Device Technical Specifications (PPMID), which describe the minimum physical, functional, interface, data, testing and certification requirements of a PPMID maintained to comply with standard condition 46 of the gas supply licence or standard condition 52 of the electricity supply licence.

Section 8 of this document constitutes the HAN Connected Auxiliary Load Control Switch (HCALCS) Technical Specifications, which describe the minimum physical, functional, interface, testing and certification requirements of an HCALCS maintained to comply with standard condition 52 of the electricity supply licence.

SMETS was notified to the European Commission in accordance with the requirements of the Technical Standards and Regulations Directive[2] laying down a procedure for the provision of information in the field of technical regulations and rules on Information Society services.

This document should be read in conjunction with any other relevant supply licence conditions and with regard to the wider statutory and regulatory framework applying to devices installed for the purpose of energy supply to Premises, for example; the Measuring Instruments (Active Electrical Energy Meters) Regulations 2006 and the Measuring Instruments (Gas Meters) Regulations 2006[3].

[1] Sections 1 and 2 of this document are not used
[2] SMETS was notified (2017/0350/UK) under Article 8 of Directive 98/34/EC of the European Parliament and of the Council (OJ L 204, 21.7.1998, p. 37) as amended by Directive 98/48/EC of the European Parliament and of the Council (OJ L 217, 5.8.1998, p. 18). Directive 98/34/EC has now been replaced by Directive 2015/1535/EU of the European Parliament and of the Council (OJ L 241, 17.9.2015, p.1), which came into force on 7 October 2015
[3] These regulations transpose the Measuring Instruments Directive (2004/22/EC)

The Smart Metering technical and security architecture is based on a suite of agreed, open standards, reflecting the UK Government strategy to facilitate the development of third party innovative solutions for consumer devices.

Mutual recognition: Any requirement for any device to comply with any of the technical specifications contained or referred to in this document shall be satisfied by compliance with:

- a relevant standard or code of practice of a national standards body or equivalent body of any EEA State or Turkey; or
- any relevant international standard recognised for use in any EEA State or Turkey; or
- any relevant technical regulation with mandatory or de facto mandatory application for marketing or use in any EEA State or Turkey,

in so far as compliance with the standard, code of practice or technical regulation in question enables the equipment to achieve, in an equivalent manner, all of the physical, functional, interface and data capabilities that are achieved by compliance with the requirements of any of the technical specifications contained or referred to in this document.

4 Gas Smart Metering Equipment Technical Specifications

4.1 Overview

Section 4 of this document describes the minimum physical, minimum functional, minimum interface, minimum data and minimum testing and certification requirements of Gas Smart Metering Equipment (GSME) that a gas Supplier is required to install and maintain to comply with standard condition 33 of its gas supply licence.

Any requirements to Lock, Enable, Disable or Arm Supply set out in this *Section 4*, only apply to Gas Smart Metering Equipment other then Large Gas Meters installed at Domestic Premises.

4.2 SMETS Testing and Certification Requirements

4.2.1 Conformance with the SMETS

GSME shall have been tested to ensure that it meets the requirements described in this *Section 4*, and evidence must be available to confirm such testing and conformance.

4.2.2 Conformance with the Great Britain Companion Specification

GSME shall meet the requirements described in the Great Britain Companion Specification.

GSME shall have been certified by the ZigBee Alliance as being compliant with those ZigBee SEP requirements that are identified as being required in the Great Britain Companion Specification and that were certifiable under the ZigBee SEP certification scheme on 31 August 2017.

4.2.3 Conformance with the Commercial Product Assurance Security Characteristics for GB Smart Metering

GSME shall meet the requirements described in the Commercial Product Assurance Security Characteristic Gas Smart Metering Equipment.

GSME shall be certified by NCSC as compliant with the Commercial Product Assurance Security Characteristic Gas Smart Metering Equipment.

4.3 Physical requirements

GSME shall as a minimum include the following components:

i. a Clock;
ii. a Data Store;
iii. a Gas Meter;
iv. a HAN Interface;
v. a Random Number Generator;
vi. a User Interface;
vii. where installed at Domestic Premises and is not a Large Gas Meter, a Valve; and
viii. where installed with a Communications Hub provided by the Data and Communications Company, a Communications Hub Physical Interface (this may comprise a Communications Hub Physical Interface forming part of ESME where present at the time of installation in the Premises).

The Communications Hub Physical Interface shall as a minimum include a physical interface that meets the requirements defined by the Data and Communications Company at the time of installation (available on the Data and Communications Company's website) and includes provision for a DC power supply to the Communications Hub.

GSME shall include a power source. GSME shall be capable of automatically resuming operation after loss of power in its operating state prior to such failure.

To the extent that it is mains powered, GSME shall be capable of performing the minimum functional, interface and data requirements set out in *Sections 4.4*, *4.5* and *4.6* respectively operating at a nominal voltage of 230VAC without consuming more than an average of 1 watt of electricity under normal operating conditions.

GSME shall:

ix. permanently display the *GSME Identifier(4.6.1.1)* on the GSME; and

x. have a Secure Perimeter.

The HAN Interface of GSME shall be capable of joining a ZigBee SEP Smart Metering Home Area Network which:

xi. operates within the 2400 – 2483.5 MHz harmonised frequency band or Sub GHz Bands; and

xii. supports the Communications Links described in S*ections 4.5.1* and *4.5.3*.

On joining a ZigBee SEP Smart Metering Home Area Network GSME shall be capable of generating and sending an Alert to that effect via its HAN Interface.

GSME shall be designed taking all reasonable steps so as to prevent Unauthorised Physical Access and Unauthorised communications through its Secure Perimeter that could compromise the Confidentiality and / or Data Integrity of:

xiii. Personal Data;

xiv. Consumption data used for billing;

xv. Security Credentials;

xvi. Random Number Generator;

xvii. Cryptographic Algorithms;

xviii. the Gas Meter; and

xix. Firmware and data essential for ensuring its integrity,

stored or executing on GSME.

GSME shall be capable of detecting any attempt at Unauthorised Physical Access through its Secure Perimeter that could compromise such Confidentiality and / or Data Integrity and on such detection shall be capable of:

xx. providing evidence of such an attempt through the use of tamper evident coatings or seals,

and where reasonably practicable:

xxi. generating an entry to that effect in the *Security Log(4.6.5.17)*;

xxii. generating and sending an Alert to that effect via its HAN Interface; and

xxiii. where the *Supply Tamper State(4.6.4.26)* is configured to require Locking, sending an Alert that the Supply is being disabled for this reason via its HAN Interface, and establishing a Locked state whereby the Supply is Disabled and can only be Armed in response to a Command to Arm the Supply (as described in *Section 4.5.3.7*).

When operating within Sub GHz Bands, the GSME shall:

xxiv. be capable of supporting Frequency Agility; and

xxv. not exceed a transmit power of 25 mW.

4.4 Functional requirements

This Section describes the minimum functions that GSME shall be capable of performing.

4.4.1 Clock

The Clock forming part of GSME shall be capable of operating so as to be accurate to within 10 seconds of the UTC date and time under normal operating conditions.

GSME shall be capable of comparing its date and time with the Communications Hub Date and Time, and making adjustments to its date and time. Where the difference between GSME date and time and the Communications Hub Date and Time is more than 10 seconds GSME shall be capable of:

i. not adjusting its date and time;
ii. generating an entry in the *Security Log(4.6.5.17)* to that effect; and
iii. generating and sending an Alert via its HAN interface.

Except when executing a *Set Clock(4.5.3.20)* Command, GSME shall not be capable of making adjustments to its date and time more than once within any 24 hour time period.

4.4.2 Communications

GSME, and any device forming part of it, shall be capable of ensuring that the security characteristics of all Communications Links it establishes meet the requirements described in *Section 4.4.10.5*.

GSME shall only be capable of establishing a Communications Link with a Gas Proxy Function, and a PPMID with Security Credentials in the *Device Log(4.6.4.11)* and with the exception of a Communications Hub Function shall not be capable of establishing a Communications Link via its HAN Interface with any other Devices.

When any Command addressed to GSME is received via any Communications Link GSME shall be capable of:

i. using the Security Credentials GSME holds, Authenticating to a Trusted Source the Command;
ii. verifying in accordance with *Section 4.4.10.2.3* that the sender of the Command is Authorised to execute the Command; and
iii. verifying the integrity of the Command.

On failure of any of *(i)* to *(iii)* above, GSME shall be capable of generating an entry in the *Security Log(4.6.5.17)* to that effect, discarding the Command without execution and without either generating or sending a Response, and generating and sending an Alert to that effect via its HAN Interface.

When executing an immediate Command, GSME shall be capable of generating and sending a Response via its HAN Interface, which shall either confirm successful execution of the Command or shall detail why it has failed to execute the Command.

Where the Command is not due to be executed immediately, GSME shall be capable of generating and sending a Response via its HAN Interface to confirm successful receipt. When executing a future dated Command GSME shall be capable of generating and sending an Alert via its HAN Interface which shall either confirm successful execution of the Command or shall detail why it has failed to execute the Command.

GSME shall only be capable of addressing a Response to the sender of the relevant Command.

GSME shall be capable of restricting the generation and sending of Alerts for each Alert described in this *Section 4* and for each event, which this *Section 4* requires the GSME to be capable of logging in the event log and which is not a Critical Event according to the *Alerts Configuration Settings(4.6.4.1)*.

For each event which this *Section 4* requires the GSME to be capable of logging in the event log and which is not a Critical Event, the GSME shall be capable of:

iv. sounding an Alarm; and
v. logging the event in the event log

according to the *Events Configuration Settings(4.6.4.34)*.

4.4.2.1 Communications Links with a PPMID via its HAN Interface

GSME shall be capable of establishing and maintaining Communications Links via its HAN Interface with a minimum of one PPMID.

GSME shall be capable of supporting the following types of Communications Links:

i. receiving the Commands (set out in *Section 7.5.4*) that may be sent from a PPMID every 30 minutes; and
ii. generating and sending the Responses (set out in *Section 4.5.3*) to a PPMID.

4.4.2.2 Communications Links with a Communications Hub Function via its HAN Interface

GSME shall be capable of establishing and maintaining Communications Links via its HAN Interface with one Communications Hub Function.

GSME shall be capable of receiving the Communications Hub Date and Time from the Communications Hub Function.

4.4.2.3 Communications with a Gas Proxy Function via its HAN Interface

GSME shall be capable of establishing and maintaining a Communications Link via its HAN Interface with a Gas Proxy Function.

GSME shall be capable of generating and sending the information (set out in *Section 4.5.1*) to a Gas Proxy Function.

4.4.3 Data storage

GSME shall be capable of retaining all information held in its Data Store at all times, including on loss of power.

4.4.4 Privacy PIN Protection

GSME shall be capable of preventing the display on the User Interface of items annotated [PIN] in *Section 4.4.5,* and preventing access on the User Interface to the Commands annotated [PIN] in *Section 4.5.2*, except on successful execution of an *Allow Access to User Interface* Command *(4.5.2.3)* via the User Interface.

4.4.5 Display of information

GSME shall be capable of displaying the following up to date information on its User Interface:

i. the *Payment Mode(4.6.4.21)* currently in operation, being Prepayment Mode or Credit Mode [PIN];
ii. the *Tariff TOU Register Matrix(4.6.5.20)* with appropriate precision and the *Tariff Block Counter Matrix(4.6.5.19)* with appropriate precision*;*
iii. the *Consumption Register(4.6.5.4)* with appropriate precision*;*

iv. the *Meter Balance(4.6.5.11)* [PIN];
v. the Debt to Clear (calculated as set out in *Section 4.4.7.2*) [PIN];
vi. the *Customer Identification Number(4.6.4.7)* [PIN];
vii. whether Emergency Credit is available for activation [PIN];
viii. whether GSME has suspended the Disablement of Supply during a period defined in the *Non-Disablement Calendar(4.6.4.20)* (as set out in *Section 4.4.7.2*) [PIN];
ix. the *Emergency Credit Balance(4.6.5.8)* where Emergency Credit is activated [PIN];
x. any low credit condition [PIN];
xi. where GSME includes a Battery, any low battery condition;
xii. the *Supply State(4.6.5.18)*;
xiii. any time-based debts and Time-based Debt Recovery rates [PIN];
xiv. any payment-based debt [PIN];
xv. any accumulated debt recorded in the *Accumulated Debt Register(4.6.5.1)* [PIN];
xvi. the *Meter Point Reference Number (MPRN)(4.6.4.19)* [PIN];
xvii. the Local Time;
xviii. any *Standing Charge(4.6.4.23)* [PIN];
xix. the *Contact Details(4.6.4.4)*;
xx. the *Active Tariff Price(4.6.5.2)* [PIN]; and
xxi. the *Event Log(4.6.5.9)* (with the exception of any Personal Data).

GSME shall be capable of displaying the *Security Log(4.6.5.17)* on its User Interface following physical access through the Secure Perimeter of GSME.

GSME shall be capable of displaying Currency Units in GB Pounds and European Central Bank Euro.

4.4.5.1 Presentation of information on the User Interface

For each of the values currently stored in the *Consumption Register(4.6.5.4)*, the *Tariff Block Counter Matrix(4.6.5.19)* and the *Tariff ToU Register Matrix(4.6.5.20)*, GSME shall be capable of displaying a value calculated from the stored value by:

i. converting the stored value in to a decimal, integer number of thousandths of metres cubed, rounding the stored value down to the nearest thousandth of a metre cubed;
ii. discarding all except the eight least significant decimal digits so produced;
iii. adding leading zeros (if necessary) so that there are exactly eight decimal digits; and
iv. placing the decimal point separator between the fourth and third least significant digits.

4.4.6 Monitoring

4.4.6.1 Battery capacity

Where GSME includes a Battery, it shall be capable of estimating the remaining Battery capacity in days (to facilitate replacement of the Battery before it is fully depleted) and storing the estimate in *Remaining Battery Capacity(4.6.5.16)*.

If the *Remaining Battery Capacity(4.6.5.16)* falls below ten percent of the nominal Battery capacity GSME shall be capable of:

i. generating an entry to that effect in the *Event Log(4.6.5.9)*; and
ii. generating and sending an Alert to that effect via its HAN Interface.

4.4.6.2 GSME power supply

Prior to or at the loss of power, GSME shall be capable of:

i. in circumstances where the *Supply Depletion State(4.6.4.25)* is configured to require Locking, establishing a Locked state whereby the Supply is Disabled and can only be Armed in response to a Command to Arm the Supply *(*as described in *Section 4.5.3.7)*; and

ii. generating and sending an Alert to that effect via its HAN Interface.

4.4.6.3 GSME Operational Integrity

GSME shall be capable of taking all reasonable steps to detect conditions affecting its Smart Meter Operational Integrity and on such detection shall be capable of generating an entry to that effect in the *Event Log(4.6.5.9)* and generating and sending an Alert to that effect via its HAN Interface where reasonably practicable, including in the Alert information relating to the nature of the condition detected.

4.4.7 Payment Mode

GSME shall be capable of operating in Credit Mode and Prepayment Mode and of being remotely switched from one mode to the other.

4.4.7.1 Credit Mode

GSME, when operating in Credit Mode, shall be capable of maintaining a calculation of the *Meter Balance(4.6.5.11)* based on:

i. the Consumption in the *Tariff TOU Register Matrix(4.6.5.20)* converted by *Calorific Value(4.6.4.3)* and *Conversion Factor(4.6.4.5)* and the Prices in the *Tariff TOU Price Matrix(4.6.4.32)* and, if operating Time-of-use with Block Pricing, the Consumption in the *Tariff Block Counter Matrix(4.6.5.19)* converted by *Calorific Value(4.6.4.3)* and *Conversion Factor(4.6.4.5)* and the Prices in the *Tariff Block Price Matrix(4.6.4.29)*; and

ii. the *Standing Charge(4.6.4.23)*.

4.4.7.2 Prepayment Mode

GSME shall be capable of operating in Prepayment Mode, including during periods of loss of its Communications Link via its HAN Interface, and maintaining a balance of credit and reflecting any reduction in credit based on Consumption, standing charge and Time-based Debt Recovery.

GSME shall be capable of adding credit to the *Meter Balance(4.6.5.11)* (as set out in *Sections 4.5.2.2* and *4.5.3.3*) and reducing the amount of credit in the *Meter Balance(4.6.5.11)*.

GSME shall be capable of making Emergency Credit available to the Consumer (by means of the *Emergency Credit Balance(4.6.5.8)*) if the *Meter Balance(4.6.5.11)* is below the *Emergency Credit Threshold(4.6.4.14)*. GSME shall be capable of displaying the availability of Emergency Credit on its User Interface and of generating and sending an Alert indicating the availability of Emergency Credit via its HAN Interface. The amount of Emergency Credit made available to the Consumer shall be equal to the *Emergency Credit Limit(4.6.4.13)*. GSME shall be capable of reducing the amount of credit in the *Emergency Credit Balance(4.6.5.8)* where Emergency Credit is activated by the Consumer *(*as set out in *Sections 4.5.2.1* and *4.5.3.1)* and the *Meter Balance(4.6.5.11)* is exhausted. Any Emergency Credit used shall be repaid when credit is added to GSME (as set out in *Sections 4.5.2.2* and *4.5.3.3*).

GSME shall be capable of reducing the *Meter Balance(4.6.5.11)* until it reaches the *Disablement Threshold(4.6.4.12)* followed by reducing the *Emergency Credit Balance(4.6.5.8)*, where activated, until exhausted, on the basis of:

i. the Consumption in the *Tariff TOU Register Matrix(4.6.5.20)* converted by *Calorific Value(4.6.4.3)* and *Conversion Factor(4.6.4.5)* and the Prices in the *Tariff TOU Price Matrix(4.6.4.32)* and, if operating Time-of-use with Block Pricing, the Consumption in the *Tariff Block Counter Matrix(4.6.5.19)* converted by *Calorific Value(4.6.4.3)* and *Conversion Factor(4.6.4.5)* and the Prices in the *Tariff Block Price Matrix(4.6.4.29)*;

ii. the *Standing Charge(4.6.4.23)*; and

iii. the recovery of debt hourly or daily through each of the *Time Debt Registers [1 … 2](4.6.5.21)* at rates defined by the *Debt Recovery Rates [1 … 2](4.6.4.9)*.

Where configured by *Suspend Debt Emergency(4.6.4.28)* to do so and when Emergency Credit is in use, GSME shall be capable of suspending the application of *(ii)* and *(iii)* to the *Emergency Credit Balance(4.6.5.8)*, and accumulating *(ii) and (iii)* in the *Accumulated Debt Register(4.6.5.1)*.

GSME shall be capable of recording debt recovered, or accumulated in the *Accumulated Debt Register(4.6.5.1),* in the *Billing Data Log(4.6.5.3)*.

GSME shall be capable of monitoring the *Meter Balance(4.6.5.11)* and where activated the *Emergency Credit Balance(4.6.5.8)* and:

iv. if the combined credit of the *Meter Balance(4.6.5.11)* and *Emergency Credit Balance(4.6.5.8)* falls below the *Low Credit Threshold(4.6.4.16)*, displaying an Alert to that effect on its User Interface and generating and sending an Alert to that effect via its HAN Interface;

v. if the combined credit of the *Meter Balance(4.6.5.11)* and *Emergency Credit Balance(4.6.5.8)* falls below the *Disablement Threshold(4.6.4.12)*:

   a) receiving and executing Add Credit(4.5.3.3) and Activate Emergency Credit(*4.5.3.1*) Commands from a PPMID and a Gas Proxy Function; and
   b) once any such Commands have been executed if the combined credit of the *Meter Balance*(*4.6.5.11*) and *Emergency Credit Balance*(*4.6.5.8*) remains below the *Disablement Threshold*(*4.6.4.12*), Disabling the Supply, displaying an Alert to that effect on its User Interface and generating and sending an Alert to that effect via its HAN Interface;

vi. where the Supply is Disabled (as set out in *(b)* above):

   c) where configured by *Suspend Debt Disabled*(*4.6.4.27*) not to suspend Time-based Debt Recovery, continuing to apply (*ii*) and (*iii*) above to reduce the *Meter Balance*(*4.6.5.11*);
   d) where configured by *Suspend Debt Disabled*(*4.6.4.27*) to suspend Time-based Debt Recovery, suspending the application of (*iii*) above to the *Meter Balance*(*4.6.5.11*) and continuing to apply (*ii*) above to reduce the *Meter Balance*(*4.6.5.11*); and

vii. if the Supply is Enabled, suspending the Disablement of Supply (as set out in *(b)* above) during periods defined in the *Non-Disablement Calendar(4.6.4.20)*, continuing to reduce the *Meter Balance(4.6.5.11)* on the basis of *(i)*, *(ii)* and *(iii)* above, displaying on its User Interface an indication that the combined *Meter Balance(4.6.5.11)* and *Emergency Credit Balance(4.6.5.8)* is below the *Disablement Threshold(4.6.4.12)* and that Disablement of Supply due to insufficient credit has been suspended, and generating and sending an Alert that Disablement of Supply due to insufficient credit has been suspended via its HAN Interface.

If the *Meter Balance(4.6.5.11)* is equal to or below the *Disablement Threshold(4.6.4.12)* GSME shall be capable of maintaining a calculation of the Debt to Clear based on:

viii. the difference between the *Meter Balance(4.6.5.11)* and the *Disablement Threshold(4.6.4.12)*;
ix. amount of debt accumulated in the *Accumulated Debt Register(4.6.5.1)*;
x. amount of Emergency Credit activated and used by the Consumer; and
xi. the payment-based debt to be collected based on *(viii)*, *(ix)* and *(x)* (as defined by *Debt Recovery per Payment(4.6.4.8)* taking account of the amount remaining in the *Payment Debt Register(4.6.5.13)*, the payment-based debt payments in the *Billing Data Log(4.6.5.3)* and the *Debt Recovery Rate Cap(4.6.4.10)*).

For Time-based Debt Recovery, the GSME shall be capable of recovering the lesser of:

xii. the amount in the relevant *Time Debt Registers [1 … 2](4.6.5.21)*; and
xiii. the corresponding amount determined by the *Debt Recovery Rates [1 … 2] (4.6.4.9)*.

For Payment-based Debt Recovery, the GSME shall be capable of recovering the lesser of:

xiv. the amount defined by *Debt Recovery per Payment(4.6.4.8)* subject to the *Debt Recovery Rate Cap(4.6.4.10)*; and
xv. the amount in the *Payment Debt Register(4.6.5.13).*

Where an Adjust Debt Command is to reduce the amount in a Debt Register and the amount in the Command is greater than the amount in the Debt Register, GSME shall be capable of setting the amount in the Debt Register to zero then applying the difference in the amounts in the following order:

xvi. recovering debt accumulated in the *Accumulated Debt Register(4.6.5.1)*;
xvii. repaying Emergency Credit activated and used by the Consumer; and
xviii. increasing the *Meter Balance(4.6.5.11)*.

GSME shall be capable of monitoring the *Meter Balance(4.6.5.11)* and, where the Supply is Disabled, GSME shall be capable of Arming the Supply if the *Meter Balance(4.6.5.11)* rises above the *Disablement Threshold(4.6.4.12)*, displaying any such change in the *Supply State(4.6.5.18)* on its User Interface and generating and sending an Alert that the Supply has been Armed via its HAN Interface.

4.4.8 Pricing

GSME shall be capable of applying Time-of-use Pricing and Time-of-use with Block Pricing.

GSME shall be capable of maintaining the *Active Tariff Price(4.6.5.2)*.

4.4.8.1 Time-of-use Pricing

GSME shall be capable of recording Consumption according to Time-of-use Bands in one of four Tariff Registers in the *Tariff TOU Register Matrix(4.6.5.20).*

GSME shall be capable of switching between different Tariff Registers once per Day. The switching between Time-of-use Bands and thus Tariff Registers shall be based on the switching rules defined in the *Tariff Switching Table(4.6.4.30)*.

4.4.8.2 Time-of-use with Block Pricing

GSME shall be capable of recording Consumption according to Time-of-use Bands in one of four Tariff Registers in the *Tariff TOU Register Matrix(4.6.5.20).*

GSME shall also be capable of accumulating Consumption in one of four Block Counters in the *Tariff Block Counter Matrix(4.6.5.19)* for the first Time-of-use Band. GSME shall be capable of switching between Block Counters according to the Consumption thresholds in the *Tariff Threshold Matrix(4.6.4.31)*.

GSME shall be capable of switching between different Tariff Registers once per Day. The switching between Time-of-use Bands and thus Tariff Registers shall be based on the switching rules set out in the *Tariff Switching Table(4.6.4.30)*.

4.4.9 Recording

4.4.9.1 Billing data

In accordance with the timetable set out in the *Billing Calendar(4.6.4.2)* GSME shall be capable of taking a UTC date and time stamped copy of:

i. the *Tariff TOU Register Matrix(4.6.5.20)*;
ii. the *Tariff Block Counter Matrix(4.6.5.19)*; and
iii. the *Consumption Register(4.6.5.4)*,

and where in Prepayment mode:

iv. the *Meter Balance(4.6.5.11)*;
v. the *Emergency Credit Balance(4.6.5.8)*;
vi. the *Payment Debt Register(4.6.5.13)*;
vii. the *Time Debt Registers [1 … 2](4.6.5.21)*; and
viii. the *Accumulated Debt Register(4.6.5.1)*,

in the *Billing Data Log(4.6.5.3)*, then immediately resetting the Block Counters in the *Tariff Block Counter Matrix(4.6.5.19)* and if operating in Credit Mode immediately resetting the *Meter Balance(4.6.5.11)*.

4.4.9.2 Consumption data

GSME shall be capable of recording cumulative Consumption in the *Consumption Register(4.6.5.4)*.

GSME shall be capable of recording to the *Cumulative and Historical Value Store(4.6.5.5)* in kWh:

i. Energy Consumption on each of the eight Days prior to the current Day;
ii. Energy Consumption in the Week in which the calculation is performed;
iii. Energy Consumption in each of the five Weeks prior to such Week;
iv. Energy Consumption in the month in which the calculation is performed; and
v. Energy Consumption in the thirteen months prior to such month.

GSME shall be capable of recording to the *Cumulative Current Day Value Store(4.6.5.6)* in kWh the Energy Consumption on the Day up to the Local Time.

4.4.9.3 Cost of Consumption data

GSME shall be capable of calculating and recording in the *Cumulative and Historical Value Store(4.6.5.5)* the cost of:

i. Consumption on each of the eight Days prior to the current Day;
ii. Consumption in the Week in which the calculation is performed;
iii. Consumption in each of the five Weeks prior to such Week;
iv. Consumption in the month in which the calculation is performed; and
v. Consumption in the thirteen months prior to such month.

GSME shall be capable of recording to the *Cumulative Current Day Value Store(4.6.5.6)* the cost of Consumption on the Day up to the Local Time.

GSME shall be capable of calculating cost of Consumption as above on the basis of:

vi. the Consumption in the *Tariff TOU Register Matrix(4.6.5.20)* converted by *Calorific Value(4.6.4.3)* and *Conversion Factor(4.6.4.5)* and the Prices in the *Tariff TOU Price*

Matrix(4.6.4.32) and, if operating Time-of-use with Block Pricing, the Consumption in the *Tariff Block Counter Matrix(4.6.5.19)* converted by *Calorific Value(4.6.4.3)* and *Conversion Factor(4.6.4.5)* and the Prices in the *Tariff Block Price Matrix(4.6.4.29)*; and

vii. the *Standing Charge(4.6.4.23)*.

4.4.9.4 Daily read data

GSME shall be capable of taking a copy of and storing the *Tariff TOU Register Matrix(4.6.5.20)*, the *Tariff Block Counter Matrix(4.6.5.19)* and the *Consumption Register(4.6.5.4)* together with a UTC date and time stamp in the *Daily Read Log(4.6.5.4)* every day at midnight UTC.

If operating in Prepayment Mode GSME shall be capable of recording the *Meter Balance(4.6.5.11)*, *Emergency Credit Balance(4.6.5.8)*, *Accumulated Debt Register(4.6.5.1)*, *Payment Debt Register(4.6.5.13)* and *Time Debt Registers [1 … 2](4.6.5.21)* in the *Prepayment Daily Read Log(4.6.5.14)* every day at midnight UTC.

4.4.9.5 Half hour profile data

GSME shall be capable of recording Consumption in each thirty minute period (commencing at the start of minutes 00 and 30 in each hour), including the UTC date and time at the end of the 30 minute period to which the Consumption relates, in the *Profile Data Log(4.6.5.15)*.

4.4.10 Security

4.4.10.1 General

GSME shall be designed taking all reasonable steps so as to ensure that any failure or compromise of its integrity shall not compromise the Security Credentials or Personal Data stored on it or compromise the integrity of any other Device to which it is connected by means of a Communications Link.

GSME shall be capable of securely disabling Critical Commands other than those Commands set out in S*ection 4.5* that are Critical Commands.

GSME shall be capable of verifying its Firmware at power-on and prior to activation of the Firmware, to verify that the Firmware, at that time, is in the form originally received. On failure of verification GSME shall be capable of:

i. generating an entry to that effect in the *Security Log(4.6.5.17)*; and
ii. generating and sending an Alert to that effect via its HAN Interface.

Where GSME comprises more than one device, each device other than the Gas Meter shall be capable of verifying its Firmware at power-on and prior to activation of the Firmware, to verify that the Firmware, at that time, is in the form originally received. On failure of verification GSME shall be capable of:

iii. generating an entry to that effect in the *Security Log(4.6.5.17)*; and
iv. generating and sending an Alert to that effect via its HAN Interface.

GSME shall be capable of logging in the *Security Log(4.6.5.17)* the occurrence and type of any Sensitive Event.

4.4.10.2 Security Credentials

4.4.10.2.1 Meter Private Keys

GSME shall be capable of generating Public-Private Key Pairs to support the Cryptographic Algorithms set out in S*ection 4.4.10.3*.

GSME shall be capable of securely storing such Private Keys and shall be capable of formatting and sending via its HAN Interface a Certificate Signing Request containing the corresponding Public Key and the *GSME Identifier(4.6.1.1)*.

GSME shall be capable of securely storing Key Agreement values.

4.4.10.2.2 Public Key Certificates

GSME shall be capable of securely storing Security Credentials from Certificates including for use in the Cryptographic Algorithms as set out in S*ection 4.4.10.3*.

During the replacement of any *GSME Security Credentials(4.6.4.15)* (as set out in S*ection 4.5.3.18*) GSME shall be capable of ensuring that the *GSME Security Credentials(4.6.4.15)* being replaced remain usable until the successful completion of the replacement.

4.4.10.2.3 Role Based Access Control (RBAC)

GSME shall be capable of restricting Authorisation to execute Commands and of issuing Alerts according to Role permissions.

4.4.10.3 Cryptographic Algorithms

GSME shall be capable of supporting the following Cryptographic Algorithms:

i. Elliptic Curve DSA;
ii. Elliptic Curve DH; and
iii. SHA-256.

In executing and creating any Command, Response or Alert, GSME shall be capable of applying Cryptographic Algorithms (alone or in combination*)* for:

iv. Digital Signing;
v. Digital Signature verification;
vi. Hashing;
vii. Message Authentication; and
viii. Encryption and Decryption.

4.4.10.4 Firmware

GSME shall only be capable of activating Firmware on receipt of an Activate Firmware Command (as set out in S*ection 4.5.3.2*).

4.4.10.5 Communications

GSME shall be capable of preventing and detecting, on all of its interfaces, Unauthorised access that could compromise the Confidentiality and / or Data Integrity of:

i. Personal Data whilst being transferred via an interface;
ii. Consumption data used for billing whilst being transferred via an interface;
iii. Security Credentials whilst being transferred via an interface; and
iv. Firmware and data essential for ensuring its integrity whilst being transferred via an interface,

and any Command that could compromise the Confidentiality and / or Data Integrity of:

v. Personal Data;
vi. Consumption data used for billing;
vii. Security Credentials; and
viii. Firmware and data essential for ensuring its integrity,

stored or executing on GSME, and on such detection shall be capable of:

ix. generating an entry to that effect in the *Security Log(4.6.5.17)*; and

x. generating and sending an Alert to that effect via its HAN Interface.

GSME shall be capable of employing techniques to protect against Replay Attacks relating to Commands received.

GSME shall not be capable of executing a Command to modify or delete entries from the *Security Log(4.6.5.17)*.

4.5 Interface requirements

This Section describes the minimum required interactions which GSME shall be capable of undertaking via its HAN Interface and its User Interface (including with Devices as set out in *Sections 4.4.2.1* and *4.4.2.3)*.

4.5.1 Gas Proxy Function information provision

GSME shall be capable, immediately upon establishment of a Communications Link with a Gas Proxy Function (as set out in *Section 4.4.2.3)*, of providing the Operational Data (set out in *Section 4.6.5)* to that Gas Proxy Function (and with the exception of the *Cumulative and Historical Value Store(4.6.5.5)* and the *Profile Data Log(4.6.5.15)*, updates of any changes in that data every 30 minutes thereafter).

4.5.2 User Interface Commands

GSME shall be capable of executing immediately the Commands set out in this *Section 4.5.2* following their receipt via its User Interface.

GSME shall be capable of logging all such Commands received and Outcomes in the *Event Log(4.6.5.9)*.

4.5.2.1 Activate Emergency Credit [PIN]

A Command to activate Emergency Credit when GSME is operating in Prepayment Mode where Emergency Credit is available (as set out in *Section 4.4.7.2*).

In executing the Command, if the Supply is Disabled, GSME shall be capable of Arming the Supply if the combined credit of the *Meter Balance(4.6.5.11)* and *Emergency Credit Balance(4.6.5.8)* rises above the *Disablement Threshold(4.6.4.12)* and displaying any such change in the *Supply State(4.6.5.18)* on its User Interface and generating and sending an Alert that the Supply has been Armed via its HAN Interface.

4.5.2.2 Add Credit

A Command to accept credit to be applied to GSME when GSME is operating in Prepayment Mode on input of a UTRN. In executing the Command, GSME shall be capable of:

i. comparing the credit value of the UTRN with the *Maximum Credit Threshold(4.6.4.17)* and rejecting the UTRN where the credit value is greater than that threshold;
ii. comparing the projected new *Meter Balance(4.6.5.11)* (calculated on the basis of *(xii)* to *(xv)* below and the credit value of the UTRN and rejecting the UTRN where the projected new *Meter Balance(4.6.5.11)* is greater than the *Maximum Meter Balance Threshold(4.6.4.18)*;
iii. verifying the Authenticity of the UTRN;
iv. verifying that GSME is the intended recipient of the UTRN;
v. using the UTRN to generate a UTRN Counter, and comparing this against the last 100 verified UTRN Counters and rejecting duplicate presentation of verified UTRNs; and
vi. controlling the number of invalid UTRN entries entered and processed.

GSME shall be capable of generating an entry in the *Security Log(4.6.5.17)*:

vii. where the UTRN is rejected as set out in *(i)* above;
viii. where the UTRN is rejected as set out in *(ii)* above;
ix. on failure of *(iii)* above;
x. on failure of *(iv)* above; and
xi. where duplicates are rejected as set out in *(v)* above.

In executing the Command, GSME shall be capable of applying the credit added in the following order:

xii. recovery of payment-based debt of an amount defined by *Debt Recovery per Payment(4.6.4.8)* from the *Payment Debt Register(4.6.5.13)* subject to the *Debt Recovery Rate Cap(4.6.4.10)*;
xiii. recovery of debt accumulated in the *Accumulated Debt Register(4.6.5.1)*;
xiv. repayment of Emergency Credit activated and used by the Consumer; and
xv. adding remaining credit (the credit after deduction of *(xii)*, *(xiii)* and *(xiv)* above) to the *Meter Balance(4.6.5.11)*.

In executing the Command, GSME shall be capable of Arming the Supply if the *Meter Balance(4.6.5.11)* rises above the *Disablement Threshold(4.6.4.12)* and displaying any such change in the *Supply State(4.6.5.18)* on its User Interface and generating and sending an Alert that the Supply has been Armed via its HAN Interface.

In executing the Command, GSME shall be capable of:

xvi. recording the credit applied to the *Meter Balance(4.6.5.11)* and the amount of payment-based debt recovered (as set out in *(xii)*) in the *Billing Data Log(4.6.5.3)*; and
xvii. generating and sending an Alert containing the UTC date and time of the last update of the *Meter Balance(4.6.5.11)* via its HAN Interface.

4.5.2.3 Allow Access to User Interface

Where Privacy PIN Protection is enabled, a Command to enable temporary access to the restricted display items annotated [PIN] in *Section 4.4.5* and the restricted User Interface Commands annotated [PIN] in *Section 4.5.2* on input of a number that matches the *Privacy PIN(4.6.3.1)*.

4.5.2.4 Check for HAN Interface Commands

A Command to check immediately for any pending *Add Credit(4.5.3.3)* and *Activate Emergency Credit(4.5.3.1)* Commands. If there are any such pending Commands GSME shall be capable of executing the Commands as set out in *Section 4.5.3*.

4.5.2.5 Disable Privacy PIN Protection [PIN]

A Command to disable Privacy PIN Protection.

4.5.2.6 Enable Supply [PIN]

A Command to Enable the Supply if the Supply is Armed.

In executing the Command, GSME shall be capable of detecting when the flow rate exceeds a level defined by *Uncontrolled Gas Flow Rate(4.6.4.33)* and where the flow rate is exceeded, of Disabling the Supply and then Arming the Supply, sending an Alert to that effect via its HAN interface and sounding an Alarm via its User Interface.

4.5.2.7 Reset Remaining Battery Capacity

A Command to reset the *Remaining Battery Capacity(4.6.5.16)*. The Command shall only be available following physical access through the Secure Perimeter of GSME.

In executing the Command GSME shall be capable of:

i. generating an entry to that effect in the *Security Log(4.6.5.17)*; and
ii. generating and sending an Alert to that effect via its HAN Interface.

4.5.2.8 Find Smart Metering Home Area Network and Re-establish Communications Links

A Command to seek the frequency at which a ZigBee SEP Smart Metering Home Area Network is operating and then:

i. re-establish the Communications Links set out in *Sections 4.4.2.1, 4.4.2.2 and 4.4.2.3*;
ii. generate an entry to that effect in the *Event Log(4.6.5.9)*; and
iii. generate and send an Alert to that effect via its HAN Interface.

Where the GSME has Communications Links set out in *(i)* GSME shall be capable of not executing the Command.

4.5.2.9 Set Privacy PIN [PIN]

A Command to set a new value of the *Privacy PIN(4.6.3.1)*.

In executing the Command where Privacy PIN Protection is disabled GSME shall be capable of enabling Privacy PIN Protection.

4.5.2.10 Test Valve

Where GSME includes a Valve, a Command to:

i. where the *Supply State(4.6.5.18)* is Enabled, Disable the Supply for one minute and then Arm the Supply and set the *Supply State(4.6.5.18)* accordingly;
ii. where the *Supply State(4.6.5.18)* is Armed, Enable the Supply for one minute and then Arm the Supply and set the *Supply State(4.6.5.18)* accordingly; and
iii. where the *Supply State(4.6.5.18)* is Disabled, Enable the Supply for one minute and then Disable the Supply and set the *Supply State(4.6.5.18)* accordingly.

The Command shall only be available following physical access through the Secure Perimeter of GSME. In executing the Command GSME shall be capable of:

iv. generating an entry to that effect in the *Event Log(4.6.5.9)*; and
v. generating and sending an Alert to that effect via its HAN.

4.5.3 HAN Interface Commands

GSME shall be capable of executing the Commands set out in this Section. GSME shall be capable of logging all Commands received and Outcomes in the *Event Log(4.6.5.9)*.

GSME shall be capable of executing Commands immediately on receipt ('immediate Commands') and where specified in the Great Britain Companion Specification at a future date ('future dated Commands'). A future dated Command shall include the UTC date and time at which the Command shall be executed by GSME.

GSME shall be capable of cancelling a future dated Command. A future dated Command shall be capable of being cancelled by an Authorised party, subject to RBAC (as set out in *Section 4.4.10.2.3*). GSME shall be capable of generating and sending a Response acknowledging that a future dated Command has been successfully cancelled.

4.5.3.1 Activate Emergency Credit

A Command to activate Emergency Credit when GSME is operating in Prepayment Mode where Emergency Credit is available (as set out in *Section 4.4.7.2*).

In executing the Command where the Supply is Disabled GSME shall be capable of Arming the Supply if the combined credit of the *Meter Balance(4.6.5.11)* and *Emergency Credit Balance(4.6.5.8)* rises above the *Disablement Threshold(4.6.4.12)* and displaying any such change in the *Supply State(4.6.5.18)* on its User Interface and generating and sending an Alert that the Supply has been Armed via its HAN Interface.

When operating in Credit Mode, GSME shall be capable of not executing the Command and generating and sending a Response to that effect via its HAN Interface.

4.5.3.2 Activate Firmware

A Command to activate Firmware.

In executing the Command GSME shall be capable of installing new Firmware using a mechanism that is robust against failure and loss of data.

The new Firmware shall include version information. Where new Firmware is successfully installed, GSME shall be capable of recording the version information of that new Firmware in *Firmware Version(4.6.5.10)*.

4.5.3.3 Add Credit

A Command to accept credit to be applied to GSME when GSME is operating in Prepayment Mode on receipt of a UTRN from a PPMID or a UTRN from an Authorised party.

In executing the Command following receipt of a UTRN from a PPMID GSME shall be capable of applying credit as set out in S*ection 4.5.2.2.*

In executing the Command following receipt of a UTRN from an Authorised party, GSME shall be capable of:

i. comparing the credit value of the UTRN with the *Maximum Credit Threshold(4.6.4.17)* and rejecting the UTRN where the credit value is greater than that threshold;
ii. comparing the projected new *Meter Balance(4.6.5.11)* (calculated on the basis of *(xii)* to *(xv)* below and the credit value of the UTRN and rejecting the UTRN where the projected new *Meter Balance(4.6.5.11)* is greater than the *Maximum Meter Balance Threshold(4.6.4.18)*;
iii. verifying the Authenticity of the UTRN;
iv. verifying that GSME is the intended recipient of the UTRN;
v. comparing the UTRN Counter against the last 100 verified UTRN Counters and rejecting duplicate presentation of verified UTRNs; and
vi. controlling the number of invalid UTRN entries entered and processed.

GSME shall be capable of generating an entry in the *Security Log(4.6.5.17)*:

vii. where the UTRN is rejected as set out in *(i)* above;
viii. where the UTRN is rejected as set out in *(ii)* above;
ix. on failure of *(iii)* above;
x. on failure of *(iv)* above; and
xi. where duplicates are rejected as set out in *(v)* above.

In executing the Command, GSME shall be capable of applying the credit added in the following order:

xii. recovery of payment-based debt of an amount defined by *Debt Recovery per Payment(4.6.4.8)* from the *Payment Debt Register(4.6.5.13)* subject to the *Debt Recovery Rate Cap(4.6.4.10)*;
xiii. recovery of debt accumulated in the *Accumulated Debt Register(4.6.5.1)*;
xiv. repayment of Emergency Credit activated and used by the Consumer; and

xv. adding remaining credit (the credit after deduction of *(xii)*, *(xiii)* and *(xiv)* above*)* to the *Meter Balance(4.6.5.11)*.

In executing the Command, GSME shall be capable of Arming the Supply if the *Meter Balance(4.6.5.11)* rises above the *Disablement Threshold(4.6.4.12)*, displaying any such change in the *Supply State(4.6.5.18)* on its User Interface and generating and sending an Alert that the Supply has been Armed via its HAN Interface.

In executing the Command, GSME shall be capable of recording the credit applied to the *Meter Balance(4.6.5.11)* and the amount of payment-based debt recovered (as set out in *(xii)*) in the *Billing Data Log(4.6.5.3)*.

In executing the Command from a PPMID, GSME shall be capable of generating and sending an Alert containing the UTC date and time stamp of the last update of the *Meter Balance(4.6.5.11)* via its HAN Interface.

When operating in Credit Mode, GSME shall be capable of not executing the Command and generating and sending a Response to that effect via its HAN Interface.

4.5.3.4 Add Device Security Credentials

A Command to add Security Credentials for a PPMID or a Gas Proxy Function to the *Device Log(4.6.4.11)*.

In executing the Command, GSME shall be capable of:

i. verifying the Security Credentials; and
ii. recording the Command and Outcome to the *Security Log(4.6.5.17)*.

4.5.3.5 Adjust Debt

A Command to apply positive and negative adjustments to the *Time Debt Registers [1 … 2](4.6.5.21)* and the *Payment Debt Register(4.6.5.13)* when operating in Prepayment Mode.

When operating in Credit Mode, GSME shall be capable of not executing the Command and generating and sending a Response to that effect via its HAN Interface.

4.5.3.6 Adjust Meter Balance

A Command to apply positive and negative adjustments to the *Meter Balance(4.6.5.11)*.

In executing the Command where GSME is operating in Prepayment Mode and where, following any such adjustment, the *Meter Balance(4.6.5.11)* rises above the *Disablement Threshold(4.6.4.12)*, GSME shall be capable of Arming the Supply, displaying any such change in the *Supply State(4.6.5.18)* on its User Interface and generating and sending an Alert that the Supply has been Armed via its HAN Interface.

4.5.3.7 Arm Supply

A Command to return GSME from a Locked state to an Unlocked state.

In executing the Command where the state of the Supply is Enabled or Armed, GSME shall Arm the Supply and shall set the *Supply State(4.6.5.18)* to Armed.

In executing the Command where the state of the Supply is only Disabled as a result of:

i. a Disable Supply Command;
ii. an attempt at Unauthorised Physical Access through its Secure Perimeter and the *Supply Tamper State(4.6.4.26)*; or
iii. GSME power supply and the *Supply Depletion State(4.6.4.25),*

GSME shall Arm the Supply and shall set the *Supply State(4.6.5.18)* to Armed; otherwise GSME shall not Arm the Supply.

4.5.3.8 Clear Event Log

A Command to clear all entries from the *Event Log(4.6.5.9)*. GSME shall be capable of logging that the Command has been executed in the *Security Log(4.6.5.17)*.

4.5.3.9 Disable Privacy PIN Protection

A Command to disable Privacy PIN Protection.

4.5.3.10 Disable Supply

A Command to establish a Locked state whereby the Supply is Disabled and can only be Armed in response to a Command to Arm the Supply (as described in *Section 4.5.3.7*).

In executing the Command GSME shall be capable of setting the *Supply State(4.6.5.18)* to Disabled.

4.5.3.11 Issue GSME Security Credentials

A Command to generate a Public-Private Key Pair and issue a corresponding Certificate Signing Request.

4.5.3.12 Read Configuration Data

A Command to read the value of one or more of the configuration data items set out in *Section 4.6.4*.

In executing the Command, GSME shall be capable of sending such value(s) in a Response via its HAN Interface.

4.5.3.13 Read Constant Data

A Command to read the value of one or more of the constant data items set out in *Section 4.6.1*.

In executing the Command, GSME shall be capable of sending such value(s) in a Response via its HAN Interface.

4.5.3.14 Read Operational Data

A Command to read the value of one or more of the operational data items set out in *Section 4.6.5*.

In executing the Command, GSME shall be capable of sending such value(s) in a Response via its HAN Interface.

4.5.3.15 Receive Firmware

A Command to receive Firmware.

In executing the Command GSME shall be capable of:

i. only accepting new Firmware from an Authorised and Authenticated source; and
ii. verifying the Authenticity and integrity of new Firmware before installation.

4.5.3.16 Record Network Data

A Command to initiate the recording of UTC date and time-stamped Consumption data for each six minute interval over a period of four hours in the *Network Data Log(4.6.5.12)*.

4.5.3.17 Remove Device Security Credentials

A Command to remove Security Credentials for a PPMID or a Gas Proxy Function from the *Device Log(4.6.4.11)*.

In executing the Command GSME shall be capable of recording the Command and Outcome to the *Security Log(4.6.5.17)*.

4.5.3.18 Replace GSME Security Credentials

A Command to replace *GSME Security Credentials(4.6.4.15)*.

In executing the Command GSME shall be capable of:

i. maintaining the Command's Transactional Atomicity; and
ii. recording the Command and Outcome to the *Security Log(4.6.5.17)*.

4.5.3.19 Reset Meter Balance

A Command to reset the *Meter Balance(4.6.5.11)* to zero.

In executing the Command, GSME shall reset the *Accumulated Debt Register(4.6.5.1)*, the Emergency Credit activated and used, and the *Emergency Credit Balance(4.6.5.8)*.

4.5.3.20 Set Clock

A Command to set the Clock date and time via its HAN Interface.

In executing the Command, GSME shall be capable of comparing the date and time specified in the Command with the Communications Hub Date and Time. Where the difference is:

i. within the tolerance specified in the Command GSME shall be capable of adjusting its date and time to the Communications Hub Date and Time and generating an entry to that effect in the *Event Log(4.6.5.9)*; and
ii. outside the tolerance specified in the Command GSME shall be capable of not adjusting its date and time and:

    a) generating an entry to that effect in the Event Log(4.6.5.9); and
    b) generating and sending an Alert to that effect via its HAN Interface.

GSME shall be capable of ensuring that any adjustments do not cause calendar-based events to be missed or future-dated Commands to be missed or repeated.

4.5.3.21 Set Payment Mode

A Command to set the payment mode as either Prepayment Mode or Credit Mode and to record the mode of operation in *Payment Mode(4.6.4.21)*.

In executing the Command, GSME shall be capable of taking a UTC date and time stamped copy of:

i. the *Tariff TOU Register Matrix(4.6.5.20)*;
ii. the *Tariff Block Counter Matrix(4.6.5.19)*; and
iii. the *Consumption Register(4.6.5.4)*,

and unless in Credit Mode both before and after execution of the Command:

iv. the *Meter Balance(4.6.5.11)*;
v. the *Emergency Credit Balance(4.6.5.8)*;
vi. the *Payment Debt Register(4.6.5.13)*;
vii. the *Time Debt Registers [1 … 2](4.6.5.21)*; and
viii. the *Accumulated Debt Register(4.6.5.1)*,

in the *Billing Data Log(4.6.5.3)*.

4.5.3.22 Set Tariff

A Command to accept new values for *Tariff TOU Price Matrix(4.6.4.32), Tariff Block Price Matrix(4.6.4.29)*, *Tariff Switching Table(4.6.4.30)* and *Tariff Threshold Matrix(4.6.4.31)*.

In executing the Command, GSME shall be capable of taking a UTC date and time stamped copy of:

i. the *Tariff TOU Register Matrix(4.6.5.20)*;
ii. the *Tariff Block Counter Matrix(4.6.5.19)*; and
iii. the *Consumption Register(4.6.5.4)*,

and where in Prepayment mode:

iv. the *Meter Balance(4.6.5.11)*;
v. the *Emergency Credit Balance(4.6.5.8)*;
vi. the *Payment Debt Register(4.6.5.13)*;
vii. the *Time Debt Registers [1 … 2](4.6.5.21)*; and
viii. the *Accumulated Debt Register(4.6.5.1)*,

in the *Billing Data Log(4.6.5.3)*.

4.5.3.23 Write Configuration Data

A Command to record one or more new values of the configuration data items set out in *Section 4.6.4*.

In executing the Command, GSME shall be capable of generating an entry to that effect in the *Event Log(4.6.5.9)*.

4.6 Data requirements

This Section describes the minimum information which GSME shall be capable of holding in its Data Store.

4.6.1 Constant data

Describes data that remains constant and unchangeable at all times.

4.6.1.1 GSME Identifier

A globally unique identifier used to identify GSME based on the EUI-64 Institute of Electrical and Electronic Engineers standard.

4.6.1.2 Manufacturer Identifier

An identifier used to identify the manufacturer of GSME.

4.6.1.3 Model Type

An identifier used to identify the model of GSME.

4.6.2 This Section is not used

4.6.3 Locally Set Configuration Data

Describes data that is configured by execution of a User Interface Command and that is not accessible via any GSME interface.

4.6.3.1 Privacy PIN

A number comprising four digits used by the Consumer to enable temporary access to a specified set of display items and Commands via the User Interface of GSME.

4.6.4 Configuration data

Describes data that configures the operation of various functions of GSME.

4.6.4.1 Alerts Configuration Settings

Settings to control whether to generate and send an Alert.

4.6.4.2 Billing Calendar

A calendar defining billing dates for the storage of billing related information in the *Billing Data Log(4.6.5.3)*.

4.6.4.3 Calorific Value

The value used in the conversion of gas volume to kWh usage, based on the energy stored in one cubic metre of gas released when burnt at a standard temperature and pressure.

4.6.4.4 Contact Details

The name and contact telephone number of the current gas Supplier.

4.6.4.5 Conversion Factor

The value used in the conversion of gas volume to kWh usage, based on the temperature, pressure and compressibility of the gas.

4.6.4.6 Currency Units

The Currency Units currently used by GSME, which shall be either GB Pounds or European Central Bank Euro.

4.6.4.7 Customer Identification Number

A number issued to GSME for display on the User Interface.

4.6.4.8 Debt Recovery per Payment

The percentage of a payment to be recovered against debt when GSME is operating Payment-based Debt Recovery in Prepayment Mode.

4.6.4.9 Debt Recovery Rates [1 … 2]

Two debt recovery rates in Currency Units per unit time for when GSME is using Time-based Debt Recovery in Prepayment Mode.

4.6.4.10 Debt Recovery Rate Cap

The maximum amount in Currency Units per unit time that can be recovered through Payment-based Debt Recovery when GSME is operating in Prepayment Mode.

4.6.4.11 Device Log

The Security Credentials and Device identifier for each of the Gas Proxy Function and PPMID with which GSME can establish Communications Links.

4.6.4.12 Disablement Threshold

The threshold in Currency Units for controlling when to Disable the Supply.

4.6.4.13 Emergency Credit Limit

The amount of Emergency Credit in Currency Units to be made available to a Consumer where Emergency Credit is activated by the Consumer.

4.6.4.14 Emergency Credit Threshold

The threshold in Currency Units below which *Emergency Credit Balance(4.6.5.8)* may be activated by the Consumer if so configured when GSME is operating in Prepayment Mode.

4.6.4.15 GSME Security Credentials

The Security Credentials for GSME and parties Authorised to establish Communications Links with it.

4.6.4.16 Low Credit Threshold

The threshold in Currency Units below which a low credit Alert is signalled.

4.6.4.17 Maximum Credit Threshold

The maximum credit which can be applied by any Add Credit Command.

4.6.4.18 Maximum Meter Balance Threshold

The *Meter Balance(4.6.5.11)* threshold in Currency Units above which an Add Credit Command is rejected.

4.6.4.19 Meter Point Reference Number (MPRN)

The reference number identifying a gas metering point.

4.6.4.20 Non-Disablement Calendar

A Switching Table comprising a set of rules specifying periods during which the Supply will not be Disabled due to the combined credit of the *Meter Balance(4.6.5.11)* and *Emergency Credit Balance(4.6.5.8)* falling below the *Disablement Threshold(4.6.4.12)* when GSME is operating in Prepayment Mode.

The rules stored within the table shall specify which of five Day Profiles should be used to specify Non-Disablement Periods for each day according to:

i. where the day is one of 20 Special Days, the Day Profile specified for that day; or
ii. where the day is not a Special Day, the Day Profile specified by the active Season Profile and Week Profile.

A Day Profile shall contain up to one contiguous time period during which the Supply may be Disabled due to the combined credit of the *Meter Balance(4.6.5.11)* and *Emergency Credit Balance(4.6.5.8)* falling below the *Disablement Threshold(4.6.4.12)* when GSME is operating in Prepayment Mode.

The Switching Table shall support three Season Profiles and two Week Profiles. Each Week Profile shall support two Day Profiles.

All dates and times shall be specified as UTC.

4.6.4.21 Payment Mode

The current mode of operation, being Prepayment Mode or Credit Mode.

4.6.4.22 Public Key Security Credentials Store

A store for Security Credentials relating to Public Keys.

4.6.4.23 Standing Charge

A charge to be levied in Currency Units per unit time when operating in Credit Mode and Prepayment Mode.

4.6.4.24 Supplier Message

A message issued to, and held on, GSME for provision to the Consumer.

4.6.4.25 Supply Depletion State

A setting to control the state of the Supply in the case of loss of power to GSME, being Locked or unchanged.

4.6.4.26 Supply Tamper State

A setting to control the state of the Supply in the case of Unauthorised Physical Access being detected, being Locked or unchanged.

4.6.4.27 Suspend Debt Disabled

A setting controlling whether debt should be collected when GSME is operating in Prepayment Mode and Supply is Disabled.

4.6.4.28 Suspend Debt Emergency

A setting controlling whether standing charges and debt should be deducted from the *Emergency Credit Balance(4.6.5.8)* when GSME is operating in Prepayment Mode and Emergency Credit is in use.

4.6.4.29 Tariff Block Price Matrix

A 4 x 1 matrix containing Prices for Block Pricing.

4.6.4.30 Tariff Switching Table

A set of rules for allocating daily Consumption to a Tariff Register for Time-of-use Pricing and Time-of-use with Block Pricing. The rules stored within the table shall specify which of four Day Profiles should be used to allocate Consumption to a Tariff Register according to:

i. where the day is one of 20 Special Days, the Day Profile specified for that day; or
ii. where the day is not a Special Day, the Day Profile specified by the active Season Profile and Week Profile.

The Switching Table shall support three Season Profiles and two Week Profiles.

All dates shall be specified as UTC.

4.6.4.31 Tariff Threshold Matrix

A 3 x 1 matrix capable of holding thresholds in kWh for controlling Block Tariffs.

4.6.4.32 Tariff TOU Price Matrix

A 1 x 4 matrix containing Prices for Time-of-use Pricing.

4.6.4.33 Uncontrolled Gas Flow Rate

The flow rate in units of volume per unit time used in the detection of uncontrolled flow of gas on Enablement of Supply.

4.6.4.34 Events Configuration Settings

Settings to control, for each Alert described in this *Section 4* and for each event which this *Section 4* requires the GSME to be capable of logging in the event log which is not a Critical Event, whether an Alarm is sounded and whether an event log entry is created.

4.6.5 Operational data

Describes data used by the functions of GSME for output of information.

4.6.5.1 Accumulated Debt Register

The debt resulting from the collection of *Standing Charge(4.6.4.23)* and / or time-based debt when Emergency Credit is in Use as configured by *Suspend Debt Emergency(4.6.4.28)*, when operating in Prepayment Mode.

4.6.5.2 Active Tariff Price

The Price currently active.

4.6.5.3 Billing Data Log

A log capable of storing the following UTC date and time stamped entries:

i. twelve entries comprising *Tariff TOU Register Matrix(4.6.5.20)*, the *Consumption Register(4.6.5.4)* and *Tariff Block Counter Matrix(4.6.5.19)*;

and where in Prepayment mode:

ii. five entries comprising the value of prepayment credits;
iii. ten entries comprising the value of payment-based debt payments; and
iv. twelve entries comprising *Meter Balance(4.6.5.11)*, *Emergency Credit Balance(4.6.5.8)*, *Accumulated Debt Register(4.6.5.1)*, *Payment Debt Register(4.6.5.13)* and *Time Debt Registers [1 … 2](4.6.5.21)*,

each of *(i)* to *(iv)* arranged as a circular buffer such that when full, further writes shall cause the oldest entry to be overwritten.

4.6.5.4 Consumption Register

The register recording cumulative Consumption.

4.6.5.5 Cumulative and Historical Value Store

A store capable of holding the following values:

i. eight Days of Energy Consumption comprising the prior eight Days, in kWh and Currency Units;
ii. six Weeks of Energy Consumption comprising the current Week and the prior five Weeks, in kWh and Currency Units; and
iii. fourteen months of Energy Consumption comprising the current month and the prior thirteen months, in kWh and Currency Units.

4.6.5.6 Cumulative Current Day Value Store

A store capable of holding the value of Energy Consumption on the current Day, in kWh and Currency Units.

4.6.5.7 Daily Read Log

A log capable of storing thirty one UTC date and time stamped entries of the *Tariff TOU Register Matrix(4.6.5.20)*, the *Tariff Block Counter Matrix(4.6.5.19)* and the *Consumption Register(4.6.5.4)* arranged as a circular buffer such that when full, further writes shall cause the oldest entry to be overwritten.

4.6.5.8 Emergency Credit Balance

The amount of Emergency Credit available to the Consumer after it has been activated by the Consumer.

4.6.5.9 Event Log

A log capable of storing one hundred UTC date and time stamped entries of non-security related information for diagnosis and auditing, arranged as a circular buffer such that when full, further writes shall cause the oldest entry to be overwritten.

4.6.5.10 Firmware Version

The active version of Firmware of GSME.

4.6.5.11 Meter Balance

The amount of money in Currency Units as determined by GSME. If operating in Prepayment Mode, the Meter Balance represents GSME's determination of the amount of credit available to the Consumer (excluding any *Emergency Credit Balance(4.6.5.8)*). If operating in Credit Mode, it represents GSME's determination of the amount of money due from the Consumer since the Meter Balance was last reset.

4.6.5.12 Network Data Log

A log capable of storing four hours of UTC date and time stamped six minute Consumption data arranged as a circular buffer such that when full, further writes shall cause the oldest entry to be overwritten.

4.6.5.13 Payment Debt Register

A Debt Register recording Debt to be recovered as a percentage of payment when using Payment-based Debt Recovery in Prepayment Mode.

4.6.5.14 Prepayment Daily Read Log

A log capable of storing thirty one UTC date and time stamped entries of *Meter Balance(4.6.5.11)*, *Emergency Credit Balance(4.6.5.8)*, *Accumulated Debt Register(4.6.5.1)*, *Payment Debt Register(4.6.5.13)* and *Time Debt Registers [1 … 2](4.6.5.21)* arranged as a circular buffer such that when full, further writes shall cause the oldest entry to be overwritten.

4.6.5.15 Profile Data Log

A log capable of storing a minimum of three months of UTC date and time stamped half hourly Consumption data arranged as a circular buffer such that when full, further writes shall cause the oldest entry to be overwritten.

4.6.5.16 Remaining Battery Capacity

Where GSME includes a Battery, the remaining Battery capacity in days.

4.6.5.17 Security Log

A log capable of storing one hundred UTC date and time stamped entries of security related information for diagnosis and auditing arranged as a circular buffer such that when full, further writes shall cause the oldest entry to be overwritten.

4.6.5.18 Supply State

The state of the Supply, being Enabled, Disabled or Armed.

4.6.5.19 Tariff Block Counter Matrix

A 4 x 1 matrix for storing Block Counters for Block Pricing.

4.6.5.20 Tariff TOU Register Matrix

A 1 x 4 matrix for storing Tariff Registers for Time-of-use Pricing.

4.6.5.21 Time Debt Registers [1 … 2]

Two Debt Registers recording independent debts to be recovered over time when operating Time-based Debt Recovery in Prepayment Mode.

5 Electricity Smart Metering Equipment Technical Specifications

5.1 Introduction

Section 5 of this document describes the minimum physical, minimum functional, minimum interface, minimum data and minimum testing and certification requirements of Electricity Smart Metering Equipment that an electricity Supplier is required to install and maintain to comply with standard condition 39 of its electricity supply licence.

Part A of this *Section 5* applies to Single Element Electricity Metering Equipment.

Part B of this *Section 5* applies to Twin Element Electricity Metering Equipment.

Part C of this *Section 5* applies to Polyphase Electricity Metering Equipment.

Where an Auxiliary Load Control Switch is installed within ESME, an electricity Supplier must comply, in addition, with the minimum functional, interface and data requirements described in Part D of this *Section 5*.

Where the Boost Function is installed within ESME, an electricity Supplier must comply, in addition, with the minimum functional and data requirements described in Part E of this *Section 5*.

Part A - Single Element Electricity Metering Equipment

5.2 Overview

In this Part A ESME shall mean Single Element Electricity Metering Equipment.

5.3 SMETS Testing and Certification Requirements

5.3.1 Conformance with the SMETS

ESME shall have been tested to ensure that it meets the requirements described in this *Section 5 Part A*, and evidence must be available to confirm such testing and conformance.

5.3.2 Conformance with the Great Britain Companion Specification

ESME shall meet the requirements described in the Great Britain Companion Specification.

ESME shall have been certified:

i. by the ZigBee Alliance as being compliant with those ZigBee SEP requirements that are identified as being required in the Great Britain Companion Specification and that were certifiable under the ZigBee SEP certification scheme on 31 August 2017; and

ii. by the DLMS User Association as being compliant with those DLMS COSEM requirements that are identified as being required described in the Great Britain Companion Specification and that were certifiable under the DLMS COSEM certification scheme on 31 August 2017.

5.3.3 Conformance with the Commercial Product Assurance Security Characteristics for GB Smart Metering

ESME shall meet the requirements described in the Commercial Product Assurance Security Characteristic Electricity Smart Metering Equipment.

ESME shall be certified by NCSC as compliant with the Commercial Product Assurance Security Characteristic Electricity Smart Metering Equipment.

5.4 Physical Requirements

ESME shall as a minimum include the following components:

i. a Clock;
ii. a Data Store;
iii. an Electricity Meter containing one measuring element;
iv. a HAN Interface;
v. a Load Switch;
vi. a Random Number Generator;
vii. a User Interface; and
viii. where installed with a Communications Hub provided by the Data and Communications Company, a Communications Hub Physical Interface (this may comprise a Communications Hub Physical Interface forming part of GSME where present at the time of installation in the Premises).

The Communications Hub Physical Interface shall as a minimum include a physical interface that meets the requirements defined by the Data and Communications Company at the time

of installation (pursuant to section H12 of the Smart Energy Code*)* and includes provision for a DC power supply to the Communications Hub.

ESME shall be mains powered and be capable of performing the minimum functional, interface and data requirements set out in *Sections 5.5*, *5.6* and *5.7* respectively operating at a nominal voltage of 230VAC without consuming more than an average of 4 watts of electricity under normal operating conditions.

ESME shall be capable of automatically resuming operation after a power failure in its operating state prior to such failure.

ESME shall:

ix. permanently display the *ESME Identifier(5.7.1.1)* on the ESME; and
x. have a Secure Perimeter.

The HAN Interface of ESME shall be capable of joining a ZigBee SEP Smart Metering Home Area Network which:

xi. operates within the 2400 – 2483.5 MHz harmonised frequency band; and
xii. supports the Communications Links described in S*ections 5.6.1*, *5.6.3* and *5.6.4*.

On joining a ZigBee SEP Smart Metering Home Area Network ESME shall be capable of generating and sending an Alert to that effect via its HAN Interface.

ESME shall be designed taking all reasonable steps so as to prevent Unauthorised Physical Access and Unauthorised communications through its Secure Perimeter that could compromise the Confidentiality and / or Data Integrity of:

xiii. Personal Data;
xiv. Consumption data used for billing;
xv. Security Credentials;
xvi. Random Number Generator;
xvii. Cryptographic Algorithms;
xviii. the Electricity Meter; and
xix. Firmware and data essential for ensuring its integrity,

stored or executing on ESME.

ESME shall be capable of detecting any attempt at Unauthorised Physical Access through its Secure Perimeter that could compromise such Confidentiality and / or Data Integrity and on such detection shall be capable of:

xx. providing evidence of such an attempt through the use of tamper evident coatings or seals,

and where reasonably practicable:

xxi. generating an entry to that effect in the *Security Log(5.7.5.31)*;
xxii. generating and sending an Alert to that effect via its HAN Interface; and
xxiii. where the *Supply Tamper State(5.7.4.44)* is configured to require Locking, sending an Alert that the Supply is being disabled for this reason via its HAN Interface, and establishing a Locked state whereby the Supply is Disabled and can only be Enabled or Armed in response to a Command to Arm the Supply (as described in *Section 5.6.3.7*) or Enable the Supply (as described in *Section 5.6.3.12*).

5.5 Functional Requirements

This Section describes the minimum functions that ESME shall be capable of performing.

5.5.1 Clock

The Clock forming part of ESME shall be capable of operating so as to be accurate to within 10 seconds of the UTC date and time under normal operating conditions.

ESME shall be capable of comparing its date and time with the Communications Hub Date and Time, and making adjustments to its date and time. Where the difference between ESME date and time and the Communications Hub Date and Time is more than 10 seconds ESME shall be capable of:

i. not adjusting its date and time;
ii. generating an entry in the *Security Log(5.7.5.31)* to that effect; and
iii. generating and sending an Alert via its HAN Interface.

Except when executing a *Set Clock(5.6.3.32)* Command, ESME shall not be capable of making adjustments to its date and time more than once within any 24 hour time period.

5.5.2 Communications

ESME, and any device forming part of it, shall be capable of ensuring that the security characteristics of all Communications Links it establishes meet the requirements described in *Section 5.5.10.5*.

With the exception of a Communications Hub Function ESME shall only be capable of establishing a Communications Link with a Device with Security Credentials in the *Device Log(5.7.4.14)* and shall not be capable of establishing a Communications Link via its HAN Interface with any other Devices.

When any Command addressed to ESME is received via any Communications Link ESME shall be capable of:

i. using the Security Credentials ESME holds, Authenticating to a Trusted Source the Command;
ii. verifying in accordance with *Section 5.5.10.2.3* that the sender of the Command is Authorised to execute the Command; and
iii. verifying the integrity of the Command.

On failure of any of *(i)* to *(iii)* above, ESME shall be capable of generating an entry in the *Security Log(5.7.5.31)* to that effect, discarding the Command without execution and without either generating or sending a Response, and generating and sending an Alert to that effect via its HAN Interface.

When executing an immediate Command ESME shall be capable of generating and sending a Response via its HAN Interface which shall either confirm successful execution of the Command or shall detail why it has failed to execute the Command.

Where the Command is not due to be executed immediately, ESME shall be capable of generating and sending a Response via its HAN Interface to confirm successful receipt. When executing a future dated Command ESME shall be capable of generating and sending an Alert via its HAN Interface which shall either confirm successful execution of the Command or shall detail why it has failed to execute the Command.

ESME shall only be capable of addressing a Response to the sender of the relevant Command.

ESME shall be capable of restricting the generation and sending of Alerts for each Alert described in this *Section 5* and for each event, which this *Section 5* requires the ESME to be capable of logging in the event log and which is not a Critical Event according to the *Alerts Configuration Settings(5.7.4.1)*.

For each Alert described in this *Section 5* and for each event which this *Section 5* requires the ESME to be capable of logging in the *Event Log(5.7.5.16)* or *Power Event Log(5.7.5.25)* and which is not a Critical Event, the ESME shall be capable of logging the event in that event log according to the *Events Configuration Settings(5.7.4.51)*.

Additionally, if the ESME has the capability to sound an Alarm, the ESME shall be capable of sounding such Alarms according to the *Events Configuration Settings(5.7.4.51)*.

5.5.2.1 Communications Links with a Communications Hub Function via its HAN Interface

ESME shall be capable of establishing and maintaining Communications Links via its HAN Interface with one Communications Hub Function.

ESME shall be capable of receiving the Communications Hub Date and Time from a Communications Hub Function.

5.5.2.2 Communications Links with Type 1 Devices via its HAN Interface

ESME shall be capable of establishing and maintaining Communications Links via its HAN Interface with a minimum of six Type 1 Devices (including a minimum of one PPMID).
ESME shall be capable of supporting up to five Auxiliary Load Control Switches or HAN Connected Auxiliary Load Control Switches.

ESME shall be capable of supporting the following types of Communications Links:

i. receiving the Commands (set out in *Section 7.5.5* and *Section 8.5.2*) that may be sent from each Type 1 Device;
ii. sending the Responses (set out in *Section 5.6.3*) to a Type 1 Device;
iii. sending the Commands (set out in *Section 5.6.4*) to a Type 1 Device and acting on the corresponding Responses from a Type 1 Device;
iv. sending the information (set out in *Section 5.6.1*) to a Type 1 Device; and
v. sending Alerts to a Type 1 Device.

5.5.2.3 Communications Links with Type 2 Devices via its HAN Interface

ESME shall be capable of establishing and maintaining Communications Links via its HAN Interface with a minimum of four Type 2 Devices.

ESME shall be capable of supporting the following types of Communications Links:

i. sending the information (set out in *Section 5.6.1*) to a Type 2 Device; and
ii. sending Alerts to a Type 2 Device.

5.5.3 Data storage

ESME shall be capable of retaining all information held in its Data Store at all times, including on loss of power.

5.5.4 Display of information

ESME shall be capable of displaying the following up to date information on its User Interface:

i. the *Payment Mode [INFO](5.7.4.31)* currently in operation, being Prepayment Mode or Credit Mode [PIN];
ii. the *Tariff TOU Register Matrix [INFO](5.7.5.34)* with appropriate precision, the *Tariff TOU Block Register Matrix(5.7.5.35)* with appropriate precision and the *Tariff Block Counter Matrix [INFO](5.7.5.33)* with appropriate precision;
iii. the *Active Import Register [INFO](5.7.5.3)* with appropriate precision;
iv. the *Active Export Register [INFO](5.7.5.2)* with appropriate precision;

v. the *Meter Balance [INFO](5.7.5.22)* [PIN];
vi. the Debt to Clear (calculated as set out in *Section 5.5.7.2*) [PIN];
vii. the *Customer Identification Number [INFO](5.7.4.10)* [PIN];
viii. whether Emergency Credit is available for activation [PIN];
ix. whether ESME has suspended the Disablement of Supply during a period defined in the *Non-Disablement Calendar [INFO](5.7.4.30)* (as set out in *Section* 5.5.7.2) [PIN];
x. the *Emergency Credit Balance [INFO](5.7.5.15)* where Emergency Credit is activated [PIN];
xi. any low credit condition [PIN];
xii. the *Supply State [INFO](5.7.5.32)*;
xiii. any time-based debts and Time-based Debt Recovery rates [PIN];
xiv. any payment-based debt [PIN];
xv. any accumulated debt recorded in the *Accumulated Debt Register [INFO](5.7.5.1)* [PIN];
xvi. any *Standing Charge [INFO](5.7.4.42)* [PIN];
xvii. the *Meter Point Administration Numbers (MPAN*) *[INFO](5.7.4.28)* [PIN];
xviii. the Local Time;
xix. the *Contact Details [INFO](5.7.4.8)*;
xx. the *Active Tariff Price [INFO](5.7.5.5)* [PIN]; and
xxi. the *Event Log(5.7.5.16)* and the *Power Event Log(5.7.5.25)* (with the exception of any Personal Data).

ESME shall be capable of displaying the *Security Log(5.7.5.31)* on its User Interface following physical access through the Secure Perimeter of ESME.

ESME shall be capable of displaying Currency Units in GB Pounds and European Central Bank Euro.

5.5.4.1 Presentation of information on the User Interface

For each of the values currently stored in the *Active Import Register [INFO](5.7.5.3),* the *Active Export Register [INFO](5.7.5.2),* the *Tariff ToU Register Matrix [INFO](5.7.5.34),* and the *Tariff ToU Block Register Matrix(5.7.5.35),* ESME shall be capable of displaying a value calculated from the stored value by:

i. converting the stored value in to a decimal, integer number of kilowatt hours, rounding the stored value down to the nearest kilowatt hour;
ii. discarding all except the five least significant decimal digits so produced; and
iii. adding leading zeros (if necessary) so that there are exactly five decimal digits.

5.5.5 Privacy PIN Protection

ESME shall be capable of preventing the display on the User Interface of items annotated [PIN] in *Section 5.5.4,* and preventing access on the User Interface to the Commands annotated [PIN] in *Section 5.6.2*, except on successful execution of an *Allow Access to User Interface(5.6.2.3)* Command via the User Interface.

5.5.6 Load limiting

ESME shall be capable of determining when the *Active Power Import [INFO](5.7.5.4)* is above, for the *Load Limit Period(5.7.4.19)*, the *Load Limit Power Threshold(5.7.4.20)* and on such an occurrence ESME shall be capable of:

i. generating an entry to that effect in the *Event Log(5.7.5.16)*;
ii. generating and sending an Alert to that effect via its HAN Interface and its User Interface;
iii. counting the number of such occurrences in the *Load Limit Counter(5.7.5.18)*; and

iv. Disabling the Supply in circumstances where the *Load Limit Supply State(5.7.4.22)* is configured to require Disablement, and then:

a) immediately Arming the Supply such that it can be Enabled as set out in *Section 5.6.2.5*;
b) prior to the *Load Limit Restoration Period*(*5.7.4.21*) elapsing,

- disabling the Supply if ESME is in Prepayment Mode, and either:
  - it is not in a Non-Disablement Period and combined *Meter Balance [INFO](5.7.5.22*) and *Emergency Credit Balance [INFO](5.7.5.15)* falls below the *Disablement Threshold [INFO]*(*5.7.4.15)*; or
  - a Non-Disablement Period ends and the combined *Meter Balance [INFO](5.7.5.22*) and *Emergency Credit Balance [INFO]*(*5.7.5.15*) is below the *Disablement Threshold [INFO](5.7.4.15)*.
- then placing the Supply in such a state whereby Supply will be Armed where the combined *Meter Balance [INFO]*(*5.7.5.22*) and *Emergency Credit Balance [INFO](5.7.5.15)* rises above the *Disablement Threshold [INFO](5.7.4.15*).

c) after the *Load Limit Restoration Period*(*5.7.4.21*) has elapsed, unless ESME is in Prepayment Mode, not in a Non-Disablement Period and the combined *Meter Balance [INFO](5.7.5.22)* and *Emergency Credit Balance [INFO](5.7.5.15)* is below the *Disablement Threshold [INFO](5.7.4.15),* then:

- enabling the Supply, and setting the *Load Limit Supply State*(*5.7.4.22*) to unchanged; and
- displaying any such change in the Supply State [INFO](5.7.5.32) on its User Interface and generating and sending an Alert indicating the change in state via its HAN Interface.

5.5.7 Payment Mode

ESME shall be capable of operating in Credit Mode and Prepayment Mode and of being remotely switched from one mode to the other.

5.5.7.1 Credit Mode

ESME, when operating in Credit Mode, shall be capable of maintaining a calculation of the *Meter Balance [INFO](5.7.5.22)* based on:

i. the Consumption in the *Tariff TOU Register Matrix [INFO](5.7.5.34)* and the Prices in the *Tariff TOU Price Matrix [INFO](5.7.4.50)* and, if operating Time-of-use with Block Pricing, the Consumption in the *Tariff TOU Block Register Matrix(5.7.5.35)* and the Prices in the *Tariff Block Price Matrix [INFO](5.7.4.47)*; and
ii. the *Standing Charge [INFO](5.7.4.42)*.

5.5.7.2 Prepayment Mode

ESME shall be capable of operating in Prepayment Mode, including during periods of loss of its Communications Link via its HAN Interface, and maintaining a balance of credit and reflecting any reduction in credit based on Consumption, standing charge and Time-based Debt Recovery.

ESME shall be capable of adding credit to the *Meter Balance [INFO](5.7.5.22)* (as set out in *Sections 5.6.2.2* and *5.6.3.3*) and reducing the amount of credit in the *Meter Balance [INFO](5.7.5.22)*.

ESME shall be capable of making Emergency Credit available to the Consumer (by means of the *Emergency Credit Balance [INFO](5.7.5.15)* if the *Meter Balance [INFO](5.7.5.22)* is

below the *Emergency Credit Threshold [INFO](5.7.4.17)*). ESME shall be capable of displaying the availability of Emergency Credit on its User Interface and of generating and sending an Alert indicating the availability of Emergency Credit via its HAN Interface. The amount of Emergency Credit made available to the Consumer shall be equal to the *Emergency Credit Limit [INFO](5.7.4.16)*. ESME shall be capable of reducing the amount of credit in the *Emergency Credit Balance [INFO](5.7.5.15)* where Emergency Credit is activated by the Consumer (as set out in *Sections 5.6.2.1* and *5.6.3.1*) and the *Meter Balance [INFO](5.7.5.22)* is exhausted. Any Emergency Credit used shall be repaid when credit is added to ESME (as set out in S*ections 5.6.2.2* and *5.6.3.3*).

ESME shall be capable of reducing the *Meter Balance [INFO](5.7.5.22)* until it reaches the *Disablement Threshold [INFO](5.7.4.15)* followed by reducing the *Emergency Credit Balance [INFO](5.7.5.15)*, where activated, until exhausted, on the basis of:

i. the Consumption in the *Tariff TOU Register Matrix [INFO](5.7.5.34)* and the Prices in the *Tariff TOU Price Matrix [INFO](5.7.4.50)*, and if operating Time-of-use with Block Pricing the Consumption in the *Tariff TOU Block Register Matrix(5.7.5.35)* and the Prices in the *Tariff Block Price Matrix [INFO](5.7.4.47)*;
ii. the *Standing Charge [INFO](5.7.4.42)*; and
iii. the recovery of debt hourly or daily through each of the *Time Debt Registers [1 … 2] [INFO](5.7.5.36)* at rates defined by the *Debt Recovery Rates [1 … 2] [INFO](5.7.4.12)*.

Where configured by *Suspend Debt Emergency(5.7.4.46)* to do so and when Emergency Credit is in use, ESME shall be capable of suspending the application of *(ii)* and *(iii)* to the *Emergency Credit Balance [INFO](5.7.5.15)*, and of accumulating *(ii)* and *(iii)* in the *Accumulated Debt Register [INFO](5.7.5.1)*.

ESME shall be capable of recording debt recovered, or accumulated in the *Accumulated Debt Register [INFO](5.7.5.1),* in the *Billing Data Log(5.7.5.10)*.

ESME shall be capable of monitoring the *Meter Balance [INFO](5.7.5.22)* and where activated the *Emergency Credit Balance [INFO](5.7.5.15)* and:

iv. if the combined credit of the *Meter Balance [INFO](5.7.5.22)* and *Emergency Credit Balance [INFO](5.7.5.15)* falls below the *Low Credit Threshold [INFO](5.7.4.23)*, displaying an Alert to that effect on its User Interface and generating and sending an Alert to that effect via its HAN Interface;
v. if the combined credit of the *Meter Balance [INFO](5.7.5.22)* and *Emergency Credit Balance [INFO](5.7.5.15)* falls below the *Disablement Threshold [INFO](5.7.4.15)*, Disabling the Supply, displaying an Alert to that effect on its User Interface and generating and sending an Alert to that effect via its HAN Interface;
vi. where the Supply is Disabled (as set out in *(v)* above):
    a) where configured by *Suspend Debt Disabled*(*5.7.4.45*) not to suspend Time-based Debt Recovery, continuing to apply (ii) and (*iii*) above to reduce the *Meter Balance* [INFO](*5.7.5.22*);
    b) where configured by *Suspend Debt Disabled*(*5.7.4.45*) to suspend Time-based Debt Recovery, suspending the application of (*iii*) above to the *Meter Balance* [INFO](*5.7.5.22*), and continuing to apply (ii) to reduce the *Meter Balance* [INFO](*5.7.5.22*); and
vii. if the Supply is Enabled, suspending the Disablement of Supply (as set out in *(v)* above) during periods defined in the *Non-Disablement Calendar [INFO](5.7.4.30)*, continuing to reduce the *Meter Balance [INFO](5.7.5.22)* on the basis of *(i)*, *(ii)* and *(iii)* above, displaying on its User Interface an indication that the combined *Meter Balance [INFO](5.7.5.22)* and *Emergency Credit Balance [INFO](5.7.5.15)* is below

the *Disablement Threshold [INFO](5.7.4.15)* and that Disablement of Supply due to insufficient credit has been suspended, and generating and sending an Alert that Disablement of Supply due to insufficient credit has been suspended via its HAN Interface.

If the *Meter Balance [INFO](5.7.5.22)* is equal to or below the *Disablement Threshold [INFO](5.7.4.15)* ESME shall be capable of maintaining a calculation of the Debt to Clear based on:

viii. the difference between the *Meter Balance [INFO](5.7.5.22)* and the *Disablement Threshold [INFO](*5.7.4.15*)*;

ix. amount of debt accumulated in the *Accumulated Debt Register [INFO](5.7.5.1)*;

x. amount of Emergency Credit activated and used by the Consumer; and

xi. the payment-based debt to be collected based on (viii), (ix) and (x) (as defined by *Debt Recovery per Payment [INFO]*(*5.7.4.11*) taking account of the amount remaining in the *Payment Debt Register [INFO]*(*5.7.5.23*), the payment-based debt payments in the *Billing Data Log(5.7.5.10)* and the *Debt Recovery Rate Cap [INFO]*(*5.7.4.13*)).

For Time-based Debt Recovery, the ESME shall be capable of recovering the lesser of:

xii. the amount in the relevant *Time Debt Registers [1 … 2] [INFO]*(*5.7.5.36*); and

xiii. the corresponding amount determined by the *Debt Recovery Rates [1 … 2] [INFO]*(*5.7.4.12*).

For Payment-based Debt Recovery, the ESME shall be capable of recovering the lesser of:

xiv. the amount defined by *Debt Recovery per Payment [INFO]*(*5.7.4.11*) subject to the *Debt Recovery Rate Cap [INFO]*(*5.7.4.13*); and

xv. the amount in the *Payment Debt Register [INFO](5.7.5.23)*.

Where an Adjust Debt Command is to reduce the amount in a Debt Register and the amount in the Command is greater than the amount in the Debt Register, ESME shall be capable of setting the amount in the Debt Register to zero then applying the difference in the amounts in the following order:

xvi. recovering debt accumulated in the *Accumulated Debt Register [INFO](5.7.5.1)*;

xvii. repaying Emergency Credit activated and used by the Consumer; and

xviii. increasing the *Meter Balance [INFO](5.7.5.22)*.

ESME shall be capable of monitoring the *Meter Balance [INFO](5.7.5.22)* and, where the Supply is Disabled, ESME shall be capable of Arming the Supply if the *Meter Balance [INFO](5.7.5.22)* rises above the *Disablement Threshold [INFO](5.7.4.15)*, displaying any such change in the *Supply State [INFO](5.7.5.32)* on its User Interface and generating and sending an Alert that the Supply has been Armed via its HAN Interface.

5.5.8 Pricing

ESME shall be capable of applying Time-of-use Pricing and Time-of-use with Block Pricing.

When switching between Time-of-use Bands and Tariff Registers as set out in this Section ESME shall be capable of applying the *Randomised Offset(5.7.5.28)*.

ESME shall be capable of maintaining the *Active Tariff Price [INFO](5.7.5.5)*.

5.5.8.1 Time-of-use Pricing

ESME shall be capable of recording Consumption according to Time-of-use Bands in one of forty-eight Tariff Registers in the *Tariff TOU Register Matrix [INFO](5.7.5.34).*

ESME shall be capable of switching between different Tariff Registers once every 30 minutes. The switching between Time-of-use Bands and thus Tariff Registers shall be based on the switching rules defined in the *Tariff Switching Table(5.7.4.48)*.

5.5.8.2 Time-of-use with Block Pricing

ESME shall be capable of recording Consumption in one of four Block Registers for each of eight Time-of-use Bands in the *Tariff TOU Block Register Matrix(5.7.5.35).*

The switching between Time-of-use Bands and sets of Block Registers shall be based on the switching rules set out in the *Tariff Switching Table(5.7.4.48)*. ESME shall be capable of switching between Time-of-use Bands once every 30 minutes.

Switching between the Block Registers within each Time-of-use Band shall be based on Consumption accumulated in the *Tariff Block Counter Matrix [INFO](5.7.5.33)* and Consumption thresholds in the *Tariff Threshold Matrix [INFO](5.7.4.49)*.

ESME shall also be capable of accumulating Consumption in one of four Block Counters in the *Tariff Block Counter Matrix [INFO](5.7.5.33)* for each of the eight Time-of-use Bands. ESME shall be capable of switching between Block Counters according to the Consumption thresholds in the *Tariff Threshold Matrix [INFO](5.7.4.49)*.

ESME shall be capable of resetting the counters in the *Tariff Block Counter Matrix [INFO](5.7.5.33)* once per Day and in accordance with the timetable set out in the *Billing Calendar(5.7.4.7)*.

5.5.9 Recording

5.5.9.1 Active Energy Imported

ESME shall be capable of recording cumulative Active Energy Imported in the *Active Import Register [INFO](5.7.5.3)*.

5.5.9.2 Active Energy Exported

ESME shall be capable of recording cumulative Active Energy Exported in the *Active Export Register [INFO](5.7.5.2)*.

5.5.9.3 Billing data

In accordance with the timetable set out in the *Billing Calendar(5.7.4.7)* ESME shall be capable of taking a UTC date and time stamped copy of:

i. the *Tariff TOU Register Matrix [INFO](5.7.5.34)*;
ii. the *Tariff TOU Block Register Matrix(5.7.5.35)*; and
iii. the *Active Import Register [INFO](5.7.5.3)*,

and where in Prepayment mode:

iv. the *Meter Balance [INFO](5.7.5.22)*;
v. the *Emergency Credit Balance [INFO](5.7.5.15)*;
vi. the *Payment Debt Register [INFO](5.7.5.23)*;
vii. the *Time Debt Registers [1 … 2] [INFO](5.7.5.36)*; and
viii. the *Accumulated Debt Register [INFO](5.7.5.1)*,

in the *Billing Data Log(5.7.5.10)*, and:

ix. generating and sending an Alert via its HAN Interface containing the most recent entries in the *Billing Data Log(5.7.5.10)* of *(i)* to *(iii)* above; and
x. if operating in Credit Mode, immediately resetting the *Meter Balance [INFO](5.7.5.22)*.

5.5.9.4 Consumption data

ESME shall be capable of recording to:

i. the *Cumulative and Historical Value Store [INFO](5.7.5.12)* in kWh:

   a) Consumption on the Day up to the Local Time;
   b) Consumption on each of the eight Days prior to such Day;
   c) Consumption in the Week in which the calculation is performed;
   d) Consumption in each of the five Weeks prior to such Week;
   e) Consumption in the month in which the calculation is performed; and
   f) Consumption in the thirteen months prior to such month.

ii. the *Daily Consumption Log [INFO](5.7.5.14)* in kWh, the Consumption on each of the 731 Days prior to the current Day.

5.5.9.5 Cost of Consumption data

ESME shall be capable of calculating and recording in the *Cumulative and Historical Value Store [INFO](5.7.5.12)* the cost of:

i. Consumption on the Day up to the Local Time;
ii. Consumption on each of the eight Days prior to such Day;
iii. Consumption in the Week in which the calculation is performed;
iv. Consumption in each of the five Weeks prior to such Week;
v. Consumption in the month in which the calculation is performed; and
vi. Consumption in the thirteen months prior to such month.

ESME shall be capable of calculating cost of Consumption as above on the basis of:

vii. the Consumption in the *Tariff TOU Register Matrix [INFO](5.7.5.34)* and the Prices in the *Tariff TOU Price Matrix [INFO](5.7.4.50)* and, if operating Time-of-use with Block Pricing, the Consumption in the *Tariff TOU Block Register Matrix(5.7.5.35)* and the Prices in the *Tariff Block Price Matrix [INFO](5.7.4.47)*; and
viii. the *Standing Charge [INFO](5.7.4.42)*.

5.5.9.6 Cost of Instantaneous consumption

ESME shall be capable of calculating and recording the *Cost of Instantaneous Active Power Import(5.7.5.11)* on the basis of:

i. the *Active Power Import [INFO](5.7.5.4)*; and
ii. the *Active Tariff Price [INFO](5.7.5.5)*.

5.5.9.7 Daily read data

ESME shall be capable of taking a copy of and storing the *Tariff TOU Register Matrix [INFO](5.7.5.34)*, the *Tariff TOU Block Register Matrix(5.7.5.35)*, the *Active Import Register(5.7.5.3)* and the *Active Export Register [INFO](5.7.5.2)* together with a UTC date and time stamp in the *Daily Read Log(5.7.5.13)* every day at midnight UTC.

If operating in Prepayment Mode ESME shall be capable of recording the *Meter Balance [INFO](5.7.5.22)*, *Emergency Credit Balance [INFO](5.7.5.15), Accumulated Debt Register [INFO](5.7.5.1)*, *Payment Debt Register [INFO](5.7.5.23)* and *Time Debt Registers [1 … 2] [INFO](5.7.5.36)* in the *Prepayment Daily Read Log(5.7.5.26)* every day at midnight UTC.

5.5.9.8 Daily Consumption data

ESME shall be capable of calculating and storing Consumption for the previous Day together with a UTC date stamp in the *Daily Consumption Log [INFO](5.7.5.14)* every Day at midnight UTC.

5.5.9.9 Half hour profile data

ESME shall be capable of recording in each 30 minute period (commencing at the start of minutes 00 and 30 in each hour), the following information (including the UTC date and time at the end of the 30 minute period to which the data relates) in the *Profile Data Log [INFO](5.7.5.27)*:

i. Consumption;
ii. Active Energy Exported;
iii. Reactive Energy Imported; and
iv. Reactive Energy Exported.

5.5.9.10 Maximum Demand Import data

ESME shall be capable of calculating the average value of *Active Power Import [INFO](5.7.5.4)* over each 30 minute period (commencing at the start of minutes 00 and 30 in each hour) and recording:

i. to the *Maximum Demand Active Power Import Value(5.7.5.19)*, the maximum value so calculated since the *Maximum Demand Active Power Import Value(5.7.5.19)* was last reset (as set out in *Section 5.6.3.26*) including the UTC date and time at the end of the 30 minute period to which the data relates; and
ii. to the *Maximum Demand (Configurable Time) Active Power Import* Value*(5.7.5.20)*, the maximum value so calculated in any 30 minute period (commencing at the start of minutes 00 and 30 in each hour) within the time period specified in *Maximum Demand Configurable Time Period(5.7.4.26)* (including the UTC date and time at the end of the 30 minute period to which the data relates) since the *Maximum Demand (Configurable Time) Active Power Import* Value*(5.7.5.20)* was last reset (as set out in *Section 5.6.3.28*).

5.5.9.11 Maximum Demand Export data

ESME shall be capable of calculating the average value of Active Power Export over each 30 minute period (commencing at the start of minutes 00 and 30 in each hour) and recording to the *Maximum Demand Active Power Export Value(5.7.5.21)* the maximum value so calculated since the *Maximum Demand Active Power Export Value(5.7.5.21)* was last reset (as set out in *Section 5.6.3.27*) including the UTC date and time at the end of the 30 minute period to which the data relates.

5.5.9.12 Power Threshold Status

ESME shall be capable of comparing the *Active Power Import [INFO](5.7.5.4)* against thresholds and:

i. if the *Active Power Import [INFO](5.7.5.4)* is equal to or lower than the *Low Medium Power Threshold [INFO](5.7.4.24)*, setting *Power Threshold Status(5.7.5.24)* to low;
ii. if the Active Power Import *[INFO](*5.7.5.4*)* is higher than the *Low Medium Power Threshold [INFO](5.7.4.24)* and equal to or lower than the *Medium High Power Threshold [INFO](5.7.4.29)*, setting *Power Threshold Status(5.7.5.24)* to medium; and
iii. otherwise, setting the *Power Threshold Status(5.7.5.24)* to high.

5.5.9.13 Reactive Energy Imported

ESME shall be capable of recording cumulative Reactive Energy Imported in the *Reactive Import Register(5.7.5.30)*.

5.5.9.14 Reactive Energy Exported

ESME shall be capable of recording cumulative Reactive Energy Exported in the *Reactive Export Register(5.7.5.29)*.

5.5.10 Security

5.5.10.1 General

ESME shall be designed taking all reasonable steps so as to ensure that any failure or compromise of its integrity shall not compromise the Security Credentials or Personal Data stored on it or compromise the integrity of any other Device to which it is connected by means of a Communications Link.

ESME shall be capable of securely disabling Critical Commands other than those Commands set out in *Section 5.6* that are Critical Commands.

ESME shall be capable of verifying its Firmware at power-on and prior to activation of the Firmware, to verify that the Firmware, at that time, is in the form originally received. On failure of verification ESME shall be capable of:

i. generating an entry to that effect in the *Security Log(5.7.5.31)*; and
ii. generating and sending an Alert to that effect via its HAN Interface.

Where ESME comprises more than one Device, each Device other than the Electricity Meter shall be capable of verifying its Firmware at power-on and prior to activation of the Firmware, to verify that the Firmware, at that time, is in the form originally received. On failure of verification ESME shall be capable of:

iii. generating an entry to that effect in the *Security Log(5.7.5.31)*; and
iv. generating and sending an Alert to that effect via its HAN Interface.

ESME shall be capable of logging in the *Security Log(5.7.5.31)* the occurrence and type of any Sensitive Event.

5.5.10.2 Security Credentials

5.5.10.2.1 Meter Private Keys

ESME shall be capable of generating Public-Private Key Pairs to support the Cryptographic Algorithms set out in *Section 5.5.10.3*.

ESME shall be capable of securely storing such Private Keys and shall be capable of formatting and sending via its HAN Interface a Certificate Signing Request containing the corresponding Public Key and the *ESME Identifier(5.7.1.1)*.

ESME shall be capable of securely storing Key Agreement values.

5.5.10.2.2 Public Key Certificates

ESME shall be capable of securely storing Security Credentials from Certificates including for use in the Cryptographic Algorithms as set out in *Section 5.5.10.3*.

During the replacement of any *ESME Security Credentials(5.7.4.18)* (as set out in *Section 5.6.3.20*), ESME shall be capable of ensuring that the *ESME Security Credentials(5.7.4.18)* being replaced remain usable until the successful completion of the replacement.

5.5.10.2.3 Role-based Access Control (RBAC)

ESME shall be capable of restricting Authorisation to execute Commands and of issuing Alerts according to Role permissions.

5.5.10.3 Cryptographic Algorithms

ESME shall be capable of supporting the following Cryptographic Algorithms:

i. Elliptic Curve DSA;
ii. Elliptic Curve DH; and
iii. SHA-256.

In executing and creating any Command, Response or Alert, ESME shall be capable of applying Cryptographic Algorithms (alone or in combination) for:

iv. Digital Signing;
v. Digital Signature verification;
vi. Hashing;
vii. Message Authentication; and
viii. Encryption and Decryption.

5.5.10.4 Firmware

ESME shall only be capable of activating Firmware on receipt of an Activate Firmware Command (as set out in *Section 5.6.3.2*).

5.5.10.5 Communications

ESME shall be capable of preventing and detecting, on all of its interfaces, Unauthorised access that could compromise the Confidentiality and / or Data Integrity of:

i. Personal Data whilst being transferred via an interface;
ii. Consumption data used for billing whilst being transferred via an interface;
iii. Security Credentials whilst being transferred via an interface; and
iv. Firmware and data essential for ensuring its integrity whilst being transferred via an interface,

and any Command that could compromise the Confidentiality and / or Data Integrity of:

v. Personal Data;
vi. Consumption data used for billing;
vii. Security Credentials; and
viii. Firmware and data essential for ensuring its integrity,

stored or executing on ESME, and on such detection shall be capable of:

ix. generating an entry to that effect in the *Security Log(5.7.5.31)*; and
x. generating and sending an Alert to that effect via its HAN Interface.

ESME shall be capable of employing techniques to protect against Replay Attacks relating to Commands received.

ESME shall not be capable of executing a Command to modify or delete entries from the *Security Log(5.7.5.31)*.

5.5.11 Controlling Auxiliary Loads

ESME shall be capable of supporting up to a maximum combined total of five Auxiliary Load Control Switches and HAN Connected Auxiliary Load Control Switches.

5.5.11.1 Calendar-based switching of HAN Connected Auxiliary Loads

ESME shall be capable of monitoring the *Auxiliary Load Control Switch Calendar(5.7.4.2)* and at times defined in the calendar:

i. where a *Set HAN Connected Auxiliary Load Control Switch [n] State(5.6.3.33)* Command has been issued and the time period has not elapsed, taking no further action;
ii. where the *Supply State [INFO](5.7.5.32)* is Disabled or Armed, taking no further action; and
iii. where the *Supply State [INFO](5.7.5.32)* is Enabled, applying the *Randomised Offset(5.7.5.28)* and then issuing a *Control HAN Connected Auxiliary Load Control Switch(5.6.4.1)* Command containing the time period remaining until the next switching event defined in the calendar for HCALCS [n] (taking account of the *Randomised Offset(5.7.5.28)*).

On receipt of a *Request Control of HAN Connected Auxiliary Load Control Switch(5.6.3.21)* Command and on receipt of a *Reset HAN Connected Auxiliary Load Control Switch [n] State(5.6.3.24)* Command ESME shall be capable of:

iv. where the *Supply State [INFO](5.7.5.32)* is Disabled or Armed, taking no further action; and
v. where the *Supply State [INFO](5.7.5.32)* is Enabled, issuing a *Control HAN Connected Auxiliary Load Control Switch(5.6.4.1)* Command to set the commanded state of HCALCS [n] according to the rules defined in the *Auxiliary Load Control Switch Calendar(5.7.4.2)* containing the time period remaining until the next switching event defined in the calendar for HCALCS [n] (taking account of the *Randomised Offset(5.7.5.28)*).

When controlling an HCALCS as set out in this *Section 5.5.11*, ESME shall be capable of applying the *Randomised Offset(5.7.5.28)*.

5.5.12 Voltage Quality Measurements

5.5.12.1 Average RMS voltage

ESME shall be capable of calculating the average value of RMS voltage over a configurable period as defined in the *Average RMS Voltage Measurement Period(5.7.4.6)* and:

i. recording the value calculated (including the UTC date and time at the end of the period to which the value relates) in the *Average RMS Voltage Profile Data Log(5.7.5.9)*;
ii. detecting when the value calculated is above the *Average RMS Over Voltage Threshold(5.7.4.4)*, and on detection:
    a) counting the number of such occurrences in the *Average RMS Over Voltage Counter*(*5.7.5.7*);
    b) where the value calculated in the prior configurable period was below the *Average RMS Over Voltage Threshold*(*5.7.4.4*):
        - generating an entry to that effect in the *Power Event Log(5.7.5.25)*; and
        - generating and sending an Alert to that effect via its HAN Interface.
iii. detecting when the value calculated is below the *Average RMS Over Voltage Threshold(5.7.4.4)*, and where the value calculated in the prior configurable period was above the *Average RMS Over Voltage Threshold(5.7.4.4)*:
    a) generating an entry to that effect in the Power Event Log(5.7.5.25); and
    b) generating and sending an Alert to that effect via its HAN Interface.
iv. detecting when the value calculated is below the *Average RMS Under Voltage Threshold(5.7.4.5)*, and on detection:

a) counting the number of such occurrences in the *Average RMS Under Voltage Counter*(*5.7.5.8*);
b) where the value calculated in the prior configurable period was above the *Average RMS Under Voltage Threshold*(*5.7.4.5*):

- generating an entry to that effect in the *Power Event Log(5.7.5.25)*; and
- generating and sending an Alert to that effect via its HAN Interface.

v. detecting when the value is above the *Average RMS Under Voltage Threshold(5.7.4.5)*, and where the value calculated in the prior configurable period was below the *Average RMS Under Voltage Threshold(5.7.4.5)*:

a) generating an entry to that effect in the Power Event Log(5.7.5.25); and
b) generating and sending an Alert to that effect via its HAN Interface.

5.5.12.2 RMS extreme over voltage detection

ESME shall be capable of:

i. detecting when the RMS voltage rises above the *RMS Extreme Over Voltage Threshold(5.7.4.35)* for a continuous period longer than the *RMS Extreme Over Voltage Measurement Period(5.7.4.34)* and on detection:

a) generating an entry to that effect in the Power Event Log(5.7.5.25); and
b) generating and sending an Alert to that effect via its HAN Interface; and

ii. detecting when the RMS voltage returns below the *RMS Extreme Over Voltage Threshold(5.7.4.35)* for a continuous period longer than the *RMS Extreme Over Voltage Measurement Period(5.7.4.34)* and on detection:

a) generating an entry to that effect in the Power Event Log(5.7.5.25); and
b) generating and sending an Alert to that effect via its HAN Interface.

5.5.12.3 RMS extreme under voltage detection

ESME shall be capable of:

i. detecting when the RMS voltage falls below the *RMS Extreme Under Voltage Threshold(5.7.4.37)* for a continuous period longer than the *RMS Extreme Under Voltage Measurement Period(5.7.4.36)* and on detection:

a) generating an entry to that effect in the Power Event Log(5.7.5.25);
b) generating and sending an Alert to that effect via its HAN Interface;

ii. detecting when the RMS voltage rises back above the *RMS Extreme Under Voltage Threshold(5.7.4.37)* for a continuous period longer than the *RMS Extreme Under Voltage Measurement Period(5.7.4.36)* and on detection:

a) generating an entry to that effect in the Power Event Log(5.7.5.25);
b) generating and sending an Alert to that effect via its HAN Interface;

5.5.12.4 RMS voltage sag detection

ESME shall be capable of:

i. detecting when the RMS voltage falls below the *RMS Voltage Sag Threshold(5.7.4.40)* for a continuous period longer than the *RMS Voltage Sag Measurement Period(5.7.4.38)* and on detection:

a) generating an entry to that effect in the Power Event Log(5.7.5.25); and
b) generating and sending an Alert to that effect via its HAN Interface;

ii. detecting when the RMS voltage returns above the *RMS Voltage Sag Threshold(5.7.4.40)* for longer than the *RMS Voltage Sag Measurement Period(5.7.4.38)* and on detection:

a) generating an entry to that effect in the Power Event Log(5.7.5.25); and
b) generating and sending an Alert to that effect via its HAN Interface.

5.5.12.5 RMS voltage swell detection

ESME shall be capable of:

i. detecting when the RMS voltage rises above the *RMS Voltage Swell Threshold(5.7.4.41)* for a continuous period longer than the *RMS Voltage Swell Measurement Period(5.7.4.39)* and on detection:

a) generating an entry to that effect in the Power Event Log(5.7.5.25); and
b) generating and sending an Alert to that effect via its HAN Interface;

ii. detecting when the RMS voltage returns below the *RMS Voltage Swell Threshold(5.7.4.41)* for a continuous period longer than the *RMS Voltage Swell Measurement Period(5.7.4.39)* and on detection:

a) generating an entry to that effect in the Power Event Log(5.7.5.25); and
b) generating and sending an Alert to that effect via its HAN Interface.

5.5.12.6 Supply outage reporting

ESME shall be capable of recording the UTC date and time at which the Supply is interrupted and the UTC date and time when the Supply is restored and:

i. generating entries to that effect in the *Power Event Log(5.7.5.25)*;
ii. following restoration of the Supply, generating and sending an Alert to that effect via its HAN Interface containing details of the UTC dates and times of interruption and restoration; and
iii. following restoration of the Supply, when the time difference between the Supply being interrupted and restored is greater than or equal to three minutes, generating and sending an Alert to that effect via its HAN Interface containing details of the UTC dates and times of interruption and restoration.

5.5.13 ESME Operational Integrity

ESME shall be capable of taking all reasonable steps to detect conditions affecting its Smart Meter Operational Integrity and on such detection shall be capable of generating an entry to that effect in the *Event Log(5.7.5.16)* and generating and sending an Alert to that effect via its HAN Interface where reasonably practicable, including in the Alert information relating to the nature of the condition detected.

5.6 Interface Requirements

This Section describes the minimum required interactions which ESME shall be capable of undertaking via its HAN Interface and its User Interface (including with Devices as set out in *Sections 5.5.2.2* and *5.5.2.3*).

5.6.1 Type 1 Devices and Type 2 Device information provision

ESME shall be capable, immediately upon establishment of a Communications Link with Type 1 Devices (as set out in *Section 5.5.2.2*) and Type 2 Devices (as set out in *Section 5.5.2.3*), of providing the data annotated [INFO] set out in *Sections 5.7.1*, *5.7.4* and *5.7.5* to Type 1 Devices and Type 2 Devices (with timely updates of any changes to all data).

5.6.2 User Interface Commands

ESME shall be capable of executing immediately the Commands set out in this *Section 5.6.2* following their receipt via its User Interface.

ESME shall be capable of logging all such Commands received and Outcomes in the *Event Log(5.7.5.16)*.

5.6.2.1 Activate Emergency Credit [PIN]

A Command to activate Emergency Credit when ESME is operating in Prepayment Mode where Emergency Credit is available (as set out in *Section 5.5.7.2*).

In executing the Command, if the Supply is Disabled, ESME shall be capable of Arming the Supply if the combined credit of the *Meter Balance [INFO](5.7.5.22)* and *Emergency Credit Balance [INFO](5.7.5.15)* rises above the *Disablement Threshold [INFO](5.7.4.15)*, displaying any such change in the *Supply State [INFO](5.7.5.32)* on its User Interface and generating and sending an Alert that the Supply has been Armed via its HAN Interface.

5.6.2.2 Add Credit

A Command to accept credit to be applied to ESME when ESME is operating in Prepayment Mode on input of a UTRN. In executing the Command, ESME shall be capable of:

i. comparing the credit value of the UTRN with the *Maximum Credit Threshold(5.7.4.25)* and rejecting the UTRN where the credit value is greater than that threshold;
ii. comparing the projected new *Meter Balance [INFO](5.7.5.22)* (calculated on the basis of *(xii)* to *(xv)* below and the credit value of the UTRN and rejecting the UTRN where the projected new *Meter Balance [INFO](5.7.5.22)* is greater than the *Maximum Meter Balance Threshold(5.7.4.27)*;
iii. verifying the Authenticity of the UTRN;
iv. verifying that ESME is the intended recipient of the UTRN;
v. using the UTRN to generate a UTRN Counter, and comparing this against the last 100 verified UTRN Counters and rejecting duplicate presentation of verified UTRNs; and
vi. controlling the number of invalid UTRN entries entered and processed.

ESME shall be capable of generating an entry in the *Security Log(5.7.5.31)*:

vii. where the UTRN is rejected as set out in *(i)* above;
viii. where the UTRN is rejected as set out in *(ii)* above;
ix. on failure of *(iii)* above;
x. on failure of *(iv)* above; and
xi. where duplicates are rejected as set out in *(v)* above.

In executing the Command, ESME shall be capable of applying the credit added in the following order:

xii. recovery of payment-based debt of an amount defined by *Debt Recovery per Payment [INFO](5.7.4.11)* from the *Payment Debt Register [INFO](5.7.5.23)* subject to the *Debt Recovery Rate Cap [INFO](5.7.4.13)*;
xiii. recovery of debt accumulated in the *Accumulated Debt Register [INFO](5.7.5.1)*;
xiv. repayment of Emergency Credit activated and used by the Consumer; and
xv. adding remaining credit (the credit after deduction of *(xii)*, *(xiii)* and *(xiv)* above) to the *Meter Balance [INFO] (5.7.5.22)*.

In executing the Command, ESME shall be capable of Arming the Supply if the *Meter Balance [INFO](5.7.5.22)* rises above the *Disablement Threshold [INFO](5.7.4.15)* and

displaying any such change in the *Supply State [INFO](5.7.5.32)* on its User Interface and generating and sending an Alert that the Supply has been Armed via its HAN Interface.

In executing the Command, ESME shall be capable of:

xvi. recording the credit applied to the *Meter Balance [INFO](5.7.5.22)* and the amount of payment-based debt recovered (as set out in *(xii)*) in the *Billing Data Log(5.7.5.10)*; and

xvii. generating and sending an Alert containing the UTC date and time of the last update of the *Meter Balance [INFO](5.7.5.22)* via its HAN Interface.

5.6.2.3 Allow Access to User Interface

Where Privacy PIN Protection is enabled, a Command to enable temporary access to the restricted display items annotated [PIN] in *Section 5.5.4* and the restricted User Interface Commands annotated [PIN] in *Section 5.6.2* on input of a number that matches the *Privacy PIN(5.7.3.1)*.

5.6.2.4 Disable Privacy PIN Protection [PIN]

A Command to disable Privacy PIN Protection.

5.6.2.5 Enable Supply [PIN]

A Command to Enable the Supply if the Supply is Armed.

In executing the Command ESME shall be capable of setting the *Supply State [INFO](5.7.5.32)* accordingly.

5.6.2.6 Find Smart Metering Home Area Network and Re-establish Communications Links

A Command to seek the frequency at which a ZigBee SEP Smart Metering Home Area Network is operating and then:

i. re-establish the Communications Links set out in *Sections 5.5.2.1, 5.5.2.2* and *5.5.2.3*;

ii. generate an entry to that effect in the *Event Log(5.7.5.16)*; and

iii. generate and sending an Alert to that effect via its HAN Interface.

Where the ESME has Communications Links set out in *5.6.2.6(i)* ESME shall be capable of not executing the Command.

5.6.2.7 Set Privacy PIN [PIN]

A Command to set a new value of the *Privacy PIN(5.7.3.1)*.

In executing the Command where Privacy PIN Protection is disabled ESME shall be capable of enabling Privacy PIN Protection.

5.6.3 HAN Interface Commands

ESME shall be capable of executing the Commands set out in this Section. ESME shall be capable of logging all Commands received and Outcomes in the *Event Log(5.7.5.16)*.

ESME shall be capable of executing Commands immediately on receipt ('immediate Commands') and where specified in the Great Britain Companion Specification at a future date ('future dated Commands'). A future dated Command shall include the UTC date and time at which the Command shall be executed by ESME.

ESME shall be capable of cancelling a future dated Command. A future dated Command shall be capable of being cancelled by an Authorised party, subject to RBAC (as set out in

Section 5.5.10.2.3). ESME shall be capable of generating and sending a Response acknowledging that a future dated Command has been successfully cancelled.

5.6.3.1 Activate Emergency Credit

A Command to activate Emergency Credit when ESME is operating in Prepayment Mode where Emergency Credit is available (as set out in *Section 5.5.7.2*).

In executing the Command where the Supply is Disabled ESME shall be capable of Arming the Supply if the combined credit of the *Meter Balance [INFO](5.7.5.22)* and *Emergency Credit Balance [INFO](5.7.5.15)* rises above the *Disablement Threshold [INFO](5.7.4.15)*, displaying any such change in the *Supply State [INFO](5.7.5.32)* on its User Interface and generating and sending an Alert that the Supply has been Armed via its HAN Interface.

When operating in Credit Mode, ESME shall be capable of not executing the Command and generating and sending a Response to that effect via its HAN Interface.

5.6.3.2 Activate Firmware

A Command to activate Firmware.

In executing the Command ESME shall be capable of installing new Firmware using a mechanism that is robust against failure and loss of data.

The new Firmware shall include version information. Where new Firmware is successfully installed, ESME shall be capable of recording the version information of that new Firmware in *Firmware Version(5.7.5.17)*.

5.6.3.3 Add Credit

A Command to accept credit to be applied to ESME when ESME is operating in Prepayment Mode on receipt of: a UTRN from a Type 1 Device or a UTRN from an Authorised party.

In executing the Command following receipt of a UTRN from a Type 1 Device ESME shall be capable of applying credit as set out in *Section 5.6.2.2*.

In executing the Command following receipt of a UTRN from an Authorised party, ESME shall be capable of:

i. comparing the credit value of the UTRN with the *Maximum Credit Threshold(5.7.4.25)* and rejecting the UTRN where the credit value is greater than that threshold;
ii. comparing the projected new *Meter Balance [INFO](5.7.5.22)* (calculated on the basis of *(xii)* to *(xv)* below and the credit value of the UTRN and rejecting the UTRN where the projected new *Meter Balance [INFO](5.7.5.22)* is greater than the *Maximum Meter Balance Threshold(5.7.4.27)*;
iii. verifying the Authenticity of the UTRN;
iv. verifying that ESME is the intended recipient of the UTRN;
v. comparing the UTRN Counter against the last 100 verified UTRN Counters and rejecting duplicate presentation of verified UTRNs; and
vi. controlling the number of invalid UTRN entries entered and processed.

ESME shall be capable of generating an entry in the *Security Log(5.7.5.31)*:

vii. where the UTRN is rejected as set out in *(i)* above;
viii. where the UTRN is rejected as set out in *(ii)* above;
ix. on failure of *(iii)* above;
x. on failure of *(iv)* above; and
xi. where duplicates are rejected as set out in *(v)* above.

In executing the Command, ESME shall be capable of applying the credit added in the following order:

xii. recovery of payment-based debt of an amount defined by *Debt Recovery per Payment [INFO](5.7.4.11)* from the *Payment Debt Register [INFO](5.7.5.23)* subject to the *Debt Recovery Rate Cap [INFO](5.7.4.13)*;
xiii. recovery of debt accumulated in the *Accumulated Debt Register [INFO](5.7.5.1)*;
xiv. repayment of Emergency Credit activated and used by the Consumer; and
xv. adding remaining credit (the credit after deduction of *(xii), (xiii)* and *(xiv)* above*)* to the *Meter Balance [INFO](5.7.5.22)*.

In executing the Command, ESME shall be capable of Arming the Supply if the *Meter Balance [INFO](5.7.5.22)* rises above the *Disablement Threshold [INFO](5.7.4.15)*, displaying any such change in the *Supply State [INFO](5.7.5.32)* on its User Interface and generating and sending an Alert that the Supply has been Armed via its HAN Interface.

In executing the Command, ESME shall be capable of recording the credit applied to the *Meter Balance [INFO](5.7.5.22)* and the amount of payment-based debt recovered (as set out in *(xii)*) in the *Billing Data Log(5.7.5.10)*.

In executing the Command from a Type 1 Device, ESME shall be capable of generating and sending an Alert containing the UTC date and time stamp of the last update of the *Meter Balance [INFO](5.7.5.22)* via its HAN Interface.

When operating in Credit Mode, ESME shall be capable of not executing the Command and generating and sending a Response to that effect via its HAN Interface.

5.6.3.4 Add Device Security Credentials

A Command to add Security Credentials for a Type 1 Device or a Type 2 Device to the *Device Log(5.7.4.14)*.

In executing the Command, ESME shall be capable of:

i. verifying the Security Credentials; and
ii. recording the Command and Outcome to the *Security Log(5.7.5.31)*.

5.6.3.5 Adjust Debt

A Command to apply positive and negative adjustments to the *Time Debt Registers [1 … 2] [INFO](5.7.5.36)* and the *Payment Debt Register [INFO](5.7.5.23)* when operating in Prepayment Mode.

When operating in Credit Mode, ESME shall be capable of not executing the Command and generating and sending a Response to that effect via its HAN Interface.

5.6.3.6 Adjust Meter Balance

A Command to apply positive and negative adjustments to the *Meter Balance [INFO](5.7.5.22)*.

In executing the Command where ESME is operating in Prepayment Mode and where, following any such adjustment, the *Meter Balance [INFO](5.7.5.22)* rises above the *Disablement Threshold [INFO](5.7.4.15)*, ESME shall be capable of Arming the Supply and displaying any such change in the *Supply State [INFO](5.7.5.32)* on its User Interface, generating and sending an Alert that the Supply has been Armed via its HAN Interface.

5.6.3.7 Arm Supply

A Command to return ESME from a Locked state to an Unlocked state.

In executing the Command where the state of the Supply is Enabled or Armed, ESME shall Arm the Supply and shall set the *Supply State [INFO](5.7.5.32)* to Armed.

In executing the Command where the state of the Supply is only Disabled as a result of:

i. a Disable Supply Command; or
ii. an attempt at Unauthorised Physical Access through its Secure Perimeter and the *Supply Tamper State(5.7.4.44)*,

ESME shall Arm the Supply and shall set the *Supply State [INFO](5.7.5.32)* to Armed; otherwise ESME shall not Arm the Supply.

5.6.3.8 Clear Auxiliary Load Control Switch Event Log

A Command to clear all entries from the *Auxiliary Load Control Switch Event Log(5.7.5.6)*. ESME shall be capable of logging that the Command has been executed in the *Security Log(5.7.5.31)*.

5.6.3.9 Clear Event Log

A Command to clear all entries from the *Event Log(5.7.5.16)*. ESME shall be capable of logging that the Command has been executed in the *Security Log(5.7.5.31)*.

5.6.3.10 Disable Privacy PIN Protection

A Command to disable Privacy PIN Protection.

5.6.3.11 Disable Supply

A Command to establish a Locked state whereby the Supply is Disabled and can only be Enabled or Armed in response to a Command to Arm the Supply (as described in *Section 5.6.3.7*) or Enable the Supply (as described in *Section 5.6.3.12*).

In executing the Command ESME shall be capable of setting the *Supply State(5.7.5.32)* to Disabled.

5.6.3.12 Enable Supply

A Command to return ESME from a Locked state to an Unlocked state.

In executing the Command where the state of the Supply is Enabled or Armed, ESME shall Enable the Supply and shall set the *Supply State [INFO](5.7.5.32)* to Enabled.

In executing the Command where the state of the Supply is only Disabled as a result of:

i. a Disable Supply Command; or
ii. an attempt at Unauthorised Physical Access through its Secure Perimeter and the *Supply Tamper State(5.7.4.44)*,

ESME shall Enable the Supply and shall set the *Supply State [INFO](5.7.5.32)* to Enabled; otherwise ESME shall not Enable the Supply.

5.6.3.13 Issue ESME Security Credentials

A Command to generate a Public-Private Key Pair and issue a corresponding Certificate Signing Request.

5.6.3.14 PPMID Enable Supply

A Command issued by a PPMID to Enable the Supply if the Supply is Armed. In executing the Command ESME shall be capable of setting the *Supply State [INFO](5.7.5.32)* accordingly.

5.6.3.15 Read Configuration Data

A Command to read the value of one or more of the configuration data items set out in *Section 5.7.4*.

In executing the Command, ESME shall be capable of sending such value(s) in a Response via its HAN Interface.

5.6.3.16 Read Constant Data

A Command to read the value of one or more of the constant data items set out in *Section 5.7.1*.

In executing the Command, ESME shall be capable of sending such value(s) in a Response via its HAN Interface.

5.6.3.17 Read Operational Data

A Command to read the value of one or more of the operational data items set out in *Section 5.7.5*.

In executing the Command, ESME shall be capable of sending such value(s) in a Response via its HAN Interface.

5.6.3.18 Receive Firmware

A Command to receive Firmware.

In executing the Command ESME shall be capable of:

i. only accepting new Firmware from an Authorised and Authenticated source; and
ii. verifying the Authenticity and integrity of new Firmware before installation.

5.6.3.19 Remove Device Security Credentials

A Command to remove Security Credentials for a Type 1 Device or a Type 2 Device from the *Device Log(5.7.4.14)*.

In executing the Command ESME shall be capable of recording the Command and Outcome to the *Security Log(5.7.5.31)*.

5.6.3.20 Replace ESME Security Credentials

A Command to replace *ESME Security Credentials(5.7.4.18)*.

In executing the Command ESME shall be capable of:

i. maintaining the Command's Transactional Atomicity; and
ii. recording the Command and Outcome to the *Security Log(5.7.5.31)*.

5.6.3.21 Request Control of HAN Connected Auxiliary Load Control Switch

A Command issued by an HCALCS requesting that an ESME issues a *Control HAN Connected Auxiliary Load Control Switch(5.6.4.1)* Command according to the rules set out in *Section 5.5.11*.

5.6.3.22 Reset Average RMS Over Voltage Counter

A Command to reset the *Average RMS Over Voltage Counter(5.7.5.7)* to zero.

5.6.3.23 Reset Average RMS Under Voltage Counter

A Command to reset the *Average RMS Under Voltage Counter(5.7.5.8)* to zero.

5.6.3.24 Reset HAN Connected Auxiliary Load Control Switch [n] State

A Command to revert to the state commanded by the *Auxiliary Load Control Switch Calendar(5.7.4.2)*. In executing the Command, according to the rules set out in *Section 5.5.11.1*, ESME shall be capable of issuing a *Control HAN Connected Auxiliary Load Control Switch(5.6.4.1)* Command to HCALCS [n].

5.6.3.25 Reset Load Limit Counter

A Command to reset the *Load Limit Counter(5.7.5.18)* to zero.

5.6.3.26 Reset Maximum Demand Active Power Import Value

A Command to reset the *Maximum Demand Active Power Import Value(5.7.5.19)*.

5.6.3.27 Reset Maximum Demand Active Power Export Value

A Command to reset the *Maximum Demand Active Power Export Value(5.7.5.21)*.

5.6.3.28 Reset Maximum Demand (Configurable Time) Active Power Import Value

A Command to reset the *Maximum Demand (Configurable Time) Active Power Import* Value*(5.7.5.20)*.

5.6.3.29 Reset Meter Balance

A Command to reset the *Meter Balance [INFO](5.7.5.22)* to zero.

In executing the Command, ESME shall reset the Accumulated Debt Register *[INFO](5.7.5.1)*, the Emergency Credit activated and used, and the *Emergency Credit Balance [INFO](5.7.5.15)*.

5.6.3.30 Reset Tariff Block Counter Matrix

A Command to reset the *Tariff Block Counter Matrix [INFO](5.7.5.33)* to zero.

5.6.3.31 Restrict Data

A Command to restrict provision to Type 1 Devices and Type 2 Devices of all items of Personal Data stored in ESME which have a UTC date and time stamp prior to the date and time stamp specified in the Restrict Data Command.

5.6.3.32 Set Clock

A Command to set the Clock date and time via its HAN Interface.

In executing the Command, ESME shall be capable of comparing the date and time specified in the Command with the Communications Hub Date and Time. Where the difference is:

i. within the tolerance specified in the Command ESME shall be capable of adjusting its date and time to the Communications Hub Date and Time and generating an entry to that effect in the *Event Log(5.7.5.16)*; and
ii. outside the tolerance specified in the Command ESME shall be capable of not adjusting its date and time and:
    a) generating an entry to that effect in the Event Log(*5.7.5.16*); and
    b) generating and sending an Alert to that effect via its HAN Interface.

ESME shall be capable of ensuring that any adjustments do not cause calendar-based events to be missed or future-dated Commands to be missed or repeated.

5.6.3.33 Set HAN Connected Auxiliary Load Control Switch [n] State

A Command to ignore the state defined in *Auxiliary Load Control Switch Calendar(5.7.4.2)* and to issue a *Control HAN Connected Auxiliary Load Control Switch (5.6.4.1)* Command to HCALCS [n] for a time period specified within the 'Set HAN Connected Auxiliary Load Control Switch [n] State Command'.

ESME shall only be capable of issuing a Command to set HCALCS [n] as closed when the *Supply State [INFO](5.7.5.32)* is Enabled.

5.6.3.34 Set Payment Mode

A Command to set the payment mode as either Prepayment Mode or Credit Mode and to record the mode of operation in *Payment Mode [INFO](5.7.4.31)*.

In executing the Command, ESME shall be capable of taking a UTC date and time stamped copy of:

i. the *Tariff TOU Register Matrix [INFO](5.7.5.34)*;
ii. the *Tariff TOU Block Register Matrix(5.7.5.35)*; and
iii. the *Active Import Register [INFO](5.7.5.3)*,

and unless in Credit Mode both before and after execution of the Command:

iv. the *Meter Balance [INFO](5.7.5.22)*;
v. the *Emergency Credit Balance [INFO](5.7.5.15)*;
vi. the *Payment Debt Register [INFO](5.7.5.23)*;
vii. the *Time Debt Registers [1 … 2] [INFO](5.7.5.36)*; and
viii. the *Accumulated Debt Register [INFO](5.7.5.1)*,

in the *Billing Data Log(5.7.5.10)*.

5.6.3.35 Set Tariff

A Command to accept new values for *Tariff TOU Price Matrix [INFO](5.7.4.50), Tariff Block Price Matrix [INFO](5.7.4.47)*, *Tariff Switching Table(5.7.4.48)* and *Tariff Threshold Matrix [INFO](5.7.4.49)*.

In executing the Command, ESME shall be capable of taking a UTC date and time stamped copy of:

i. the *Tariff TOU Register Matrix [INFO](5.7.5.34)*;
ii. the *Tariff TOU Block Register Matrix(5.7.5.35)*; and
iii. the *Active Import Register [INFO](5.7.5.3)*,

and where in Prepayment mode:

iv. the *Meter Balance [INFO](5.7.5.22)*;
v. the Emergency Credit Balance *[INFO](*5.7.5.15*)*;
vi. the *Payment Debt Register [INFO](5.7.5.23)*;
vii. the *Time Debt Registers [1 … 2] [INFO](5.7.5.36)*; and
viii. the *Accumulated Debt Register [INFO](5.7.5.1)*,

in the *Billing Data Log(5.7.5.10)*.

5.6.3.36 Write Configuration Data

A Command to record one or more new values of the configuration data items set out in *Section 5.7.4*.

In executing the Command, ESME shall be capable of generating an entry to that effect in the *Event Log(5.7.5.16)*.

5.6.4 HAN Interface Commands issued by ESME

ESME shall be capable of issuing the Commands set out in this Section, receiving corresponding Responses and, where required by a Response, taking the required actions.

5.6.4.1 Control HAN Connected Auxiliary Load Control Switch

A Command requesting that a HAN Connected Auxiliary Load Control Switch either closes or opens its switch for a time period specified within the Command. The ESME shall be capable of issuing a *Control HAN Connected Auxiliary Load Control Switch(5.6.4.1)* Command according to the rules set out in *Section 5.5.11.1*.

In executing the Command, ESME shall be capable of recording the Command and Outcome to the *Auxiliary Load Control Switch Event Log(5.7.5.6)*.

5.7 Data Requirements

This Section describes the minimum information which ESME shall be capable of holding in its Data Store.

5.7.1 Constant data

Describes data that remains constant and unchangeable at all times.

5.7.1.1 ESME Identifier

A globally unique identifier used to identify ESME based on the EUI-64 Institute of Electrical and Electronic Engineers standard.

5.7.1.2 Manufacturer Identifier

An identifier used to identify the manufacturer of ESME.

5.7.1.3 Model Type

An identifier used to identify the model of ESME.

5.7.1.4 Meter Variant

A data item to indicate if ESME is Single Element Electricity Metering Equipment, Twin Element Electricity Metering Equipment or Polyphase Electricity Metering Equipment.

5.7.1.5 Randomised Offset Number

A randomly generated value between 0 and 1.

5.7.2 This Section is not used

5.7.3 Locally Set Configuration Data

Describes data that is configured by execution of a User Interface Command and that is not available outside ESME.

5.7.3.1 Privacy PIN

A number comprising four digits used by the Consumer to enable temporary access to a specified set of display items and Commands via the User Interface of ESME.

5.7.4 Configuration data

Describes data that configures the operation of various functions of ESME.

5.7.4.1 Alerts Configuration Settings

Settings to control whether to generate and send an Alert.

5.7.4.2 Auxiliary Load Control Switch Calendar

A Switching Table containing a set of rules for setting the commanded state of up to five Auxiliary Load Control Switches or HAN Connected Auxiliary Load Control Switches as open and closed.

The rules stored within the table shall specify which Day Profile should be used to set the commanded state of each Auxiliary Load Control Switch or HAN Connected Auxiliary Load Control Switch according to:

i. where the day is one of 20 Special Days, the Day Profile specified for that day and the Day Profile specified for that day of the Week; or
ii. where the day is not a Special Day, the Day Profile specified for that day of the Week.

The Switching Table shall support up to 48 switching rules across all Day Profiles.

All dates and times shall be specified in UTC.

5.7.4.3 Auxiliary Load Control Switch [n] Description [INFO]

For each Auxiliary Load Control Switch or HAN Connected Auxiliary Load Control Switch, a description of the type of controlled load connected, the switch type and, for HAN Connected Auxiliary Load Control Switches, the *HCALCS Identifier(8.6.1.1)*.

5.7.4.4 Average RMS Over Voltage Threshold

The average RMS voltage above which an over voltage condition is reported. The threshold shall be configurable within the specified operating range of ESME.

5.7.4.5 Average RMS Under Voltage Threshold

The average RMS voltage below which an under voltage condition is reported. The threshold shall be configurable within the specified operating range of ESME.

5.7.4.6 Average RMS Voltage Measurement Period

The length of time in seconds over which the RMS voltage is averaged.

5.7.4.7 Billing Calendar

A calendar defining billing dates for the storage of billing related information in the *Billing Data Log(5.7.5.10)*.

5.7.4.8 Contact Details [INFO]

The name and contact telephone number of the Supplier.

5.7.4.9 Currency Units [INFO]

The Currency Units currently used by ESME, which shall be either GB Pounds or European Central Bank Euro.

5.7.4.10 Customer Identification Number [INFO]

A number issued to ESME for display on the User Interface.

5.7.4.11 Debt Recovery per Payment [INFO]

The percentage of a payment to be recovered against debt when ESME is operating Payment-based Debt Recovery in Prepayment Mode.

5.7.4.12 Debt Recovery Rates [1 … 2] [INFO]

Two debt recovery rates in Currency Units per unit time for when ESME is using Time-based Debt Recovery in Prepayment Mode.

5.7.4.13 Debt Recovery Rate Cap [INFO]

The maximum amount in Currency Units per unit time that can be recovered through Payment-based Debt Recovery when ESME is operating in Prepayment Mode.

5.7.4.14 Device Log

The Security Credentials for each of the Type 1 Devices and Type 2 Devices with which ESME can establish Communications Links.

5.7.4.15 Disablement Threshold [INFO]

The threshold in Currency Units for controlling when to Disable the Supply.

5.7.4.16 Emergency Credit Limit [INFO]

The amount of Emergency Credit in Currency Units to be made available to a Consumer where Emergency Credit is activated by the Consumer.

5.7.4.17 Emergency Credit Threshold [INFO]

The threshold in Currency Units below which Emergency Credit Balance *[INFO](5.7.5.15)* may be activated by the Consumer if so configured when ESME is operating in Prepayment Mode.

5.7.4.18 ESME Security Credentials

The Security Credentials for ESME and parties Authorised to establish Communications Links with it.

5.7.4.19 Load Limit Period

The length of time in seconds which the Active Power Import *[INFO](5.7.5.4)* needs to continuously exceed the *Load Limit Power Threshold(5.7.4.20)* before a load limiting event is deemed to have occurred.

5.7.4.20 Load Limit Power Threshold

The Active Power threshold in kW above which the measurement of a *Load Limit Period(5.7.4.19)* is commenced.

5.7.4.21 Load Limit Restoration Period

The length of time in seconds after the Supply has been Armed following a Load Limiting Event before the Supply is Enabled by ESME.

5.7.4.22 Load Limit Supply State

A setting to control the state of the Supply in the case of a load limiting occurring, being Disabled or unchanged.

5.7.4.23 Low Credit Threshold [INFO]

The threshold in Currency Units below which a low credit Alert is signalled.

5.7.4.24 Low Medium Power Threshold [INFO]

A value in kW defining the threshold between an indicative low and medium *Active Power Import [INFO](5.7.5.4)* level.

5.7.4.25 Maximum Credit Threshold

The maximum credit which can be applied by any Add Credit Command.

5.7.4.26 Maximum Demand Configurable Time Period

A single time period of up to 24 hours comprising a number of half-hour periods (commencing at the start of minutes 00 and 30 in each hour) during which recording to the *Maximum Demand (Configurable Time) Active Power Import Value(5.7.5.20)* is active.

5.7.4.27 Maximum Meter Balance Threshold

The *Meter Balance [INFO](5.7.5.22)* threshold in Currency Units above which an Add Credit Command is rejected.

5.7.4.28 Meter Point Administration Numbers (MPAN) [INFO]

The reference numbers identifying an electricity metering point for Import and Export.

5.7.4.29 Medium High Power Threshold [INFO]

A value in kW defining the threshold between an indicative medium and high *Active Power Import [INFO](5.7.5.4)* level.

5.7.4.30 Non-Disablement Calendar [INFO]

A Switching Table comprising a set of rules specifying periods during which the Supply will not be Disabled due to the combined credit of the *Meter Balance [INFO](5.7.5.22)* and *Emergency Credit Balance [INFO](5.7.5.15)* falling below the *Disablement Threshold [INFO](5.7.4.15)*, when ESME is operating in Prepayment Mode.

The rules stored within the table shall specify which of five Day Profiles should be used to specify Non-disablement Periods for each day according to:

i. where the day is one of 20 Special Days, the Day Profile specified for that day; or
ii. where the day is not a Special Day, the Day Profile specified by the active Season Profile and Week Profile.

A Day Profile shall contain up to one contiguous time period during which the Supply may be Disabled due to the combined credit of the *Meter Balance [INFO](5.7.5.22)* and *Emergency Credit Balance [INFO](5.7.5.15)* falling below the *Disablement Threshold [INFO](5.7.4.15)*, when ESME is operating in Prepayment Mode.

The rules shall support three Season Profiles and two Week Profiles. Each Week Profile shall support two Day Profiles.

All dates and times shall be specified as UTC.

5.7.4.31 Payment Mode [INFO]

The current mode of operation, being Prepayment Mode or Credit Mode.

5.7.4.32 Public Key Security Credentials Store

A store for Security Credentials relating to Public Keys.

5.7.4.33 Randomised Offset Limit

A value in seconds in the range 0 to 1799.

5.7.4.34 RMS Extreme Over Voltage Measurement Period

The duration in seconds used to measure an extreme over voltage condition.

5.7.4.35 RMS Extreme Over Voltage Threshold

The RMS voltage above which an extreme over voltage condition is reported. The threshold shall be configurable within the specified operating range of ESME.

5.7.4.36 RMS Extreme Under Voltage Measurement Period

The duration in seconds used to measure an extreme under voltage condition.

5.7.4.37 RMS Extreme Under Voltage Threshold

The RMS voltage below which an extreme under voltage condition is reported. The threshold shall be configurable within the specified operating range of ESME.

5.7.4.38 RMS Voltage Sag Measurement Period

The duration in seconds used to measure a voltage sag condition.

5.7.4.39 RMS Voltage Swell Measurement Period

The duration in seconds used to measure a voltage swell condition.

5.7.4.40 RMS Voltage Sag Threshold

The RMS voltage below which a sag condition is reported. The threshold shall be configurable within the specified operating range of ESME.

5.7.4.41 RMS Voltage Swell Threshold

The RMS voltage above which a swell condition is reported. The threshold shall be configurable within the specified operating range of ESME.

5.7.4.42 Standing Charge [INFO]

A charge to be levied in Currency Units per unit time when operating in Credit Mode and Prepayment Mode.

5.7.4.43 Supplier Message [INFO]

A message issued to, and held on, ESME for provision to the Consumer.

5.7.4.44 Supply Tamper State

A setting to control the state of the Supply in the case of Unauthorised Physical Access being detected, being Locked or unchanged.

5.7.4.45 Suspend Debt Disabled

A setting controlling whether debt should be collected when ESME is operating in Prepayment Mode and Supply is Disabled.

5.7.4.46 Suspend Debt Emergency

A setting controlling whether standing charge and debt should be deducted from the *Emergency Credit Balance [INFO](5.7.5.15)* when ESME is operating in Prepayment Mode and Emergency Credit is in use.

5.7.4.47 Tariff Block Price Matrix [INFO]

A 4 x 8 matrix containing Prices for Block Pricing.

5.7.4.48 Tariff Switching Table [INFO]

A set of rules for allocating half-hourly Consumption to a Tariff Register for Time-of-use Pricing and Time-of-use with Block Pricing. The rules stored within the table shall specify which of 16 Day Profiles should be used to allocate Consumption to Tariff Registers according to:

i. where the day is one of 50 Special Days, the Day Profile specified for that day; or
ii. where the day is not a Special Day, the Day Profile specified by the active Season Profile and Week Profile.

The Switching Table shall support four Season Profiles and four Week Profiles. The Switching Table shall support up to 200 switching rules across all Day Profiles.

All dates and times shall be specified as UTC.

5.7.4.49 Tariff Threshold Matrix [INFO]

A 3 x 8 matrix capable of holding thresholds in kWh for controlling Block Tariffs.

5.7.4.50 Tariff TOU Price Matrix [INFO]

A 1 x 48 matrix containing prices for Time-of-use Pricing.

5.7.4.51 Events Configuration Settings

Settings to control, for each Alert described in this *Section 5* and for each event which this *Section 5* requires the ESME to be capable of logging in the *Event Log(5.7.5.16)* or *Power Event Log(5.7.5.25)* which is not a Critical Event, whether an Alarm is sounded and whether an Event Log entry or Power event log entry is created.

5.7.5 Operational data

Describes data used by the functions of ESME for output of information.

5.7.5.1 Accumulated Debt Register [INFO]

The debt resulting from the collection of *Standing Charge [INFO](5.7.4.42)* and / or time-based debt when Emergency Credit is in use as configured by *Suspend Debt Emergency(5.7.4.46)*, when operating in Prepayment Mode.

5.7.5.2 Active Export Register [INFO]

The register recording the cumulative Active Energy Exported.

5.7.5.3 Active Import Register [INFO]

The register recording the cumulative Active Energy Imported.

5.7.5.4 Active Power Import [INFO]

The import of Active Power measured by ESME.

5.7.5.5 Active Tariff Price [INFO]

The Price currently active.

5.7.5.6 Auxiliary Load Control Switch Event Log

A log capable of storing one hundred UTC date and time stamped entries of events related to Auxiliary Load Control Switch*(es)* or HAN Connected Auxiliary Load Control Switch*(es)* arranged as a circular buffer such that when full, further writes shall cause the oldest entry to be overwritten.

5.7.5.7 Average RMS Over Voltage Counter

The number of times the average RMS voltage, as calculated in *Section 5.5.12.1*, has been above the *Average RMS Over Voltage Threshold(5.7.4.4)* since last reset.

5.7.5.8 Average RMS Under Voltage Counter

The number of times the average RMS voltage, as calculated in *Section 5.5.12.1*, has been below the *Average RMS Under Voltage Threshold(5.7.4.5)* since last reset.

5.7.5.9 Average RMS Voltage Profile Data Log

A log capable of storing 4320 entries (including the UTC date and time at the end of the period to which the value relates*)* comprising the averaged RMS voltage for each *Average*

RMS Voltage Measurement Period(5.7.4.6) arranged as a circular buffer such that when full, further writes shall cause the oldest entry to be overwritten.

5.7.5.10 Billing Data Log

A log capable of storing the following UTC date and time stamped entries:

i. twelve entries comprising *Tariff TOU Register Matrix [INFO]*(5.7.5.34*), Tariff TOU Block Register Matrix(5.7.5.35),* the *Active Import Register [INFO](5.7.5.3)*;

and where in Prepayment mode:

ii. five entries comprising the value of prepayment credits;
iii. ten entries comprising the value of payment-based debt payments [INFO]; and
iv. twelve entries comprising *Meter Balance [INFO](5.7.5.22)*, *Emergency Credit Balance [INFO](5.7.5.15), Accumulated Debt Register [INFO](5.7.5.1)*, *Payment Debt Register [INFO](5.7.5.23)* and *Time Debt Registers [1 … 2] [INFO](5.7.5.36)*,

each of *(i)* to *(iv)* arranged as a circular buffer such that when full, further writes shall cause the oldest entry to be overwritten.

5.7.5.11 Cost of Instantaneous Active Power Import

The indicative cost in Currency Units of maintaining the Active Power Import for an hour at the Price*(*s*)* currently active.

5.7.5.12 Cumulative and Historical Value Store [INFO]

A store capable of holding the following values:

i. nine Days of Consumption comprising the current Day and the prior eight Days, in kWh and Currency Units;
ii. six Weeks of Consumption comprising the current Week and the prior five Weeks, in kWh and Currency Units; and
iii. fourteen months of Consumption comprising the current month and the prior thirteen months, in kWh and Currency Units.

5.7.5.13 Daily Read Log

A log capable of storing thirty one UTC date and time stamped entries of the *Tariff TOU Register Matrix [INFO](5.7.5.34)*, the *Tariff TOU Block Register Matrix(5.7.5.35)*, the *Active Import Register [INFO](5.7.5.3)* and the *Active Export Register [INFO](5.7.5.2)* arranged as a circular buffer such that when full, further writes shall cause the oldest entry to be overwritten.

5.7.5.14 Daily Consumption Log [INFO]

A log capable of storing 731 date stamped entries of Consumption arranged as a circular buffer such that when full, further writes shall cause the oldest entry to be overwritten.

5.7.5.15 Emergency Credit Balance [INFO]

The amount of Emergency Credit available to the Consumer after it has been activated by the Consumer.

5.7.5.16 Event Log

A log capable of storing one hundred UTC date and time stamped entries of non-security related information for diagnosis and auditing arranged as a circular buffer such that when full, further writes shall cause the oldest entry to be overwritten.

5.7.5.17 Firmware Version

The active version of Firmware of ESME.

5.7.5.18 Load Limit Counter

The number of times the *Active Power Import [INFO](5.7.5.4)* has exceeded, for the *Load Limit Period(5.7.4.19)*, the *Load Limit Power Threshold(5.7.4.20)* since last cleared.

5.7.5.19 Maximum Demand Active Power Import Value

A store capable of holding the largest average value of *Active Power Import [INFO](5.7.5.4)* recorded in any 30 minute period (commencing at the start of minutes 00 and 30 in each hour and including the UTC date and time at the end of the 30 minute period to which the data relates*)* since the value was last reset (as set out in *Section 5.6.3.26)*, together with the UTC date and time when the value was last reset, arranged such that the recording of a larger value shall cause the previous entry to be overwritten.

5.7.5.20 Maximum Demand (Configurable Time) Active Power Import Value

A store capable of holding the largest average value of *Active Power Import [INFO](5.7.5.4)* recorded in any 30 minute period (commencing at the start of minutes 00 and 30 in each hour*)* within the time period specified in *Maximum Demand Configurable Time Period(5.7.4.26)* (including the UTC date and time at the end of the 30 minute period to which the data relates) since the value was last reset (as set out in *Section 5.6.3.28*), together with the UTC date and time when the value was last reset, arranged such that the recording of a larger value shall cause the previous entry to be overwritten.

5.7.5.21 Maximum Demand Active Power Export Value

A store capable of holding the largest average value of the Active Power Export recorded in any 30 minute period (commencing at the start of minutes 00 and 30 in each hour and including the UTC date and time at the end of the 30 minute period to which the data relates) since the value was last reset (as set out in *Section 5.6.3.27*), together with the UTC date and time when the value was last reset, arranged such that the recording of a larger value shall cause the previous entry to be overwritten.

5.7.5.22 Meter Balance [INFO]

The amount of money in Currency Units as determined by ESME. If operating in Prepayment Mode, the Meter Balance represents ESME's determination of the amount of credit available to the Consumer (excluding any *Emergency Credit Balance [INFO](5.7.5.15)*). If operating in Credit Mode, it represents ESME's determination of the amount of money due from the Consumer since the Meter Balance was last reset.

5.7.5.23 Payment Debt Register [INFO]

A Debt Register recording debt to be recovered as a percentage of payment when using Payment-based Debt Recovery in Prepayment Mode.

5.7.5.24 Power Threshold Status [INFO]

An indication of the Active Power level, being low, medium or high.

5.7.5.25 Power Event Log

A log capable of storing one hundred UTC date and time stamped entries of non-security related information for diagnosis and auditing arranged as a circular buffer such that when full, further writes shall cause the oldest entry to be overwritten.

5.7.5.26 Prepayment Daily Read Log

A log capable of storing thirty one UTC date and time stamped entries of *Meter Balance [INFO](5.7.5.22)*, *Emergency Credit Balance [INFO](5.7.5.15)*, *Accumulated Debt Register [INFO](5.7.5.1)*, *Payment Debt Register [INFO](5.7.5.23)* and *Time Debt Registers [1 … 2]*

[INFO](5.7.5.36) arranged as a circular buffer such that when full, further writes shall cause the oldest entry to be overwritten.

5.7.5.27 Profile Data Log [INFO]

A log capable of storing UTC date and time-stamped half hourly data (the amount of energy Imported or Exported in a half hour period) arranged as a circular buffer such that when full, further writes shall cause the oldest entry to be overwritten. The log shall be capable of storing:

i. 13 months of Consumption;
ii. 3 months of Active Energy Exported;
iii. 3 months of Reactive Energy Imported; and
iv. 3 months of Reactive Energy Exported.

5.7.5.28 Randomised Offset

The product of the *Randomised Offset Limit(5.7.4.33)* and the *Randomised Offset Number(5.7.1.5)* rounded to the nearest second. This value is used to delay the Tariff Switching Table times, the Auxiliary Load Control Switch switching times, and HAN Connected Auxiliary Load Control Switch switching times.

5.7.5.29 Reactive Export Register

The register recording the cumulative Reactive Energy Exported.

5.7.5.30 Reactive Import Register

The register recording the cumulative Reactive Energy Imported.

5.7.5.31 Security Log

A log capable of storing one hundred UTC date and time stamped entries of security related information for diagnosis and auditing arranged as a circular buffer such that when full, further writes shall cause the oldest entry to be overwritten.

5.7.5.32 Supply State [INFO]

The state of the Supply being Enabled, Disabled or Armed.

5.7.5.33 Tariff Block Counter Matrix [INFO]

A 4 x 8 matrix for storing Block Counters for Block Pricing.

5.7.5.34 Tariff TOU Register Matrix [INFO]

A 1 x 48 matrix for storing Tariff Registers for Time-of-use Pricing.

5.7.5.35 Tariff TOU Block Register Matrix

A 4 x 8 matrix for storing Tariff Registers for Time-of-use with Block Pricing.

5.7.5.36 Time Debt Registers [1 … 2] [INFO]

Two Debt Registers recording independent debts to be recovered over time when operating Time-based Debt Recovery in Prepayment Mode.

Part B - Twin Element Electricity Metering Equipment

5.8 Overview

In this Part B ESME shall mean Twin Element Electricity Metering Equipment.

ESME shall comply with the requirements of Part A save as set out in the remainder of this Part B. Requirements in a Part A Section that are disapplied by this Part B are identified in the Part B Section of the same name. Additional or amended requirements applied by this Part B are a continuation of the Part A Section of the same name and hence must also be met by ESME.

5.9 SMETS Testing and Certification Requirements

5.9.1 Conformance with the SMETS

ESME shall have been tested to ensure that it meets the requirements described in this *Section 5 Part B*, and evidence must be available to confirm such testing and conformance.

5.9.2 Conformance with the Great Britain Companion Specification

ESME shall meet the requirements described in the Great Britain Companion Specification.

ESME shall have been certified:

i. by the ZigBee Alliance as being compliant with those ZigBee SEP requirements that are identified as being required in the Great Britain Companion Specification and that were certifiable under the ZigBee SEP certification scheme on 31 August 2017; and

ii. by the DLMS User Association as being compliant with those DLMS COSEM requirements that are identified as being required in the Great Britain Companion Specification and that were certifiable under the DLMS COSEM certification scheme on 31 August 2017.

5.9.3 Conformance with the Commercial Product Assurance Security Characteristics for GB Smart Metering

ESME shall meet the requirements described in the Commercial Product Assurance Security Characteristic for Electricity Smart Metering Equipment.

ESME shall be certified by NCSC as compliant with the Commercial Product Assurance Security Characteristic for Electricity Smart Metering Equipment.

5.10 Physical Requirements

Physical Requirements(5.4) in Part A shall not apply to ESME.

ESME shall as a minimum include the following components:

i. a Clock;
ii. a Data Store;
iii. an Electricity Meter containing two measuring elements;
iv. a HAN Interface;
v. a Load Switch;
vi. a Random Number Generator;
vii. a User Interface; and

viii. where installed with a Communications Hub provided by the Data and Communications Company, a Communications Hub Physical Interface (this may comprise a Communications Hub Physical Interface forming part of GSME where present at the time of installation in the Premises).

The Communications Hub Physical Interface shall as a minimum include a physical interface that meets the requirements defined by the Data and Communications Company at the time of installation (available on the Data and Communications Company's website) and includes provision for a DC power supply to the Communications Hub.

ESME shall be mains powered and be capable of performing the minimum functional, interface and data requirements set out in *Sections 5.11*, *5.12* and *5.13* respectively operating at a nominal voltage of 230VAC without consuming more than an average of 4 watts of electricity under normal operating conditions.

ESME shall be capable of automatically resuming operation after a power failure in its operating state prior to such failure.

ESME shall:

ix. permanently display the *ESME Identifier(5.7.1.1)* on the ESME; and

x. have a Secure Perimeter.

The HAN Interface of ESME shall be capable of joining a ZigBee SEP Smart Metering Home Area Network which:

xi. operates within the 2400 – 2483.5 MHz harmonised frequency band; and

xii. supports the Communications Links described in *Sections 5.6.3*, *5.6.4.*, *5.12.1* and *5.12.2*.

On joining a ZigBee SEP Smart Metering Home Area Network ESME shall be capable of generating and sending an Alert to that effect via its HAN Interface.

ESME shall be designed taking all reasonable steps so as to prevent Unauthorised Physical Access and Unauthorised communications through its Secure Perimeter that could compromise the Confidentiality and / or Data Integrity of:

xiii. Personal Data;

xiv. Consumption data used for billing;

xv. Security Credentials;

xvi. Random Number Generator;

xvii. Cryptographic Algorithms;

xviii. the Electricity Meter; and

xix. Firmware and data essential for ensuring its integrity,

stored or executing on ESME.

ESME shall be capable of detecting any attempt at Unauthorised Physical Access through its Secure Perimeter that could compromise such Confidentiality and / or Data Integrity and on such detection shall be capable of:

xx. providing evidence of such an attempt through the use of tamper evident coatings or seals,

and where reasonably practicable:

xxi. generating an entry to that effect in the *Security Log(5.7.5.31)*;

xxii. generating and sending an Alert to that effect via its HAN Interface; and

xxiii. where the *Supply Tamper State(5.7.4.44)* is configured to require Locking, sending an Alert that the Supply is being disabled for this reason via its HAN Interface, and establishing a Locked state whereby the Supply is Disabled and can only be

Enabled or Armed in response to a Command to Arm the Supply (as described in *Section 5.6.3.7*) or Enable the Supply (as described in *Section 5.6.3.12*), and setting the *Supply State [INFO](5.7.5.32)* to Locked.

5.11 Functional Requirements

5.11.1 Display of information

Display of information(5.5.4) in Part A shall not apply to ESME.

ESME shall be capable of displaying the following up to date information on its User Interface:

i. the *Payment Mode [INFO](5.7.4.31)* currently in operation, being Prepayment Mode or Credit Mode [PIN];
ii. the *Tariff TOU Register Matrix [INFO](5.7.5.34)* with appropriate precision, the *Secondary Tariff TOU Register Matrix [INFO](5.13.2.10)* with appropriate precision, *Tariff TOU Block Register Matrix(5.7.5.35)* with appropriate precision and the *Tariff Block Counter Matrix [INFO](5.7.5.33)* with appropriate precision;
iii. the *Active Import Register [INFO](5.7.5.3)* with appropriate precision;
iv. the *Secondary Active Import Register [INFO](5.13.2.11)* with appropriate precision;
v. the *Meter Balance [INFO](5.7.5.22)* [PIN];
vi. the Debt to Clear (calculated as set out in *Section 5.11.2.2*) [PIN];
vii. the *Customer Identification Number [INFO](5.7.4.10)* [PIN];
viii. whether Emergency Credit is available for activation [PIN];
ix. whether ESME has suspended the Disablement of Supply during a period defined in the *Non-Disablement Calendar [INFO](5.7.4.30)* (as set out in *Section 5.11.2.2*) [PIN];
x. the *Emergency Credit Balance [INFO](5.7.5.15)* where Emergency Credit is activated [PIN];
xi. any low credit condition [PIN];
xii. the *Supply State [INFO](5.7.5.32)*;
xiii. any time-based debts and Time-based Debt Recovery rates [PIN];
xiv. any payment-based debt [PIN];
xv. any accumulated debt recorded in the *Accumulated Debt Register [INFO](5.7.5.1)* [PIN];
xvi. any *Standing Charge [INFO](5.7.4.42)* [PIN];
xvii. the *Meter Point Administration Numbers (MPAN*) *[INFO](5.7.4.28)* [PIN];
xviii. the Local Time;
xix. the *Contact Details [INFO](5.7.4.8)*;
xx. the *Primary Active Tariff Price [INFO](5.13.2.6)* [PIN];
xxi. the *Secondary Active Tariff Price [INFO](5.13.2.9)* [PIN];
xxii. the *Event Log(5.7.5.16)* and the *Power Event Log*(*5.7.5.25)* (with the exception of any Personal Data)and
xxiii. the *Active Export Register [INFO](5.7.5.2).*

ESME shall be capable of displaying the *Security Log(5.7.5.31)* on its User Interface following physical access through the Secure Perimeter of ESME.

ESME shall be capable of displaying Currency Units in GB Pounds and European Central Bank Euro.

5.11.1.1 Presentation of information on the User Interface

For each of the values currently stored in the *Active Import Register [INFO](5.7.5.3)* , the *Active Export Register [INFO](5.7.5.2),* the *Secondary Active Import Register [INFO](5.13.2.11)*, the *Tariff ToU Register Matrix [INFO](5.7.5.34),* the *Tariff ToU Block*

Register Matrix(5.7.5.35) and the *Secondary Active Tariff Price [INFO](5.13.2.9),* ESME shall be capable of displaying a value calculated from the stored value by:

i. converting the stored value in to a decimal, integer number of kilowatt hours, rounding the stored value down to the nearest kilowatt hour;
ii. discarding all except the five least significant decimal digits so produced; and
iii. adding leading zeros (if necessary) so that there are exactly five decimal digits.

5.11.2 Payment Mode

Payment Mode(5.5.7) in Part A shall not apply to ESME.

ESME shall be capable of operating in Credit Mode and Prepayment Mode and of being remotely switched from one mode to the other.

5.11.2.1 Credit Mode

ESME, when operating in Credit Mode, shall be capable of maintaining a calculation of the *Meter Balance [INFO](5.7.5.22)* based on:

i. the Consumption in the *Tariff TOU Register Matrix [INFO](5.7.5.34)* and the Prices in the *Tariff TOU Price Matrix [INFO](5.7.4.50)* and if operating Time-of-use with Block Pricing, the Consumption in the *Tariff TOU Block Register Matrix(5.7.5.35)* and the Prices in the *Tariff Block Price Matrix [INFO](5.7.4.47)*;
ii. the Consumption in the *Secondary Tariff TOU Register Matrix [INFO](5.13.2.10)* and the Prices in *Secondary Tariff TOU Price Matrix [INFO](5.13.1.1)*; and
iii. the *Standing Charge [INFO](5.7.4.42)*.

5.11.2.2 Prepayment Mode

ESME shall be capable of operating in Prepayment Mode, including during periods of loss of its Communications Link via its HAN Interface, and maintaining a balance of credit and reflecting any reduction in credit based on Consumption, standing charge and Time-based Debt Recovery.

ESME shall be capable of adding credit to the *Meter Balance [INFO](5.7.5.22)* (as set out in *Sections 5.6.2.2* and *5.6.3.3*) and reducing the amount of credit in the *Meter Balance [INFO](5.7.5.22)*.

ESME shall be capable of making Emergency Credit available to the Consumer (by means of the *Emergency Credit Balance [INFO](5.7.5.15)* if the *Meter Balance [INFO](5.7.5.22)* is below the *Emergency Credit Threshold [INFO](5.7.4.17)*). ESME shall be capable of displaying the availability of Emergency Credit on its User Interface and of generating and sending an Alert indicating the availability of Emergency Credit via its HAN Interface. The amount of Emergency Credit made available to the Consumer shall be equal to the *Emergency Credit Limit [INFO](5.7.4.16)*. ESME shall be capable of reducing the amount of credit in the *Emergency Credit Balance [INFO](5.7.5.15)* where Emergency Credit is activated by the Consumer (as set out in *Sections 5.6.2.1* and *5.6.3.1*) and the *Meter Balance [INFO](5.7.5.22)* is exhausted. Any Emergency Credit used shall be repaid when credit is added to ESME (as set out in *Sections 5.6.2.2* and *5.6.3.3*).

ESME shall be capable of reducing the *Meter Balance [INFO](5.7.5.22)* until it reaches the *Disablement Threshold [INFO](5.7.4.15)* followed by reducing the *Emergency Credit Balance [INFO](5.7.5.15)*, where activated, until exhausted on the basis of:

i. the Consumption in the *Tariff TOU Register Matrix [INFO](5.7.5.34)* and the Prices in the *Tariff TOU Price Matrix [INFO](5.7.4.50)*, and if operating Time-of-use with

Block Pricing the Consumption in the *Tariff TOU Block Register Matrix(5.7.5.35)* and the Prices in the *Tariff Block Price Matrix [INFO](5.7.4.47)*;

ii. the Consumption in the *Secondary Tariff TOU Register Matrix [INFO](5.13.2.10)* and the Prices in the *Secondary Tariff TOU Price Matrix [INFO](5.13.1.1)*;

iii. the *Standing Charge [INFO](5.7.4.42)*; and

iv. the recovery of debt hourly and daily through each of the *Time Debt Registers [1 … 2] [INFO](5.7.5.36)* at rates defined by the *Debt Recovery Rates [1 … 2] [INFO](5.7.4.12)*.

Where configured by *Suspend Debt Emergency(5.7.4.46)* to do so and when Emergency Credit is in use, ESME shall be capable suspending the application of *(iii)* and *(iv)* to the *Emergency Credit Balance [INFO](5.7.5.15)*, and of accumulating *(iii)* and *(iv)* in the *Accumulated Debt Register [INFO](5.7.5.1).*

ESME shall be capable of recording debt recovered, or accumulated in the *Accumulated Debt Register [INFO](5.7.5.1),* in the *Billing Data Log(5.13.2.3).*

ESME shall be capable of monitoring the *Meter Balance [INFO](5.7.5.22)* and where activated the *Emergency Credit Balance [INFO](5.7.5.15)* and:

v. if the combined credit of the *Meter Balance [INFO](5.7.5.22)* and *Emergency Credit Balance [INFO](5.7.5.15)* falls below the *Low Credit Threshold [INFO](5.7.4.23)*, displaying an Alert to that effect on its User Interface and generating and sending an Alert to that effect via its HAN Interface;

vi. if the combined credit of the *Meter Balance [INFO](5.7.5.22)* and *Emergency Credit Balance [INFO](5.7.5.15)* falls below the *Disablement Threshold [INFO](5.7.4.15)*, Disabling the Supply, displaying an Alert to that effect on its User Interface and generating and sending an Alert to that effect via its HAN Interface;

vii. where the Supply is Disabled (as set out in *(vi)* above):

a) where configured by *Suspend Debt Disabled*(*5.7.4.45*) not to suspend Time-based Debt Recovery, continuing to apply (*iii*) and (*iv*) above to reduce the *Meter Balance* [INFO](*5.7.5.22*);

b) where configured by *Suspend Debt Disabled*(*5.7.4.45*) to suspend Time-based Debt Recovery, suspending the application of (*iv*) above to the *Meter Balance* [INFO](*5.7.5.22*), and continuing to apply (*iii*) above to reduce the *Meter Balance* [INFO](*5.7.5.22*); and

viii. if the Supply is Enabled, suspending the Disablement of Supply (as set out in *(vi)* above) during periods defined in the *Non-Disablement Calendar [INFO](5.7.4.30)*, continuing to reduce the *Meter Balance [INFO](5.7.5.22)* on the basis of *(i)* to *(iv)* above, displaying on its User Interface an indication that the combined *Meter Balance [INFO](5.7.5.22)* and *Emergency Credit Balance [INFO](5.7.5.15)* is below the *Disablement Threshold [INFO](5.7.4.15)* and that Disablement of Supply due to insufficient credit has been suspended, and generating and sending an Alert that Disablement of Supply due to insufficient credit has been suspended via its HAN Interface.

If the *Meter Balance [INFO](5.7.5.22)* is equal to or below the *Disablement Threshold [INFO](5.7.4.15)* ESME shall be capable of maintaining a calculation of the Debt to Clear based on:

ix. the difference between the *Meter Balance [INFO](5.7.5.22)* and the *Disablement Threshold [INFO](5.7.4.15)*;

x. the amount of debt accumulated in the *Accumulated Debt Register [INFO](5.7.5.1)*

xi. the amount of Emergency Credit activated and used by the Consumer; and

xii. the payment-based debt to be collected based on *(ix)*, *(x)* and *(xi)* (as defined by *Debt Recovery per Payment [INFO](5.7.4.11)* taking account of the amount remaining in the *Payment Debt Register [INFO](5.7.5.23)*, the payment-based debt payments in the *Billing Data Log(5.13.2.3)* and the *Debt Recovery Rate Cap [INFO](5.7.4.13)*.

For Time-based Debt Recovery, the ESME shall be capable of recovering the lesser of:

xiii. the amount in the relevant *Time Debt Registers [1 … 2] [INFO](5.7.5.36)*; and

xiv. the corresponding amount determined by the *Debt Recovery Rates [1 … 2] [INFO](5.7.4.12)*.

For Payment-based Debt Recovery, the ESME shall be capable of recovering the lesser of:

xv. the amount defined by *Debt Recovery per Payment [INFO](5.7.4.11)* subject to the *Debt Recovery Rate Cap [INFO](5.7.4.13)*; and

xvi. the amount in the *Payment Debt Register [INFO](5.7.5.23)*.

Where an Adjust Debt Command is to reduce the amount in a Debt Register and the amount in the Command is greater than the amount in the Debt Register, ESME shall be capable of setting the amount in the Debt Register to zero then applying the difference in the amounts in the following order:

xvii. recovering debt accumulated in the *Accumulated Debt Register [INFO](5.7.5.1)*;

xviii. repaying Emergency Credit activated and used by the Consumer; and

xix. increasing the *Meter Balance [INFO](5.7.5.22)*.

ESME shall be capable of monitoring the *Meter Balance [INFO](5.7.5.22)* and, where the Supply is Disabled, ESME shall be capable of Arming the Supply if the *Meter Balance [INFO](5.7.5.22)* rises above the *Disablement Threshold [INFO](5.7.4.15)*, displaying any such change in the *Supply State [INFO](5.7.5.32)* on its User Interface and generating and sending an Alert that the Supply has been Armed via its HAN Interface.

5.11.3 Pricing

Pricing(5.5.8) in Part A shall not apply to ESME.

ESME shall be capable of applying Time-of-use Pricing and Time-of-use with Block Pricing.

When switching between Time-of-use Bands and Tariff Registers as set out in this Section ESME shall be capable of applying the *Randomised Offset(5.7.5.28)*.

ESME shall be capable of maintaining the *Primary Active Tariff Price [INFO](5.13.2.6)* and the *Secondary Active Tariff Price [INFO](5.13.2.9)*.

5.11.3.1 Time-of-use Pricing

ESME shall be capable of recording Consumption via the primary measuring element of its Electricity Meter according to Time-of-use Bands in one of forty-eight Tariff Registers in the *Tariff TOU Register Matrix [INFO](5.7.5.34).*

ESME shall be capable of recording Consumption via the secondary measuring element of its Electricity Meter according to Time-of-use Bands in one of four Tariff Registers in the *Secondary Tariff TOU Register Matrix [INFO](5.13.2.10)*.

ESME shall be capable of switching between different Tariff Registers once every 30 minutes. The switching between Time-of-use Bands and thus Tariff Registers shall be based on the switching rules defined in the *Tariff Switching Table(5.13.1.2)*.

5.11.3.2 Time-of-use with Block Pricing

ESME shall be capable of recording Consumption via the primary measuring element of its Electricity Meter in one of four Block Registers for each of eight Time-of-use Bands in the *Tariff TOU Block Register Matrix(5.7.5.35).*

The switching between Time-of-use Bands and sets of Block Registers shall be based on the switching rules set out in the *Tariff Switching Table [INFO](5.13.1.2)*. ESME shall be capable of switching between Time-of-use Bands once every 30 minutes.

Switching between the Block Registers within each Time-of-use Band shall be based on Consumption via the primary measuring element of its Electricity Meter accumulated in the *Tariff Block Counter Matrix [INFO](5.7.5.33)* and Consumption thresholds in the *Tariff Threshold Matrix [INFO](5.7.4.49)*.

ESME shall also be capable of accumulating Consumption via the primary measuring element of its Electricity Meter in one of four Block Counters in the *Tariff Block Counter Matrix [INFO](5.7.5.33)* for each of the eight Time-of-use Bands. ESME shall be capable of switching between Block Counters according to the Consumption thresholds in the *Tariff Threshold Matrix [INFO](5.7.4.49)*.

ESME shall be capable of resetting the counters in the *Tariff Block Counter Matrix [INFO](5.7.5.33)* once per Day and in accordance with the timetable set out in the *Billing Calendar(5.7.4.7)*.

5.11.4 Recording

Recording(5.5.9) in Part A shall not apply to ESME.

5.11.4.1 Active Energy Imported

ESME shall be capable of recording:

i. cumulative Active Energy Imported via the primary measuring element of its Electricity Meter in the *Active Import Register [INFO](5.7.5.3)*; and
ii. cumulative Active Energy Imported via the secondary measuring element of its Electricity Meter in the *Secondary Active Import Register [INFO](5.13.2.11)*.

5.11.4.2 Active Energy Exported

ESME shall be capable of recording cumulative Active Energy Exported via the primary measuring element of its Electricity Meter in the *Active Export Register [INFO](5.7.5.2)*.

5.11.4.3 Billing data

In accordance with the timetable set out in the *Billing Calendar(5.7.4.7)* ESME shall be capable of taking a UTC date and time stamped copy of:

i. the *Tariff TOU Register Matrix [INFO](5.7.5.34)*;
ii. the Secondary Tariff TOU Register Matrix *[INFO](5.13.2.10)*;
iii. the *Tariff TOU Block Register Matrix(5.7.5.35)*;
iv. the *Active Import Register [INFO](5.7.5.3)*; and
v. the *Secondary Active Import Register [INFO](5.13.2.11)*,

and where in Prepayment mode:

vi. the *Meter Balance [INFO](5.7.5.22)*;
vii. the Emergency Credit Balance *[INFO](*5.7.5.15*)*;
viii. the *Payment Debt Register [INFO](5.7.5.23)*;
ix. the *Time Debt Registers [1 … 2] [INFO](5.7.5.36)*; and
x. the *Accumulated Debt Register [INFO](5.7.5.1)*,

in the *Billing Data Log(5.13.2.3)*, and:

xi. generating and sending an Alert via its HAN Interface containing the most recent entries in the *Billing Data Log(5.13.2.3)* of *(i)* to *(v)* above; and

xii. if operating in Credit Mode immediately resetting the *Meter Balance [INFO](5.7.5.22)*.

5.11.4.4 Consumption Data

ESME shall be capable of calculating Consumption via the primary and secondary measuring elements of its Electricity Meter and recording:

i. to the *Cumulative and Historical Value Store [INFO](5.7.5.12)* in kWh:

a) Consumption on the Day up to the Local Time;
b) Consumption on each of the eight Days prior to such Day;
c) Consumption in the Week in which the calculation is performed;
d) Consumption in each of the five Weeks prior to such Week;
e) Consumption in the month in which the calculation is performed; and
f) Consumption in the thirteen months prior to such month.

ii. the *Daily Consumption Log [INFO](5.7.5.14)* in kWh the Consumption on each of the 731 Days prior to the current Day.

5.11.4.5 Cost of Consumption Data

ESME shall be capable of calculating and recording to the *Cumulative and Historical Value Store [INFO](5.7.5.12)* the cost of:

i. Consumption on the Day up to the Local Time;
ii. Consumption on each of the eight Days prior to such Day;
iii. Consumption in the Week in which the calculation is performed;
iv. Consumption in each of the five Weeks prior to such Week;
v. Consumption in the month in which the calculation is performed; and
vi. Consumption in the thirteen months prior to such month.

ESME shall be capable of calculating cost of Consumption as above on the basis of:

vii. the Consumption in the *Tariff TOU Register Matrix [INFO](5.7.5.34)* and the Prices in the *Tariff TOU Price Matrix [INFO](5.7.4.50)*, and if operating Time-of-use with Block Pricing the Consumption in the *Tariff TOU Block Register Matrix(5.7.5.35)* and the Prices in the *Tariff Block Price Matrix [INFO](5.7.4.47)*;

viii. the Consumption in the *Secondary Tariff TOU Register Matrix [INFO](5.13.2.10)* and the Prices in the *Secondary Tariff TOU Price Matrix [INFO](5.13.1.1)*; and

ix. the *Standing Charge [INFO](5.7.4.42)*.

5.11.4.6 Cost of Instantaneous Consumption

ESME shall be capable of calculating and recording the *Cost of Instantaneous Active Power Import(5.7.5.11)* on the basis of:

i. the *Primary Active Power Import [INFO](5.13.2.5)*;
ii. the *Primary Active Tariff Price [INFO](5.13.2.6)*;
iii. the *Secondary Active Power Import [INFO](5.13.2.8)*; and
iv. the *Secondary Active Tariff Price [INFO](5.13.2.9)*.

5.11.4.7 Daily read data

ESME shall be capable of taking a copy of and storing the *Tariff TOU Register Matrix [INFO](5.7.5.34)*, the *Secondary Tariff TOU Register Matrix [INFO](5.13.2.10)*, the *Tariff TOU Block Register Matrix(5.7.5.35)*, the *Active Import Register [INFO](5.7.5.3)*, the

Secondary Active Import Register [INFO](5.13.2.11) and the *Active Export Register [INFO](5.7.5.2)*, together with a UTC date and time stamp in the *Daily Read Log(5.13.2.4)* every day at midnight UTC.

If operating in Prepayment Mode ESME shall be capable of recording the *Meter Balance [INFO](5.7.5.22)*, *Emergency Credit Balance [INFO](5.7.5.15), Accumulated Debt Register [INFO](5.7.5.1)*, *Payment Debt Register [INFO](5.7.5.23)* and *Time Debt Registers [1 … 2] [INFO](5.7.5.36)* in the *Prepayment Daily Read Log(5.7.5.26)* every day at midnight UTC.

5.11.4.8 Half hour profile data

ESME shall be capable of recording in each 30 minute period (commencing at the start of minutes 00 and 30 in each hour), the following information (including the UTC date and time at the end of the 30 minute period to which the data relates) in the *Profile Data Log [INFO](5.13.2.7)*:

i. Active Energy Imported via the primary measuring element of its Electricity Meter;
ii. Active Energy Exported via the primary measuring element of its Electricity Meter;
iii. Reactive Energy Imported via the primary and secondary measuring elements of its Electricity Meter;
iv. Reactive Energy Exported via the primary measuring element of its Electricity Meter; and
v. Active Energy Imported via the secondary measuring element of its Electricity Meter.

5.11.4.9 Maximum Demand Import data

ESME shall be capable of calculating the average value of *Active Power Import [INFO](5.13.2.1)* over each 30 minute period (commencing at the start of minutes 00 and 30 in each hour) and recording:

i. to the *Maximum Demand Active Power Import Value(5.7.5.19)*, the maximum value so calculated since the *Maximum Demand Active Power Import Value(5.7.5.19)* was last reset (as set out in *Section 5.6.3.26*) including the UTC date and time at the end of the 30 minute period to which the data relates; and
ii. to the *Maximum Demand (Configurable Time) Active Power Import Value(5.7.5.20)* the maximum value so calculated in any 30 minute period (commencing at the start of minutes 00 and 30 in each hour) within the time period specified in *Maximum Demand Configurable Time Period(5.7.4.26)* (including the UTC date and time at the end of the 30 minute period to which the data relates) since the *Maximum Demand (Configurable Time) Active Power Import Value(5.7.5.20)* was last reset (as set out in *Section 5.6.3.28*).

5.11.4.10 Maximum Demand Export data

ESME shall be capable of calculating the average value of Active Power Export over each 30 minute period (commencing at the start of minutes 00 and 30 in each hour) and recording to the *Maximum Demand Active Power Export Value(5.7.5.21)* the maximum value so calculated since the *Maximum Demand Active Power Export Value(5.7.5.21)* was last reset (as set out in *Section 5.6.3.27*) including the UTC date and time at the end of the 30 minute period to which the data relates.

5.11.4.11 Power Threshold Status

ESME shall be capable of comparing the *Active Power Import [INFO](5.13.2.1)* against thresholds and:

i. if the *Active Power Import [INFO](5.13.2.1)* is equal to or lower than the *Low Medium Power Threshold [INFO](5.7.4.24)*, setting *Power Threshold Status(5.7.5.24)* to low;

ii. if the *Active Power Import [INFO](5.13.2.1)* is higher than the *Low Medium Power Threshold [INFO](5.7.4.24)* and equal to or lower than the *Medium High Power Threshold [INFO](5.7.4.29)*, setting *Power Threshold Status(5.7.5.24)* to medium; and

iii. otherwise, setting the *Power Threshold Status(5.7.5.24)* to high.

5.11.4.12 Reactive Energy Imported

ESME shall be capable of recording cumulative Reactive Energy Imported via the primary and secondary measuring elements of its Electricity Meter in the *Reactive Import Register(5.7.5.30)*.

5.11.4.13 Reactive Energy Exported

ESME shall be capable of recording cumulative Reactive Energy Exported via the primary measuring element of its Electricity Meter in the *Reactive Export Register(5.7.5.29)*.

5.12 Interface Requirements

5.12.1 HAN Interface information provision

Type 1 Devices and Type 2 Device information provision(5.6.1) in Part A shall not apply to ESME.

ESME shall be capable, immediately upon establishment of a Communications Link with Type 1 Devices (as set out in *Section 5.5.2.2*) and Type 2 Devices (as set out in *Section 5.5.2.3*), of providing the Data annotated [INFO] in *Sections 5.7.1*, *5.7.4*, *5.7.5*, *5.13.1* and *5.13.2* to Type 1 Devices and Type 2 Devices (with timely updates of any changes to all data).

5.12.2 HAN Interface Commands

5.12.2.1 Set Payment Mode

Set Payment Mode(5.6.3.34) in Part A shall not apply to ESME.

A Command to set the payment mode as either Prepayment Mode or Credit Mode and to record the mode of operation in *Payment Mode [INFO](5.7.4.31)*.

In executing the Command, ESME shall be capable of taking a UTC date and time stamped copy of:

i. the *Tariff TOU Register Matrix [INFO](5.7.5.34)*;
ii. the *Secondary Tariff TOU Register Matrix [INFO](5.13.2.10)*;
iii. the *Tariff TOU Block Register Matrix(5.7.5.35)*;
iv. the *Active Import Register [INFO](5.7.5.3)*; and
v. the *Secondary Active Import Register [INFO](5.13.2.11)*,

and unless in Credit Mode both before and after execution of the Command:

vi. the *Meter Balance [INFO](5.7.5.22)*;
vii. the *Emergency Credit Balance [INFO](5.7.5.15)*;
viii. the *Payment Debt Register [INFO](5.7.5.23)*;
ix. the *Time Debt Registers [1 … 2] [INFO](5.7.5.36)*; and
x. the *Accumulated Debt Register [INFO](5.7.5.1)*,

in the *Billing Data Log(5.13.2.3)*.

5.12.2.2 Set Tariff

Set Tariff(5.6.3.35) in Part A shall not apply to ESME.

A Command to accept new values for the *Tariff TOU Price Matrix [INFO](5.7.4.50),* the *Secondary Tariff TOU Price Matrix [INFO](5.13.1.1)*, the *Tariff Block Price Matrix [INFO](5.7.4.47)*, the *Tariff Switching Table [INFO](5.13.1.2)* and the *Tariff Threshold Matrix [INFO](5.7.4.49)*.

In executing the Command, ESME shall be capable of taking a UTC date and time stamped copy of:

i. the *Tariff TOU Register Matrix [INFO](5.7.5.34)*;
ii. the *Secondary Tariff TOU Register Matrix [INFO](5.13.2.10)*;
iii. the *Tariff TOU Block Register Matrix(5.7.5.35)*;
iv. the *Active Import Register [INFO](5.7.5.3)*; and
v. the *Secondary Active Import Register [INFO](5.13.2.11)*,

and where in Prepayment mode:

vi. the *Meter Balance [INFO](5.7.5.22)*;
vii. the *Emergency Credit Balance [INFO](5.7.5.15)*;
viii. the *Payment Debt Register [INFO](5.7.5.23)*;
ix. the *Time Debt Registers [1 … 2] [INFO](5.7.5.36)*; and
x. the *Accumulated Debt Register [INFO](5.7.5.1)*,

in the *Billing Data Log(5.13.2.3)*.

5.13 Data Requirements

This Section describes the minimum information which ESME shall be capable of holding in its Data Store.

5.13.1 Configuration Data

5.13.1.1 Secondary Tariff TOU Price Matrix [INFO]

A 1 x 4 matrix containing Prices for Time-of-use Pricing Tariffs relating to Supply via the secondary measuring element of the Electricity Meter.

5.13.1.2 Tariff Switching Table [INFO]

Tariff Switching Table(5.7.4.48) in Part A shall not apply to ESME.

A set of rules for allocating:

i. half-hourly Consumption via the primary measuring element of the Electricity Meter to a Tariff Register in the *Tariff TOU Register Matrix [INFO](5.7.5.34)* if applying Time-of-use Pricing, and in the *Tariff TOU Block Register Matrix(5.7.5.35)* if applying Time-of-use with Block Pricing; and
ii. half-hourly Consumption via the secondary measuring element of the Electricity Meter to a Tariff Register in the *Secondary Tariff TOU Register Matrix [INFO](5.13.2.10)*.

The rules stored within the table shall specify which of 16 Day Profiles should be used to allocate Consumption to Tariff Registers for Consumption via each of the primary and secondary measuring elements of the Electricity Meter according to:

iii. where the day is one of 50 Special Days, the Day Profile(s) specified for that measuring element for that day; or
iv. where the day is not a Special Day, the Day Profile(s) specified by the active Season Profile and Week Profile for that measuring element for that day.

The Switching Table shall support four Season Profiles and four Week Profiles. The Switching Table shall support up to 200 switching rules across all Day Profiles.

All dates and times shall be specified as UTC.

5.13.2 Operational Data

5.13.2.1 Active Power Import [INFO]

Active Power Import [INFO](5.7.5.4) in Part A shall not apply to ESME.

The sum of:

i. the *Primary Active Power Import [INFO](5.13.2.5)* on the primary measuring element of the Electricity Meter; and
ii. the *Secondary Active Power Import [INFO](5.13.2.8)* on the secondary measuring element of the Electricity Meter.

5.13.2.2 Active Tariff Price [INFO]

Active Tariff Price [INFO](5.7.5.5) in Part A shall not apply to ESME.

5.13.2.3 Billing Data Log

Billing Data Log(5.7.5.10) in Part A shall not apply to ESME.

A log capable of storing the following UTC date and time stamped entries:

i. twelve entries comprising the *Tariff TOU Register Matrix [INFO](5.7.5.34)*, the *Secondary Tariff TOU Register Matrix [INFO](5.13.2.10)*, the *Tariff TOU Block Register Matrix(5.7.5.35)*, the *Active Import Register [INFO](5.7.5.3)*, the *Secondary Active Import Register [INFO](5.13.2.11)*;

and where in Prepayment mode:

ii. five entries comprising the value of prepayment credits;
iii. ten entries comprising the value of payment-based debt payments; and
iv. twelve entries comprising *Meter Balance [INFO](5.7.5.22)*, *Emergency Credit Balance [INFO](5.7.5.15), Accumulated Debt Register [INFO](5.7.5.1)*, *Payment Debt Register [INFO](5.7.5.23)* and *Time Debt Registers [1 … 2] [INFO](5.7.5.36)*,

each of *(i)* to *(iv)* arranged as a circular buffer such that when full, further writes shall cause the oldest entry to be overwritten.

5.13.2.4 Daily Read Log

Daily Read Log(5.7.5.13) in Part A shall not apply to ESME.

A log capable of storing thirty one UTC date and time stamped entries of the *Tariff TOU Register Matrix [INFO](5.7.5.34)*, the *Secondary Tariff TOU Register Matrix [INFO](5.13.2.10)*, the *Tariff TOU Block Register Matrix(5.7.5.35)*, the *Active Import Register [INFO](5.7.5.3)*, the *Secondary Active Import Register [INFO](5.13.2.11)* and the *Active Export Register [INFO](5.7.5.2)* arranged as a circular buffer such that when full, further writes shall cause the oldest entry to be overwritten.

5.13.2.5 Primary Active Power Import [INFO]

The import of Active Power measured via the primary measuring element of the Electricity Meter.

5.13.2.6 Primary Active Tariff Price [INFO]

The Price currently active for Consumption via the primary measuring element of the Electricity Meter.

5.13.2.7 Profile Data Log [INFO]

Profile Data Log [INFO]*(5.7.5.27)* in Part A shall not apply to ESME.

A log capable of storing UTC date and time-stamped half hourly data (the amount of energy Imported or Exported in a half hour period) arranged as a circular buffer such that when full, further writes shall cause the oldest entry to be overwritten. The log shall be capable of storing a minimum of:

i. 13 months of Active Energy Imported via the primary measuring element of the Electricity Meter;
ii. 13 months of Active Energy Imported via the secondary measuring element of the Electricity Meter;
iii. 3 months of Active Energy Exported via the primary measuring element of the Electricity Meter;
iv. 3 months of Reactive Energy Imported via the primary and secondary measuring elements of the Electricity Meter; and
v. 3 months of Reactive Energy Exported via the primary measuring element of the Electricity Meter.

5.13.2.8 Secondary Active Power Import [INFO]

The import of Active Power measured via the secondary measuring element of the Electricity Meter.

5.13.2.9 Secondary Active Tariff Price [INFO]

The Price currently active for Consumption via the secondary measuring element of the Electricity Meter.

5.13.2.10 Secondary Tariff TOU Register Matrix [INFO]

A 1 x 4 matrix for storing Tariff Registers for Time-of-use Pricing relating to Supply via the secondary measuring element of the Electricity Meter.

5.13.2.11 Secondary Active Import Register [INFO]

The register recording the cumulative Active Energy Imported via the secondary measuring element of the Electricity Meter.

Part C - Polyphase Electricity Metering Equipment

5.14 Overview

In this Part C ESME shall mean Polyphase Electricity Metering Equipment.

ESME shall meet the requirements of Part A save as set out in the remainder of this Part C. Requirements in a Part A Section that are disapplied by this Part C are identified in the Part C Section of the same name. Additional or amended requirements applied by this Part C are a continuation of the Part A Section of the same name and hence must also be met by ESME.

5.15 SMETS Testing and Certification Requirements

5.15.1 Conformance with the SMETS

ESME shall have been tested to ensure that it meets the requirements described in this *Section 5 Part C*, and evidence must be available to confirm such testing and conformance.

5.15.2 Conformance with the Great Britain Companion Specification

ESME shall meet the requirements described in the Great Britain Companion Specification.

ESME shall have been certified:

i. by the ZigBee Alliance as being compliant with those ZigBee SEP requirements that are identified as being required in the Great Britain Companion Specification and that were certifiable under the ZigBee SEP certification scheme on 31 August 2017; and

ii. by the DLMS User Association as being compliant with those DLMS COSEM requirements that are identified as being required described in the Great Britain Companion Specification and that were certifiable under the DLMS COSEM certification scheme on 31 August 2017.

5.15.3 Conformance with the Commercial Product Assurance Security Characteristics for GB Smart Metering

ESME shall meet the requirements described in the Commercial Product Assurance Security Characteristic Electricity Smart Metering Equipment.

ESME shall be certified by NCSC as compliant with the Commercial Product Assurance Security Characteristic Electricity Smart Metering Equipment.

5.16 Physical Requirements

Physical Requirements(5.4) in Part A shall not apply to ESME.

ESME shall as a minimum include the following components:

i. a Clock;
ii. a Data Store;
iii. an Electricity Meter containing three measuring elements;
iv. a HAN Interface;
v. a Load Switch;
vi. a Random Number Generator;

vii. a User Interface; and
viii. where installed with a Communications Hub provided by the Data and Communications Company, a Communications Hub Physical Interface (this may comprise a Communications Hub Physical Interface forming part of GSME where present at the time of installation in the Premises).

The Communications Hub Physical Interface shall as a minimum include a physical interface that meets the requirements defined by the Data and Communications Company at the time of installation (available on the Data and Communications Company's website) and includes provision for a DC power supply to the Communications Hub.

ESME shall be mains powered and be capable of performing the minimum functional, interface and data requirements set out in *Sections 5.17*, *0* and *5.23* respectively operating at a nominal voltage of 230VAC without consuming more than an average of 7 watts of electricity under normal operating conditions.

ESME shall be capable of automatically resuming operation after a power failure in its operating state prior to such failure.

ESME shall:

ix. permanently display the *ESME Identifier(5.7.1.1)* on the ESME; and
x. have a Secure Perimeter.

The HAN Interface of ESME shall be capable of joining a ZigBee SEP Smart Metering Home Area Network which:

xi. operates within the 2400 – 2483.5 MHz harmonised frequency band; and
xii. supports the Communications Links described in *Sections 5.6.1*, *5.6.3*, *5.6.4* and *5.18.1*.

On joining a ZigBee SEP Smart Metering Home Area Network ESME shall be capable of generating and sending an Alert to that effect via its HAN Interface.

ESME shall be designed taking all reasonable steps so as to prevent Unauthorised Physical Access and Unauthorised communications through its Secure Perimeter that could compromise the Confidentiality and / or Data Integrity of:

xiii. Personal Data;
xiv. Consumption data used for billing;
xv. Security Credentials;
xvi. Random Number Generator;
xvii. Cryptographic Algorithms;
xviii. the Electricity Meter; and
xix. Firmware and data essential for ensuring its integrity,

stored or executing on ESME.

ESME shall be capable of detecting any attempt at Unauthorised Physical Access through its Secure Perimeter that could compromise such Confidentiality and / or Data Integrity and on such detection shall be capable of:

xx. providing evidence of such an attempt through the use of tamper evident coatings or seals,

and where reasonably practicable:

xxi. generating an entry to that effect in the *Security Log(5.7.5.31)*;
xxii. generating and sending an Alert to that effect via its HAN Interface; and
xxiii. where the *Supply Tamper State(5.7.4.44)* is configured to require Locking, sending an Alert that the Supply is being disabled for this reason via its HAN Interface, and

establishing a Locked state whereby the Supply is Disabled and can only be Enabled or Armed in response to a Command to Arm the Supply (as described in *Section 5.6.3.7*) or Enable the Supply (as described in *Section 5.6.3.12*).

5.17 Functional Requirements

ESME shall be capable of calculating Active Power Import, Consumption, Reactive Energy Import, Active Energy Export and Reactive Energy Export values as follows:

i. Active Power Import shall be the sum of the Active Power Import on the importing measuring element(s) of its Electricity Meter less the sum of the Active Power Export on the exporting measuring element(s) of its Electricity Meter;
ii. Consumption shall be the sum of the cumulative Active Energy Imported on the importing measuring element(s) of its Electricity Meter less the sum of the cumulative Active Energy Exported on the exporting measuring element(s) of its Electricity Meter;
iii. Reactive Energy Import shall be the sum of the cumulative Reactive Energy Import on the importing measuring element(s) of its Electricity Meter less the sum of the cumulative Reactive Energy Export on the exporting measuring element(s) of its Electricity Meter;
iv. Active Energy Export shall be the sum of the cumulative Active Energy Export on the exporting measuring element(s) of its Electricity Meter less the sum of the cumulative Active Energy Import on the importing measuring element(s) of its Electricity Meter; and
v. Reactive Energy Export shall be the sum of the cumulative Reactive Energy Export on the exporting measuring element(s) of its Electricity Meter less the sum of the cumulative Reactive Energy Import on the importing measuring element(s) of its Electricity Meter.

If the result of any of the calculations *(i)* to *(v)* is negative then it shall be deemed to be zero.

5.17.1 Phase Measurements

ESME shall be capable of measuring:

i. three phase four wire unbalanced supplies operating at a nominal voltage of 230VAC phase-to-neutral (400VAC phase-to-phase);
ii. two phases of a three phase four wire system;
iii. two phases of a three wire system 230-0-230VAC phase-to-neutral-to-phase (460VAC phase-to-phase); and
iv. the sum of two distinct one phase two wire 230VAC services with a common neutral.

5.17.2 Voltage Quality Measurements

Voltage Quality Measurements(5.5.12) in Part A shall not apply to ESME.

5.17.2.1 Average RMS voltage phase [n]

ESME shall be capable of calculating the average value of RMS voltage for phase [n] over a configurable period as defined in the *Phase [n] Average RMS Voltage Measurement Period(5.19.1.3)* and:

i. recording the values calculated (including the UTC date and time at the end of the period to which the values relate) in the *Phase [n] Average RMS Voltage Profile Data Log(5.19.2.3)*;
ii. detecting when the value calculated for phase [n] is above the *Phase [n] Average RMS Over Voltage Threshold(5.19.1.1)* and on detection:

a) counting the number of such occurrences in the *Phase [n] Average RMS Over Voltage Counter(5.19.2.1)*;
b) where the value calculated in the prior configurable period was below the Phase [n] Average RMS Over Voltage Threshold(*5.19.1.1*):

- generating an entry to that effect (including identification of the relevant phase) in the *Power Event Log(5.7.5.25)*; and
- generating and sending an Alert to that effect (including identification of the relevant phase) via its HAN Interface.

iii. detecting when the value calculated for phase [n] is below the *Phase [n] Average RMS Over Voltage Threshold(5.19.1.1)* and where the value calculated in the prior configurable period was above the *Phase [n] Average RMS Over Voltage Threshold(5.19.1.1)*:

a) generating an entry to that effect (including identification of the relevant phase) in the *Power Event Log(5.7.5.25)*; and
b) generating and sending an Alert to that effect (including identification of the relevant phase) via its HAN Interface.

iv. detecting when the value calculated for phase [n] is below the *Phase [n] Average RMS Under Voltage Threshold(5.19.1.2)* and on detection:

a) counting the number of such occurrences in the Phase [n] Average RMS Under Voltage Counter(*5.19.2.2*);
b) where the value calculated for phase [n] in the prior configurable period was above the Phase [n] Average RMS Under Voltage Counter(*5.19.2.2*):

- generating an entry to that effect (including identification of the relevant phase) in the *Power Event Log(5.7.5.25)*; and
- generating and sending an Alert to that effect (including identification of the relevant phase) via its HAN Interface.

v. detecting when the value calculated for phase [n] is above the *Phase [n] Average RMS Under Voltage Threshold(5.19.1.2)* and where the value calculated in the prior configurable period was below the *Phase [n] Average RMS Under Voltage Threshold(5.19.1.2)*:

a) generating an entry to that effect (including identification of the relevant phase) in the *Power Event Log(5.7.5.25)*; and
b) generating and sending an Alert to that effect (including identification of the relevant phase) via its HAN Interface.

5.17.2.2 RMS extreme over voltage detection

ESME shall be capable of:

i. detecting when the RMS voltage for phase [n] rises above the *RMS Extreme Over Voltage Threshold(5.7.4.35)* for a continuous period longer than the *RMS Extreme Over Voltage Measurement Period(5.7.4.34)* and on detection:

a) generating an entry to that effect (including identification of the relevant phase) in the *Power Event Log(5.7.5.25)*; and
b) generating and sending an Alert to that effect (including identification of the relevant phase) via its HAN Interface.

ii. detecting when the RMS voltage for phase [n] returns below the *RMS Extreme Over Voltage Threshold(5.7.4.35)* for a continuous period longer than the *RMS Extreme Over Voltage Measurement Period(5.7.4.34)* and on detection:

a) generating an entry to that effect (including identification of the relevant phase) in the *Power Event Log(5.7.5.25)*; and
b) generating and sending an Alert to that effect (including identification of the relevant phase) via its HAN Interface.

5.17.2.3 RMS extreme under voltage detection

ESME shall be capable of:

i. detecting when the RMS voltage for phase [n] falls below the *RMS Extreme Under Voltage Threshold(5.7.4.37)* for longer than the *RMS Extreme Under Voltage Measurement Period(5.7.4.36)* and on detection:

a) generating an entry to that effect (including identification of the relevant phase) in the *Power Event Log(5.7.5.25)*; and
b) generating and sending an Alert to that effect (including identification of the relevant phase) via its HAN Interface.

ii. detecting when the RMS voltage for phase [n] returns above the *RMS Extreme Under Voltage Threshold(5.7.4.37)* for longer than the *RMS Extreme Under Voltage Measurement Period(5.7.4.36)* and on detection:

a) generating an entry to that effect (including identification of the relevant phase) in the *Power Event Log(5.7.5.25)*; and
b) generating and sending an Alert to that effect (including identification of the relevant phase) via its HAN Interface.

5.17.2.4 RMS voltage sag detection

ESME shall be capable of:

i. detecting when the RMS voltage for phase [n] falls below the *RMS Voltage Sag Threshold(5.7.4.40)* for a continuous period longer than the *RMS Voltage Sag Measurement Period(5.7.4.38)* and on detection:

a) generating an entry to that effect (including identification of the relevant phase) in the *Power Event Log(5.7.5.25)*; and
b) generating and sending an Alert to that effect (including identification of the relevant phase) via its HAN Interface.

ii. detecting when the RMS voltage for phase [n] returns above the *RMS Voltage Sag Threshold(5.7.4.40)* for a continuous period longer than the *RMS Voltage Sag Measurement Period(5.7.4.38)* and on detection:

a) generating an entry to that effect (including identification of the relevant phase) in the *Power Event Log(5.7.5.25)*; and
b) generating and sending an Alert to that effect (including identification of the relevant phase) via its HAN Interface.

5.17.2.5 RMS voltage swell detection

ESME shall be capable of:

i. detecting when the RMS voltage for phase [n] rises above the *RMS Voltage Swell Threshold(5.7.4.41)* for a continuous period longer than the *RMS Voltage Swell Measurement Period(5.7.4.39)* and on detection:

a) generating an entry to that effect (including identification of the relevant phase) in the *Power Event Log(5.7.5.25)*; and
b) generating and sending an Alert to that effect (including identification of the relevant phase) via its HAN Interface.

ii. detecting when the RMS voltage for phase [n] returns below the *RMS Voltage Swell Threshold(5.7.4.41)* for a continuous period longer than the *RMS Voltage Swell Measurement Period(5.7.4.39)* and on detection:

a) generating an entry to that effect (including identification of the relevant phase) in the *Power Event Log(5.7.5.25)*; and
b) generating and sending an Alert to that effect (including identification of the relevant phase) via its HAN Interface.

5.17.2.6 Supply outage reporting phase [n]

ESME shall be capable of recording the UTC date and time at which the Supply via phase [n] is interrupted and:

i. generating entries to that effect in the *Power Event Log(5.7.5.25)*; and
ii. where Supply via phase [n] has not been restored 3 minutes after interruption, and ESME still has a power Supply, generating and sending an Alert to that effect via its HAN Interface.

ESME shall be capable of recording the UTC date and time at which the Supply via phase [n] is restored and:

iii. generating entries to that effect in the *Power Event Log(5.7.5.25)*;
iv. following restoration of the Supply via phase [n], generating and sending an Alert to that effect via its HAN Interface containing details of the UTC dates and times of interruption and restoration; and
v. following restoration of the Supply via phase [n], when the time difference between the Supply being interrupted and restored is greater than or equal to three minutes, generating and sending an Alert to that effect via its HAN Interface containing details of the UTC date and time of interruption and restoration.

5.17.3 Presentation of information on the User Interface

Presentation of information on the User Interface (5.5.4.1) in Part A shall not apply to ESME.

For each of the values currently stored in the *Active Import Register [INFO](5.7.5.3),* the *Active Export Register [INFO](5.7.5.2),* the *Tariff ToU Register Matrix [INFO](5.7.5.34),* and the *Tariff ToU Block Register Matrix(5.7.5.35),* ESME shall be capable of displaying a value calculated from the stored value by:

i. converting the stored value in to a decimal, integer number of kilowatt hours, rounding the stored value down to the nearest kilowatt hour;
ii. discarding all except the six least significant decimal digits so produced; and
iii. adding leading zeros (if necessary) so that there are exactly six decimal digits.

5.18 Interface Requirements

5.18.1 HAN Interface Commands

5.18.1.1 Reset Phase [n] Average RMS Over Voltage Counter

A Command to reset the *Phase [n] Average RMS Over Voltage Counter(5.19.2.1)* to zero.

5.18.1.2 Reset Phase [n] Average RMS Under Voltage Counter

A Command to reset the *Phase [n] Average RMS Under Voltage Counter(5.19.2.2)* to zero.

5.19 Data Requirements

This Section describes the minimum information which ESME shall be capable of holding in its Data Store.

5.19.1 Configuration Data

5.19.1.1 Phase [n] Average RMS Over Voltage Threshold

The average RMS voltage for phase [n] above which an over voltage condition is reported. The threshold shall be configurable within the specified operating range of ESME.

5.19.1.2 Phase [n] Average RMS Under Voltage Threshold

The average RMS voltage for phase [n] below which an under voltage condition is reported. The threshold shall be configurable within the specified operating range of ESME.

5.19.1.3 Phase [n] Average RMS Voltage Measurement Period

The length of time in seconds over which the RMS voltage is averaged for phase [n].

5.19.2 Operational Data

5.19.2.1 Phase [n] Average RMS Over Voltage Counter

The number of times the average RMS voltage for phase [n], as calculated in S*ection 5.17.2.1*, has been above the *Phase [n] Average RMS Over Voltage Threshold(5.19.1.1)* since this counter was last reset.

5.19.2.2 Phase [n] Average RMS Under Voltage Counter

The number of times the average RMS voltage for phase [n], as calculated in accordance with *Section 5.17.2.1*, has been below the *Phase [n] Average RMS Under Voltage Threshold(5.19.1.2)* since this counter was last reset.

5.19.2.3 Phase [n] Average RMS Voltage Profile Data Log

A log capable of storing 4320 entries (including the UTC date and time at the end of the period to which the values relate) comprising the averaged RMS voltage for phase [n] for each *Phase [n] Average RMS Voltage Measurement Period(5.19.1.3)* arranged as a circular buffer such that when full, further writes shall cause the oldest entry to be overwritten.

Part D - Auxiliary Load Control Switch

5.20 Overview

This Part D describes the minimum additional functional, interface and data requirements of ESME where one or more Auxiliary Load Control Switches are installed within ESME. Additional requirements applied by this Part D are a continuation of the Part A Section of the same name (where relevant as modified by Part B or Part C) and hence must also be met by ESME within which one or more Auxiliary Load Control Switches are installed.

5.21 Functional Requirements

5.21.1 Switching Auxiliary Loads

ESME shall be capable of monitoring the *Auxiliary Load Control Switch Calendar(5.7.4.2)* and opening or closing Auxiliary Load Control Switch [n] at times defined in the calendar.

ESME shall only be capable of closing Auxiliary Load Control Switch [n] if the Supply is Enabled. If the Supply is Disabled, then on Enablement ESME shall be capable of causing the Auxiliary Load Control Switch [n] to open, close or maintain its state as defined in the *Auxiliary Load Control Switch Calendar(5.7.4.2)*.

When switching Auxiliary Loads as set out in this *Section 5.21.1*, ESME shall be capable of:

i. applying the *Randomised Offset(5.7.5.28)*; and
ii. setting the *Auxiliary Load Control Switch [n] - Status(5.23.1.1)* to open and closed.

5.22 Interface Requirements

5.22.1 User Interface Commands

5.22.1.1 Test Auxiliary Load Control Switch [n]

A Command to cause an Auxiliary Load Control Switch [n] to change its state for 5 minutes and then to revert to normal operation in accordance with the *Auxiliary Load Control Switch Calendar(5.7.4.2)*.

In executing the Command ESME shall be capable of recording the Command and Outcome to the *Event Log(5.7.5.16)*.

5.22.2 HAN Interface Commands

5.22.2.1 Close Auxiliary Load Control Switch [n]

A Command to cause Auxiliary Load Control Switch [n] to close immediately. The Command shall include a time period. When this time period has elapsed, ESME shall be capable of causing the switch to open or remain closed as defined in the *Auxiliary Load Control Switch Calendar(5.7.4.2)*.

A Command to close an Auxiliary Load Control Switch [n] shall be executed only if the Supply is Enabled. If the Supply is Armed or Disabled, the Command shall be executed when the Supply is Enabled if, on Enablement, the time period included in the Command has not elapsed.

In executing the Command, ESME shall be capable of:

i. recording the Command and Outcome to the *Auxiliary Load Control Switch Event Log(5.7.5.6)*; and
ii. updating the corresponding *Auxiliary Load Control Switch [n] - Status(5.23.1.1)* to indicate whether the switch is now open or closed.

5.22.2.2 Open Auxiliary Load Control Switch [n]

A Command to cause Auxiliary Load Control Switch [n] to open immediately. The Command shall include a time period. When this time period has elapsed, ESME shall be capable of causing the switch to close or remain open as defined in the *Auxiliary Load Control Switch Calendar(5.7.4.2)*.

In executing the Command, ESME shall be capable of:

i. recording the Command and Outcome to the *Auxiliary Load Control Switch Event Log(5.7.5.6)*; and
ii. updating the corresponding *Auxiliary Load Control Switch [n] - Status(5.23.1.1)* to indicate whether the switch is now open or closed.

5.22.2.3 Reset Auxiliary Load Control Switch [n]

A Command to cause the Auxiliary Load Control Switch [n] to open, close or maintain its state, as defined in the *Auxiliary Load Control Switch Calendar(5.7.4.2)*.

A Command to close an Auxiliary Load Control Switch [n] shall be executed only if the Supply is Enabled. If the Supply is Armed or Disabled, the Command shall be executed when the Supply is Enabled.

In executing the Command, ESME shall be capable of:

i. recording the Command and Outcome to the *Auxiliary Load Control Switch Event Log(5.7.5.6)*; and
ii. updating the corresponding *Auxiliary Load Control Switch [n] - Status(5.23.1.1)* to indicate whether the switch is now open or closed.

5.23 Data Requirements

5.23.1 Operational Data

5.23.1.1 Auxiliary Load Control Switch [n] - Status

The current status (being ‘open’ or ‘closed’) of Auxiliary Load Control Switch [n] as commanded by ESME.

Part E - Boost Function

5.24 Overview

This Part E describes the minimum additional functional and data requirements of ESME where a Boost Function is installed within ESME. Additional requirements applied by this Part E are a continuation of the Part A Section of the same name (where relevant as modified by Part B or Part C and / or Part D) and hence must also be met by ESME within which a Boost Function is installed.

5.25 Functional Requirements

5.25.1 User Interface Commands

In executing the Commands in this *Section 5.25.1* ESME shall be capable of recording UTC date and time at the beginning and end of any Boost Period in the *Boost Function Event Log(5.26.3.1)*.

5.25.1.1 Activate Boost Period

A Command to cause the Auxiliary Load Control Switch(es) specified in *Boost Function Control [n](5.26.2.1)* to close for 15, 30, 45 or 60 minutes and then to revert to normal operation in accordance with the *Auxiliary Load Control Switch Calendar(5.7.4.2)*.

ESME shall only be capable of executing this Command if no Boost Period is currently active.

5.25.1.2 Cancel Boost Period

A Command to cause the Auxiliary Load Control Switch(es) specified in *Boost Function Control [n](5.26.2.1)* to revert to normal operation in accordance with the *Auxiliary Load Control Switch Calendar(5.7.4.2)*.

ESME shall only be capable of executing this Command if a Boost Period is active.

In executing the Command ESME shall be capable of generating an entry in the *Boost Function Event Log(5.26.3.1)* to the effect that the active Boost Period has been cancelled.

5.25.1.3 Extend Boost Period

A Command to cause the Auxiliary Load Control Switch(es) specified in *Boost Function Control [n](5.26.2.1)* to remain closed for an additional 15, 30, 45 minutes, and then to revert to normal operation in accordance with the *Auxiliary Load Control Switch Calendar(5.7.4.2)*.

ESME shall only be capable of executing this Command if a Boost Period is active. In executing the Command ESME shall be capable of limiting any active Boost Period to a maximum of 60 minutes.

5.26 Data Requirements

5.26.1 Constant Data

5.26.1.1 Boost Function Availability

A data item to identify if ESME has a configured Boost Function.

5.26.2 Configuration Data

5.26.2.1 Boost Function Control [n]

A data item to identify whether Auxiliary Load Control Switch [n] is to be controlled by the Boost Function.

5.26.3 Operational Data

5.26.3.1 Boost Function Event Log

A single log capable of storing entries for the most recent 25 Boost Periods including the UTC date and time of the beginning and end of the Boost Period.

6 In Home Display Technical Specifications

6.1 Overview

Section 6 of this document describes the minimum physical, minimum functional, minimum interface, minimum data and minimum testing and certification requirements of an In-home Display maintained to comply with the smart metering licence conditions (standard condition 34 of gas supply licences and / or standard condition 40 of electricity supply licences).

6.2 SMETS Testing and Certification Requirements

6.2.1 Conformance with the SMETS

The IHD shall have been tested to ensure that it meets the requirements described in this *Section 6*, and evidence must be available to confirm such testing and conformance.

6.2.2 ZigBee Alliance Certification

The IHD shall have been certified by the ZigBee Alliance as being compliant with those ZigBee SEP requirements that are identified as being required in the Great Britain Companion Specification and that were certifiable under the ZigBee SEP certification scheme on 31 August 2017.

6.3 Physical requirements

The IHD shall as a minimum include the following components:

i. a Data Store;
ii. a HAN Interface;
iii. a User Interface; and
xi. when capable of operating within Sub GHz Bands, a Timer.

The IHD shall be mains powered and shall be capable of performing the minimum functional, interface and data requirements set out in *Sections 6.4*, *6.5* and *6.6* respectively operating at a nominal voltage of 230VAC without consuming more than an average of 0.6 watts of electricity under normal operating conditions.

The IHD shall:

iv. permanently display the *IHD Identifier(6.6.1.1)* on the IHD;

The HAN Interface of the IHD shall be capable of joining a ZigBee SEP Smart Metering Home Area Network which:

v. operates within the 2400 – 2483.5 MHz harmonised frequency band or Sub GHz Bands; and
vi. supports the Communications Links described in *Section 6.5*.

The IHD shall be designed to enable the information displayed on it to be easily accessed and presented in a form that is clear and easy to understand including by Consumers with impaired:

vii. sight;
viii. memory and learning ability;
ix. perception and attention; or
x. dexterity.

When operating within Sub GHz Bands, the IHD shall:

xii. be capable of supporting Frequency Agility;
xiii. not exceed a transmit power of 25 mW; and
xiv. not exceed a duty cycle of 0.35%.

6.4 Functional requirements

This Section describes the minimum functions that the IHD shall be capable of performing.

6.4.1 Communications

The IHD shall be capable of establishing Communications Links via its HAN Interface.

The IHD shall be capable of ensuring that the security characteristics of all Communications Links it establishes meet the requirements described in *Section 6.4.5.2*.

6.4.1.1 Communications Links with ESME and the Gas Proxy Function via the HAN Interface

The IHD shall be capable of establishing and maintaining Communications Links via its HAN Interface with one ESME and one Gas Proxy Function.

In establishing the Communications Link, the IHD shall be capable of using its Security Credentials to enable it to be Authenticated.

The IHD shall be capable of supporting the following types of Communications Links:

i. receiving Pricing and Consumption information from ESME; and
ii. receiving Pricing and Consumption information from a Gas Proxy Function.

The IHD shall be capable of detecting a failure of a Communications Link and on detection of a failure, shall be capable of clearing or suitably annotating the information displayed on its User Interface (set out in *Sections 6.4.2*, *6.4.3* and *6.4.4*) to indicate that the information may be out of date.

6.4.2 General Information

The IHD shall be capable immediately upon establishment of a Communications Link with ESME and a Gas Proxy Function (as set out in *Section 6.4.1.1*), of providing the following information on its User Interface and providing updates of any changes to the information every 10 seconds thereafter.

6.4.2.1 Connection Link Quality

The signal strength of its HAN Interface.

6.4.2.2 Local Time

Time as UTC with adjustment for British Summer Time.

6.4.3 Information pertaining to the Supply of gas to the Premises

The IHD shall be capable immediately upon establishment of a Communications Link with a Gas Proxy Function (as set out in *Section 6.4.1.1*), of providing the following information[4] on its User Interface and providing timely updates of any changes to the information thereafter.

The IHD shall be capable of displaying Currency Units in GB Pounds and European Central Bank Euro.

[4] Information that shall be capable of being provided in numerical form is annotated [NUM]. Information that shall be capable of being provided in Ambient form is annotated [AMB]. Where information is not annotated the information may be provided in any visual format.

6.4.3.1 Active Tariff Price [NUM]

The active Tariff Price for Energy Consumption in Currency Units per kWh.

6.4.3.2 Cumulative Consumption [NUM]

i. Current Day cumulative Energy Consumption;
ii. Current Day cost to the Consumer of cumulative Energy Consumption in Currency Units;
iii. Current Week cumulative Energy Consumption;
iv. Current Week cost to the Consumer of cumulative Energy Consumption in Currency Units;
v. Current month cumulative Energy Consumption; and
vi. Current month cost to the Consumer of cumulative Energy Consumption in Currency Units.

6.4.3.3 Customer Identification Number [NUM]

A number issued to the IHD for display on the User Interface.

6.4.3.4 Debt [NUM]

Either Aggregate Debt or time-based and payment-based debt when GSME is operating in Prepayment Mode.

6.4.3.5 Debt Recovery Rate [NUM]

Either Aggregate Debt Recovery Rate or each Time-based Debt Recovery rate when GSME is operating in Prepayment Mode.

6.4.3.6 Emergency Credit Balance [NUM]

The Emergency Credit balance where Emergency Credit is activated (including a clear indication that Emergency Credit has been activated).

6.4.3.7 Historic Consumption

i. D-1 to D-8 historic Energy Consumption;
ii. D-1 to D-8 cost to the Consumer of historic Energy Consumption in Currency Units;
iii. W-1 to W-5 historic Energy Consumption;
iv. W-1 to W-5 cost to the Consumer of historic Energy Consumption in Currency Units;
v. M-1 to M-13 historic Energy Consumption; and
vi. M-1 to M-13 cost to the Consumer of historic Energy Consumption in Currency Units.

where: D-1 = current Day minus 1, D-2 = current Day minus 2, W-1 = current Week minus 1, M-1 = current month minus 1, etc.

6.4.3.8 Low Credit Alert

An indication that the combined *Meter Balance [NUM](6.4.3.9)* and *Emergency Credit Balance [NUM](6.4.3.6)* has fallen below a low credit threshold.

6.4.3.9 Meter Balance [NUM]

The amount of money in Currency Units as determined by GSME. If operating in Prepayment Mode, the Meter Balance represents GSME's determination of the amount of credit available to the Consumer (excluding any *Emergency Credit Balance [NUM](6.4.3.6)*). If operating in Credit Mode, it represents GSME's determination of the amount of money due from the Consumer since the Meter Balance was last reset.

6.4.3.10 Payment Mode

The current mode of operation of GSME, being Prepayment Mode or Credit Mode.

6.4.4 Information pertaining to the Supply of electricity to the Premises

The IHD shall be capable, upon establishment of a Communications Link with ESME (as set out in *Section 6.4.1.1*), of providing the following information[5] on its User Interface and providing updates of any changes to the information every 10 seconds thereafter.

The IHD shall be capable of displaying Currency Units in GB Pounds and European Central Bank Euro.

6.4.4.1 Active Tariff Price [NUM]

The active Tariff Price for Consumption in Currency Units per kWh.

6.4.4.2 Cumulative Consumption [NUM]

i. Current Day cumulative Consumption;
ii. Current Day cost to the Consumer of cumulative Consumption in Currency Units;
iii. Current Week cumulative Consumption;
iv. Current Week cost to the Consumer of cumulative Consumption in Currency Units;
v. Current month cumulative Consumption; and
vi. Current month cost to the Consumer of cumulative Consumption in Currency Units.

6.4.4.3 Customer Identification Number [NUM]

A number issued to the IHD for display on the User Interface.

6.4.4.4 Debt [NUM]

Either Aggregate Debt or time-based and payment-based debt when ESME is operating in Prepayment Mode.

6.4.4.5 Debt Recovery Rate [NUM]

Either Aggregate Debt Recovery Rate or each Time-based Debt Recovery rate when ESME is operating in Prepayment Mode.

6.4.4.6 Emergency Credit Balance [NUM]

The Emergency Credit balance where Emergency Credit is activated in ESME (including a clear indication that the Emergency credit has been activated).

6.4.4.7 Historic Consumption

i. D-1 to D-8 historic Consumption;
ii. D-1 to D-8 cost to the Consumer of historic Consumption in Currency Units;
iii. W-1 to W-5 historic Consumption;
iv. W-1 to W-5 cost to the Consumer of historic Consumption in Currency Units;
v. M-1 to M-13 historic Consumption; and
vi. M-1 to M-13 cost to the Consumer of historic Consumption in Currency Units.

where: D-1 = current Day minus 1, D-2 = current Day minus 2, W-1 = current Week minus 1, M-1 = current month minus 1 etc.

[5] Information that shall be capable of being provided in numerical form is annotated [NUM]. Information that shall be capable of being provided in Ambient form is annotated [AMB]. Where information is not annotated the information may be provided in any visual format.

6.4.4.8 Instantaneous Active Power Import [NUM]

A near real-time indication of the Active Power Import in kW and the cost to the Consumer of maintaining that Instantaneous Active Power Import for one hour.

6.4.4.9 Low Credit Alert

An indication that the combined *Meter Balance [NUM](6.4.4.10)* and *Emergency Credit Balance(6.4.4.6)* has fallen below a low credit threshold.

6.4.4.10 Meter Balance [NUM]

The amount of money in Currency Units as determined by ESME. If operating in Prepayment Mode, the Meter Balance represents ESME's determination of the amount of credit available to the Consumer (excluding any *Emergency Credit Balance(6.4.4.6)*). If operating in Credit Mode, it represents ESME's determination of the amount of money due from the Consumer since the Meter Balance was last reset.

6.4.4.11 Payment Mode

The current mode of operation of ESME, being Prepayment Mode or Credit Mode.

6.4.4.12 Power Threshold Status [AMB]

An indication of the level of Active Power Import as high, medium or low.

6.4.5 Security

6.4.5.1 General

The IHD shall be designed taking all reasonable steps so as to ensure that any failure or compromise of its integrity shall not compromise the Security Credentials or Personal Data stored on it or compromise the integrity of any other Device to which it is connected by means of a Communications Link.

6.4.5.2 Communications

The IHD shall be capable of preventing and detecting, on all of its interfaces, Unauthorised access that could compromise the Confidentiality and / or Data Integrity of:

i. Personal Data whilst being transferred via an interface;
ii. Consumption data used for billing whilst being transferred via an Interface; and
iii. Security Credentials whilst being transferred via an interface.

6.5 Interface Requirements

This Section describes the minimum required interactions which the IHD shall be capable of undertaking with ESME and / or a Gas Proxy Function as appropriate via its HAN Interface.

6.5.1 Receipt of information via the HAN Interface

The IHD shall be capable, immediately upon establishment of a Communications Link with ESME and / or a Gas Proxy Function (as set out in *Section 6.4.1.1*) of (as relevant):

i. receiving information (and updates of any changes of this information every 10 seconds thereafter) required to meet the display requirements described in *Section 6.4.2*;
ii. receiving information (and timely updates of any changes to the information thereafter) required to meet the display requirements described in *Section 6.4.3*; and
iii. receiving information (and updates of any changes of this information every 10 seconds thereafter) required to meet the display requirements described in *Section 6.4.4*.

6.6 Data requirements

This Section describes the minimum information which the IHD shall be capable of holding in its Data Store.

6.6.1 Constant data

Describes data that remains constant and unchangeable at all times.

6.6.1.1 IHD Identifier

A globally unique identifier used to identify the IHD based on the EUI-64 Institute of Electrical and Electronic Engineers standard.

7 Prepayment Interface Device Technical Specifications

7.1 Overview

Section 7 of this document describes the minimum physical, minimum functional, minimum interface, minimum data and minimum testing and certification requirements of a Prepayment Interface Device (PPMID), where it is maintained by a Supplier in accordance with standard condition 46 of the gas supply licence and / or standard condition 52 of the electricity supply licence.

7.2 SMETS Testing and Certification Requirements

7.2.1 Conformance with the SMETS

A PPMID shall have been tested to ensure that it meets the requirements described in this *Section 7*, and evidence must be available to confirm such testing and conformance.

7.2.2 Conformance with the Great Britain Companion Specification

A PPMID shall meet the requirements described in the Great Britain Companion Specification.

A PPMID shall have been certified by the ZigBee Alliance as being compliant with those ZigBee SEP requirements that are identified as being required in the Great Britain Companion Specification and that were certifiable under the ZigBee SEP certification scheme on 31 August 2017.

7.3 Physical Requirements

A PPMID shall as a minimum include the following components:

i. a Data Store;
ii. a HAN Interface;
iii. a User Interface; and
xiv. when capable of operating within Sub GHz Bands, a Timer.

A PPMID shall:

iv. permanently display the *PPMID Identifier(7.6.1.1)* on the PPMID; and
v. have a Secure Perimeter.

The HAN Interface of a PPMID shall be capable of joining a ZigBee SEP Smart Metering Home Area Network which:

vi. operates within the 2400 – 2483.5 MHz harmonised frequency band or Sub GHz Bands; and
vii. supports the Communications Links described in *Sections 7.5.1, 7.5.2*, *7.5.4* and *7.5.5*.

The PPMID shall be designed taking all reasonable steps so as to prevent Unauthorised Physical Access and Unauthorised communications through its Secure Perimeter that could compromise the Confidentiality and / or Data Integrity of:

viii. Personal Data;
ix. Security Credentials;
x. Cryptographic Algorithms; and

xi. Firmware and data essential for ensuring its integrity,

stored or executing on the PPMID.

The PPMID shall be capable of detecting any attempt at Unauthorised Physical Access through its Secure Perimeter that could compromise such Confidentiality and / or Data Integrity and on such detection shall be capable of:

xii. providing evidence of such an attempt through the use of tamper evident coatings or seals;

and where reasonably practicable:

xiii. generating and sending an Alert to that effect via its HAN Interface.

When operating within Sub GHz Bands, the PPMID shall:

xv. be capable of supporting Frequency Agility;
xvi. not exceed a transmit power of 25 mW; and
xvii. not exceed a duty cycle of 0.35%.

7.4 Functional Requirements

This Section describes the minimum functions that a PPMID shall be capable of performing.

7.4.1 Communications

A PPMID shall be capable of establishing Communications Links via its HAN Interface.

A PPMID shall be capable of ensuring that the security characteristics of all Communications Links it establishes meet the requirements described in *Section 7.4.7.4*.

When any Command addressed to the PPMID is received via any Communications Link the PPMID shall be capable of:

i. using the Security Credentials the PPMID holds, Authenticating to a Trusted Source the Command;
ii. verifying in accordance with *Section 7.4.7.2.3* that the sender of the Command is Authorised to execute the Command; and
iii. verifying the integrity of the Command.

On failure of any of *(i)* to *(iii)* above, the PPMID shall be capable of discarding the Command without execution and without either generating or sending a Response, and generating and sending an Alert to that effect via its HAN Interface.

Where the Command is not due to be executed immediately, the PPMID shall be capable of generating and sending a Response via its HAN Interface to confirm its successful receipt.

A PPMID shall only be capable of addressing a Response to the sender of the relevant Command.

7.4.1.1 Communications Links with ESME, GSME and Gas Proxy Function via the HAN interface

A PPMID shall be capable of establishing Communications Links via its HAN Interface with a minimum of one ESME, one GSME and one Gas Proxy Function.

A PPMID shall only be capable of establishing Communications Links via its HAN Interface with GSME and ESME with Security Credentials in the *Device Log(7.6.3.1)*.

In establishing any Communications Link via its HAN Interface, the PPMID shall be capable of using its Security Credentials to enable it to be Authenticated.

A PPMID shall be capable of supporting the following types of Communications Links:

i. receiving Price and Consumption information from ESME;
ii. receiving Price and Consumption information from a Gas Proxy Function;
iii. generating and sending the Commands (set out in *Section 7.5.4*) to GSME; and
iv. generating and sending the Commands (set out in *Section 7.5.5*) to ESME.

A PPMID shall be capable of detecting a failure of a Communications Link and on detection of a failure, shall be capable of clearing or suitably annotating the information displayed on its User Interface (set out in *Sections 7.4.5* and *7.4.6*) to indicate that the information may be out of date.

7.4.2 Data storage

A PPMID shall be capable of retaining all information held in its Data Store at all times, including on loss of power.

7.4.3 Debt to Clear Calculations

7.4.3.1 Debt to Clear GSME

If the *Meter Balance(4.6.5.11)* is equal to or below the *Disablement Threshold(4.6.4.12)* a PPMID shall be capable of maintaining a calculation of the Debt to Clear based on:

i. the difference between the *Meter Balance(4.6.5.11)* and the *Disablement Threshold(4.6.4.12)*;
ii. amount of debt accumulated in the *Accumulated Debt Register(4.6.5.1)*;
iii. amount of Emergency Credit activated and used by the Consumer; and
iv. the payment-based debt to be collected based on *(i)*, *(ii)* and *(iii)* (as defined by *Debt Recovery per Payment(4.6.4.8)* taking account of the amount remaining in the *Payment Debt Register(4.6.5.13)*, the payment-based debt payments in the *Billing Data Log(4.6.5.3)* and the *Debt Recovery Rate Cap(4.6.4.10)*).

7.4.3.2 Debt to Clear ESME

If the *Meter Balance [INFO](5.7.5.22)* is equal to or below the *Disablement Threshold [INFO](5.7.4.15)* a PPMID shall be capable of maintaining a calculation of the Debt to Clear based on:

i. the difference between the *Meter Balance [INFO](5.7.5.22)* and the *Disablement Threshold [INFO](5.7.4.15)*;
ii. amount of debt accumulated in the *Accumulated Debt Register [INFO](5.7.5.1)*;
iii. amount of Emergency Credit activated and used by the Consumer; and
iv. the payment-based debt to be collected based on (*i*), (*ii*) and (*iii*) (as defined by *Debt Recovery per Payment [INFO]*(*5.7.4.11*) taking account of the amount remaining in the *Payment Debt Register [INFO]*(*5.7.5.23*), the payment-based debt payments in the *Billing Data Log(5.7.5.10)* and the *Debt Recovery Rate Cap [INFO]*(*5.7.4.13*)).

7.4.4 General Information

A PPMID shall be capable immediately upon establishment of a Communications Link with an ESME and a Gas Proxy Function (as set out in *Section 7.4.1.1*), of displaying the following up to date information on its User Interface, and displaying updates of any changes to the information every 10 seconds thereafter.

The PPMID shall be capable of displaying Currency Units in GB Pounds and European Central Bank Euro.

7.4.4.1 Connection Link Quality

The signal strength of its HAN Interface.

7.4.4.2 Local Time

The UTC date and time adjusted for British Summer Time.

7.4.5 Information Pertaining to the Supply of Gas to the Premises

A PPMID shall be capable immediately upon establishment of a Communications Link with a Gas Proxy Function (as set out in *Section 7.4.1.1*), of displaying the following up to date information on its User Interface, and displaying timely updates of any changes to the information thereafter:

i. the *Active Tariff Price(4.6.5.2)*;
ii. the *Emergency Credit Balance(4.6.5.8)* where Emergency Credit is activated (including a clear indication that Emergency Credit has been activated);
iii. whether Emergency Credit is available for activation on GSME;
iv. any low credit condition;
v. the *Meter Balance(4.6.5.11)*;
vi. the Debt to Clear;
vii. whether GSME has suspended the Disablement of Supply during a period defined in the *Non-Disablement Calendar(4.6.4.20)* (as set out in *Section 4.4.7.2*);
viii. either Aggregate Debt or time-based and payment-based debts when GSME is operating in Prepayment Mode;
ix. either Aggregate Debt Recovery Rate or each Time-based Debt Recovery rate when GSME is operating in Prepayment Mode;
x. any *Standing Charge(4.6.4.23)*;
xi. the *Contact Details(4.6.4.4)*; and
xii. the *Supply State(4.6.5.18)*.

7.4.6 Information Pertaining to the Supply of Electricity to the Premises

A PPMID shall be capable, upon establishment of a Communications Link with ESME (as set out in *Section 7.4.1.1*), of displaying the following information on its User Interface, and displaying updates of any changes to the information every 10 seconds thereafter:

i. the *Active Tariff Price [INFO](5.7.5.5)*;
ii. the *Emergency Credit Balance [INFO](5.7.5.15)* where Emergency Credit is activated (including a clear indication that Emergency Credit has been activated);
iii. whether Emergency Credit is available for activation on ESME;
iv. any low credit condition;
v. the *Meter Balance [INFO](5.7.5.22)*;
vi. the Debt to Clear when ESME is operating in Prepayment Mode;
vii. whether ESME has suspended the Disablement of Supply during a period defined in the *Non-Disablement Calendar [INFO](5.7.4.30)* (as set out in *Section 5.5.7.2*);
viii. either Aggregate Debt or time-based and payment-based debts when ESME is operating in Prepayment Mode;
ix. either Aggregate Debt Recovery Rate or each Time-based Debt Recovery rate when ESME is operating in Prepayment Mode;
x. any *Standing Charge [INFO](5.7.4.42)*;
xi. *Contact Details [INFO](5.7.4.8)*; and
xii. the *Supply State [INFO](5.7.5.32)*.

7.4.7 Security

7.4.7.1 General

A PPMID shall be designed taking all reasonable steps to ensure that any failure or compromise of its integrity shall not compromise the Security Credentials or Personal Data stored on it or compromise the integrity of any other Device to which it is connected by means of a Communications Link.

7.4.7.2 Security Credentials

7.4.7.2.1 PPMID Private Keys

The PPMID shall be capable of securely storing Private Keys.

The PPMID shall be capable of securely storing Key Agreement values.

7.4.7.2.2 Public Key Certificates

The PPMID shall be capable of securely storing Security Credentials from Certificates including for use in the Cryptographic Algorithms as set out in *Section 7.5.2.4*.

During the replacement of any *PPMID Security Credentials(7.6.3.2)* (as set out in *Section 7.5.2.4*), the PPMID shall be capable of ensuring that the *PPMID Security Credentials(7.6.3.2)* being replaced remain usable until the successful completion of the replacement.

7.4.7.2.3 Role Based Access Control (RBAC)

The PPMID shall be capable of restricting Authorisation to execute Commands according to Role permissions.

7.4.7.3 Cryptographic Algorithms

The PPMID shall be capable of supporting the following Cryptographic Algorithms:

i. Elliptic Curve DSA;
ii. Elliptic Curve DH; and
iii. SHA-256.

In executing and generating any Command or Response or Alert, the PPMID shall be capable of applying Cryptographic Algorithms (alone or in combination) for:

iv. Digital Signing;
v. Digital Signature verification;
vi. Hashing; and
vii. Message Authentication.

7.4.7.4 Communications

A PPMID shall be capable of preventing and detecting, on all of its interfaces, Unauthorised access that could compromise the Confidentiality and / or Data Integrity of:

i. Personal Data whilst being transferred via an interface;
ii. Consumption data used for billing whilst being transferred via an interface;
iii. Security Credentials whilst being transferred via an interface; and
iv. Firmware and data essential for ensuring its integrity whilst being transferred via an interface.

7.5 Interface Requirements

This Section describes the minimum required interactions which a PPMID shall be capable of undertaking with ESME, GSME and a Gas Proxy Function as appropriate via its HAN Interface.

7.5.1 Receipt of Information via the HAN Interface

A PPMID shall be capable, immediately upon establishment of a Communications Link with ESME and a Gas Proxy Function (as set out in *Section 7.4.1.1*) of:

i. receiving information required to meet the display requirements set out in *Section 7.4.3*;
ii. receiving information (and timely updates of any changes to the information thereafter) required to meet the display requirements set out in *Section 7.4.5*; and
iii. receiving information (and updates of any changes of this information every 10 seconds thereafter) required to meet the display requirements set out in *Section 7.4.6.*

7.5.2 HAN Interface Commands

A PPMID shall be capable of executing immediately the Commands set out in this *Section 7.5.2* following their receipt via its HAN Interface.

7.5.2.1 Add Device Security Credentials

A Command to add Security Credentials for ESME or GSME to the *Device Log(7.6.3.1)*.

In executing the Command, a PPMID shall be capable of verifying the Security Credentials.

7.5.2.2 Read Configuration Data

A Command to read the value of one or more of the configuration data items set out in *Section 7.6.3*.

In executing the Command, a PPMID shall be capable of sending such value(s) in a Response via its HAN Interface.

7.5.2.3 Remove Device Security Credentials

A Command to remove Security Credentials for ESME or GSME from the *Device Log(7.6.3.1)*.

7.5.2.4 Replace PPMID Security Credentials

A Command to replace *PPMID Security Credentials(7.6.3.2)* held within the PPMID.

In executing the Command the PPMID shall be capable of maintaining the Command's Transactional Atomicity.

7.5.3 User Interface Commands

A PPMID shall be capable of executing immediately the Commands set out in this *Section 7.5.3* following their receipt via its User Interface.

7.5.3.1 Activate ESME Emergency credit

A Command to issue a *Request Emergency Credit Activation(7.5.5.1)* to ESME.

7.5.3.2 Activate GSME Emergency credit

A Command to issue a *Request Emergency Credit Activation(7.5.4.1)* to GSME.

7.5.3.3 Add Credit to ESME

A Command to generate and issue a *Request to Add Credit(7.5.5.2)* when ESME is operating in Prepayment Mode on input of a UTRN.

7.5.3.4 Add Credit to GSME

A Command to generate and issue a *Request to Add Credit(7.5.4.2)* when GSME is operating in Prepayment Mode on input of a UTRN.

7.5.3.5 Enable ESME Supply

A Command to issue a *Request to Enable ESME Supply(7.5.5.3)* to ESME.

7.5.4 HAN Interface Commands issued by PPMID to GSME

A PPMID shall be capable of generating and issuing to GSME the Commands set out in this *Section 7.5.4*.

7.5.4.1 Request Emergency Credit Activation

A Command requesting that GSME Activates Emergency Credit.

7.5.4.2 Request to Add Credit

A Command including a UTRN requesting that GSME accepts Credit.

7.5.5 HAN Interface Commands issued by PPMID to ESME

A PPMID shall be capable of generating and issuing to ESME the Commands set out in this *Section 7.5.5*.

7.5.5.1 Request Emergency Credit Activation

A Command requesting that ESME Activates Emergency Credit.

7.5.5.2 Request to Add Credit

A Command including a UTRN requesting that ESME accepts credit.

7.5.5.3 Request to Enable ESME Supply

A Command requesting that ESME Enables Supply.

7.6 Data Requirements

This Section describes the minimum information which a PPMID shall be capable of holding in its Data Store.

7.6.1 Constant data

Data that shall remain constant and unchangeable at all times.

7.6.1.1 PPMID Identifier

A globally unique identifier used to identify the PPMID based on the EUI-64 Institute of Electrical and Electronic Engineers standard.

7.6.2 This Section is not used

7.6.3 Configuration data

Data that configures the operation of various functions of the PPMID.

7.6.3.1 Device Log

The Security Credentials and Device identity details for each of the Devices with which the PPMID can communicate.

7.6.3.2 PPMID Security Credentials

The Security Credentials for the PPMID and parties Authorised to interact with it.

8 HAN Connected Auxiliary Load Control Switch Technical Specifications

8.1 Overview

Section 8 of this document describes the minimum physical, minimum functional, minimum interface, minimum data and minimum testing and certification requirements of a HAN Connected Auxiliary Load Control Switch (HCALCS), where it is maintained by a Supplier in accordance with standard condition 52 of the electricity supply licence.

8.2 SMETS Testing and Certification Requirements

8.2.1 Conformance with the SMETS

An HCALCS shall have been tested to ensure that it meets the requirements described in this *Section 8*, and evidence must be available to confirm such testing and conformance.

8.2.2 Conformance with the Great Britain Companion Specification

An HCALCS shall meet the requirements described in the Great Britain Companion Specification.

An HCALCS shall have been certified by the ZigBee Alliance as being compliant with those ZigBee SEP requirements that are identified as being required in the Great Britain Companion Specification and that were certifiable under the ZigBee SEP certification scheme on 31 August 2017.

8.2.3 Conformance with the Commercial Product Assurance Security Characteristics for GB Smart Metering

An HCALCS shall meet the requirements described in the Commercial Product Assurance Security Characteristic Smart Metering - HAN Connected Auxiliary Load Control Switch.

An HCALCS shall be certified by NCSC as compliant with the Commercial Product Assurance Security Characteristic Smart Metering - HAN Connected Auxiliary Load Control Switch.

8.3 Physical Requirements

An HCALCS shall as a minimum include the following components:

i. a HAN Interface;
ii. a Data Store;
iii. an Auxiliary Load Control Switch; and
iv. a Timer.

An HCALCS shall:

v. permanently display the *HCALCS Identifier(8.6.1.1)* on the HCALCS.

The HAN Interface of an HCALCS shall be capable of joining a ZigBee SEP Smart Metering Home Area Network which:

vi. operates within the 2400 – 2483.5 MHz harmonised frequency band or Sub GHz Bands; and

vii. supports the Communications Links described in *Sections 8.5.1 and 8.5.2*.

An HCALCS shall be designed taking all reasonable steps so as to prevent Unauthorised Physical Access and Unauthorised communications that could compromise the Confidentiality and / or Data Integrity of:

viii. Security Credentials;
ix. Cryptographic Algorithms; and
x. Firmware and data essential for ensuring its integrity,

stored or executing on the HCALCS.

When operating within Sub GHz Bands, the HCALCS shall:

xi. be capable of supporting Frequency Agility; and
xii. not exceed a transmit power of 25 mW.

8.4 Functional Requirements

This Section defines the minimum functions that an HCALCS shall be capable of performing.

8.4.1 Timer

The Timer shall be capable of measuring a configurable period of up to 24 hours with a minimum resolution of 1 minute.

8.4.2 Communications

An HCALCS shall be capable of establishing Communications Links via its HAN Interface.

An HCALCS shall be capable of ensuring that the security characteristics of all Communications Links it establishes meet the requirements described in *Section 8.4.4.4*.

When any Command addressed to the HCALCS is received via any Communications Link the HCALCS shall be capable of:

i. using the Security Credentials the HCALCS holds, Authenticating to a Trusted Source the Command;
ii. verifying in accordance with *Section 8.4.4.2.3* that the sender of the Command is Authorised to execute the Command; and
iii. verifying the integrity of the Command.

On failure of any of *(i)* to *(iii)* above, the HCALCS shall be capable of discarding the Command without execution and without either generating or sending a Response, and generating and sending an Alert to that effect via its HAN Interface.

An HCALCS shall only be capable of addressing a Response to the sender of the relevant Command.

8.4.2.1 Communications Links with ESME via the HAN interface

An HCALCS shall be capable of establishing Communications Links via its HAN Interface with one ESME.

An HCALCS shall only be capable of establishing Communications Links via its HAN Interface with one ESME with Security Credentials in the *Device Log(8.6.2.1)*.

In establishing the Communications Link, the HCALCS shall be capable of using its own, unique Security Credentials to enable it to be Authenticated by the ESME.

The HCALCS shall be capable of supporting the following types of Communications Links:

i. receiving HAN Interface Commands (set out in *Section 8.5.1*) from ESME; and
ii. sending the Commands (set out in *Section 8.5.1.6*) to ESME.

8.4.3 Data storage

An HCALCS shall be capable of retaining all information held in its Data Store at all times, including on loss of power.

8.4.4 Security

8.4.4.1 General

An HCALCS shall be designed taking all reasonable steps to ensure that any failure or compromise of its integrity shall not compromise the Security Credentials stored on it or compromise the integrity of any other Device to which it is connected by means of a Communications Link.

An HCALCS shall be capable of securely disabling Critical Commands other than those Commands set out in *Section 8.5* that are Critical Commands.

8.4.4.2 Security Credentials

8.4.4.2.1 HCALCS Private Keys

The HCALCS shall be capable of securely storing Private Keys.

The HCALCS shall be capable of securely storing Key Agreement values.

8.4.4.2.2 Public Key Certificates

The HCALCS shall be capable of securely storing Security Credentials from Public Key Certificates including for use in the Cryptographic Algorithms as set out in *Section 8.4.4.3*.

During any replacement of *HCALCS Security Credentials(8.6.2.2)* (as set out in *Section 8.5.1.3*) the HCALCS shall be capable of ensuring that the *HCALCS Security Credentials(8.6.2.2)* being replaced remain usable until the successful completion of the replacement.

8.4.4.2.3 Role Based Access Control (RBAC)

The HCALCS shall be capable of restricting Authorisation to execute Commands according to Role permissions.

8.4.4.3 Cryptographic Algorithms

The HCALCS shall be capable of supporting the following Cryptographic Algorithms:

i. Elliptic Curve DSA;
ii. Elliptic Curve DH; and
iii. SHA-256.

In creating any Command, the HCALCS shall be capable of applying Cryptographic Algorithms (alone or in combination) for:

iv. Digital Signature verification;
v. Hashing; and
vi. Message Authentication.

8.4.4.4 Communications

An HCALCS shall be capable of preventing and detecting, on all of its interfaces, Unauthorised access that could compromise the Confidentiality and / or Data Integrity of:

i. Security Credentials whilst being transferred via an interface; and
ii. Firmware and data essential for ensuring its integrity whilst being transferred via an interface.

8.5 Interface Requirements

This Section sets out the minimum required interactions which an HCALCS shall be capable of undertaking with ESME via its HAN Interface.

8.5.1 HAN Interface Commands

An HCALCS shall be capable of executing immediately the Commands set out in this Section following their receipt via its HAN Interface.

8.5.1.1 Add Device Security Credentials

A Command to add Security Credentials for ESME to the *Device Log(8.6.2.1).*

In executing the Command, the HCALCS shall be capable of verifying the Security Credentials.

8.5.1.2 Control HAN Connected Auxiliary Load Control Switch

A Command to control the HCALCS, for the time period specified within the Command.

In executing the Command, the HCALCS shall be capable of:

i. performing the specified control operation for the specified time period;
ii. send a Response detailing the Outcome via its HAN Interface; and
iii. at the end of the control time period, issuing a *Request Control of HAN Connected Auxiliary Load Control Switch(8.5.2.1)* to the ESME.

When not subject to control through this Command, the HCALCS shall default its state to open.

8.5.1.3 Read Configuration Data

A Command to read the value of one or more of the configuration data items set out in *Section 8.6.2*.

In executing the Command, the HCALCS shall be capable of sending such value(s) in a Response via its HAN Interface.

8.5.1.4 Remove Device Security Credentials

A Command to remove Security Credentials for an ESME from the *Device Log(8.6.2.1).*

8.5.1.5 Replace HCALCS Security Credentials

A Command to replace *HCALCS Security Credentials(8.6.2.2)* held within the HCALCS.

In executing the Command the HCALCS shall be capable of maintaining the Command's Transactional Atomicity.

8.5.1.6 Write Configuration Data

A Command to record one or more new values of the configuration data items set out in *Section 8.6.2*.

8.5.2 HAN Interface Commands issued by an HCALCS to ESME

An HCALCS shall be capable of issuing the Commands set out in this Section, receiving corresponding Responses and, where required by a Response, taking the required actions.

8.5.2.1 Request Control of HAN Connected Auxiliary Load Control Switch

A Command requesting that the ESME issues an updated *Control HAN Connected Auxiliary Load Control Switch(5.6.4.1)* Command.

An HCALCS shall be capable of issuing this Command after completing the execution of a *Control HAN Connected Auxiliary Load Control Switch(8.5.1.2)*.

8.6 Data Requirements

This Section describes the minimum information which an HCALCS is to be capable of holding in its Data Store.

8.6.1 Constant Data

Describes data that remains constant and unchangeable at all times.

8.6.1.1 HCALCS Identifier

A globally unique identifier used to identify the HCALCS based on the EUI-64 Institute of Electrical and Electronic Engineers standard.

8.6.2 Configuration Data

Data that configures the operation of functions of the HCALCS.

8.6.2.1 Device Log

The Security Credentials and Device identity details for the ESME with which HCALCS can communicate.

8.6.2.2 HCALCS Security Credentials

The Security Credentials for the HCALCS and parties Authorised to interact with it.

9 Glossary

Active Energy

The integral with respect to time of the Active Power in units of watt-hours (Wh) or standard multiples thereof (for example, kWh).

Active Power

The product of voltage and the in-phase component of alternating current measured in units of watts (W) or standard multiples thereof (for example, kW).

Aggregate Debt

The sum of all time-based and payment-based debt registers on ESME or GSME operating in Prepayment Mode.

Aggregate Debt Recovery Rate

The sum of the Time-based Debt Recovery rates on ESME or GSME operating in Prepayment Mode.

Alarm

A short-lived audible signal.

Alert

A message generated by a Device including in response to a problem or the risk of a potential problem.

Ambient

The representation of information in a form that can be understood at a glance.

Arm

To establish a state whereby Supply will be Enabled in response to a Command to Enable Supply; ‘Armed’ and ‘Arming’ shall be construed accordingly.

Authentication

The method used to confirm the identity of entities or Devices wishing to communicate and ‘Authenticated’ and ‘Authenticity’ shall be construed accordingly.

Authorisation

The process of granting access to a resource and ‘Authorised’ shall be construed accordingly.

Auxiliary Load Control Switch (ALCS)

A switch or other means of controlling a load on the Supply.

Battery

A component that produces electricity from a chemical reaction.

Block Counter

Storage for recording Consumption for the purposes of combined Time-of-use and Block Pricing.

Block Pricing

A pricing scheme used in conjunction with Time-of-use Pricing where Price varies based on Consumption over a given time period.

Block Register

A Tariff Register for recording Consumption for the purposes of combined Time-of-use and Block Pricing.

Block Tariff

A Tariff for Block Pricing.

Certificate

An electronic document that binds an identity, and possibly other information, to a Public Key.

Certificate Signing Request

A message requesting the issue of a Certificate by a Certification Authority.

Certification Authority (CA)

A trusted entity which issues Certificates.

Clock

A timing mechanism that has a minimum resolution of 1 second.

Command

An instruction to perform a function received or sent via any interface.

Commercial Product Assurance (CPA) Security Characteristic Electricity Smart Metering Equipment

A version of the document entitled 'Commercial Product Assurance Security Characteristic Smart Metering – Electricity Smart Metering Equipment' that is identified in the Smart Energy Code as being relevant to the GBCS.

Commercial Product Assurance (CPA) Security Characteristic Gas Smart Metering Equipment

A version of the document entitled 'Commercial Product Assurance Security Characteristic Smart Metering – Gas Smart Metering Equipment' that is identified in the Smart Energy Code as being relevant to the GBCS.

Commercial Product Assurance (CPA) Security Characteristic Smart Metering – HAN Connected Auxiliary Load Control Switch

A version of the document entitled 'Commercial Product Assurance Security Characteristic Smart Metering – HAN Connected Auxiliary Load Control Switch' that is identified in the Smart Energy Code as being relevant to the GBCS.

Communications Hub Date and Time

The CHF Date and Time as described at section 4 in the Communications Hub Technical Specifications.

Communications Hub Physical Interface

A physical interface to connect to the Communications Hub.

Communications Hub Technical Specifications (CHTS)

A version of the document entitled 'Communications Hub Technical Specifications' set out in Schedule 10 of the Smart Energy Code.

Communications Link

The means of effecting an exchange of Commands, Responses, Alerts and other information between a system or Device and another system or Device which is independent of the transport mechanism used.

Confidentiality

The state of information, in transit or at rest, where there is assurance that it is not accessible by Unauthorised parties through either unintentional means or otherwise.

Consumer

A person who lawfully resides at the Premises that is being Supplied.

Consumption

In the context of GSME Gas Consumption and in the context of ESME Electricity Consumption.

Contact Details

The name and contact telephone number of the current gas or electricity Supplier (as appropriate).

Credit Mode

A mode of operation of GSME or ESME whereby Consumers are billed for some or all of their Consumption retrospectively.

Critical Commands

Those Commands which relate to Supply being affected, financial fraud or the compromise of the security of Devices in Consumer Premises.

Critical Event

An event which relates to Supply being affected, financial fraud or the compromise of the security of Devices in Consumer Premises.

Cryptographic Algorithm

An algorithm for performing one or more cryptographic functions which may include: Encryption, Decryption, Digital Signing or Hashing of information, data, or messages; or exchange of Security Credentials.

Currency Units

The units of monetary value in major and minor units.

Customer Identification Number

A number used to verify that an individual requesting a service is present in the Consumer Premises.

Data Integrity

The state of data where there is assurance that it has not been altered by Unauthorised parties.

Data Store

An area of a Device capable of storing information for future retrieval.

Day

The period commencing 00:00:00 Local Time and ending at the next 00:00:00.

Day Profile

For the purposes of Time-of-use Pricing and Time-of-use with Block Pricing, the rules defined in a Switching Table specifying the Tariff Register to which Consumption is allocated for the day (in the context of GSME Time-of-use Pricing and Time-of-use with Block Pricing) and for each half-hour period within the day (in the context of the ESME Time-of-use Pricing and Time-of-use with Block Pricing).

For the purposes of setting the commanded state of Auxiliary Load Control Switches or HAN Connected Auxiliary Load Control Switches, the rules defined in a Switching Table specifying the commanded state of each Auxiliary Load Control Switch or HAN Connected Auxiliary Load Control Switch, for all times within the day.

For the purposes of Non-Disablement Periods the rules defined in a Switching Table specifying the times during the day when a Non-Disablement Period is active.

Debt Register

Storage for recording an amount of debt to be recovered.

Debt to Clear

The amount of credit the consumer needs to add to ESME or GSME to cause the Meter Balance to rise to the disablement threshold when operating in Prepayment Mode.

Decryption

The process of converting Encrypted information by an Authorised party to recover the original information and like terms shall be construed accordingly.

Device

GSME, ESME, a GPF, a CHF, a Type 1 Device or a Type 2 Device.

Device Language Message Specification (DLMS) Companion Specification for Energy Metering (COSEM)

The version of the document of that name identified in the GBCS.

Digital Signature

The information appended to a Message which is created using the sender's Private Key, that can be verified using the Public Key contained in the sender's Certificate, and provides the receiver with assurance that the sender is who they claim to be, the message has not been altered in transit and that the holder of the sender's Private Key created the Message.

Digital Signing

The creation of a Digital Signature.

Disable

In the context of GSME the act of interrupting the flow of gas by closing the Valve and in the context of ESME the act of interrupting the flow of electricity by opening the Load Switch(es) and like terms shall be construed accordingly.

4272 Domestic Premises

4273 Shall in the context of GSME have the meaning given to that term in standard condition 1 of
4274 gas supply licences, and in the context of ESME shall have the meaning given to that term in
4275 standard condition 1 of electricity supply licences.

4276 Electricity Consumption

4277 The Active Energy Imported into the Premises and 'Consumed' shall be construed
4278 accordingly.

4279 Electricity Meter

4280 An instrument used to measure, store and display the amount of electrical energy passing
4281 through an electrical circuit or circuits.

4282 Elliptic Curve DH

4283 The Elliptic Curve Diffie–Hellman Algorithm (see
4284 *http://nvlpubs.nist.gov/nistpubs/SpecialPublications/NIST.SP.800-56Ar2.pdf*).

4285 Elliptic Curve DSA

4286 The Elliptic Curve Digital Signature Algorithm forming part of the NSA Suite B standard (see
4287 *http://nvlpubs.nist.gov/nistpubs/FIPS/NIST.FIPS.186-4.pdf*).

4288 Emergency Credit

4289 Credit that can be made available to ensure that the Supply is not interrupted in
4290 circumstances (including situations of emergency) defined by the Supplier to the Premises.

4291 Enable

4292 In the context of GSME the act of restoring the flow of gas to the Premises by opening the
4293 Valve and in the context of ESME the act of restoring the flow of electricity to the Premises
4294 by closing the Load Switch and like terms shall be construed accordingly.

4295 Encryption

4296 The process of converting information in order to make it unintelligible other than to
4297 Authorised parties and like terms shall be construed accordingly.

4298 Energy Consumption

4299 The amount of gas in kWh or electricity in kWh Supplied to the Premises.

4300 ESME

4301 Electricity Smart Metering Equipment, being Single Element Electricity Metering Equipment,
4302 Twin Element Electricity Metering Equipment or Polyphase Electricity Metering Equipment
4303 as the context requires.

4304 Export

4305 The flow of electricity out of the Premises, and like terms shall be construed accordingly.

4306 Firmware

4307 The embedded software programmes and / or data structures that control Devices.

4308 Frequency Agility

4309 The ability to change the frequency of operation in Sub GHz Bands.

Gas Consumption

The volume of gas in cubic metres (m^3) Supplied to the Premises and 'Consumed' shall be construed accordingly.

Gas Meter

An instrument designed to measure, memorise and display the quantity of gas (volume or mass) that has passed through it.

Gas Proxy Function

Gas Proxy Function as defined in the Communications Hub Technical Specifications.

Great Britain Companion Specification

A version of the document entitled 'Great Britain Companion Specification' that is identified in the Smart Energy Code as being relevant to this version of SMETS.

GSME

Gas Smart Metering Equipment.

Hashing

A repeatable process to create a fixed size and condensed representation of a message of any arbitrary data. Hash and like terms shall be construed accordingly.

HCALCS

HAN Connected ALCS, which is a Type 1 Device.

HCALCS Technical Specifications

HCALCS Technical Specifications as described in SMETS.

Home Area Network Interface (HAN Interface)

A component of GSME, ESME, IHD or other Device that is capable of sending and receiving information to and from other Devices.

Key

Data used to determine the output of a cryptographic operation.

Key Agreement

A means to calculate a shared Key between two parties.

IHD

In-home Display.

IHD Source Device

ESME or the Gas Proxy Function.

IHD Technical Specifications

IHD Technical Specifications as described in SMETS.

Import

The flow of electricity into the Premises, and like terms shall be construed accordingly.

Large Gas Meter

Means a Gas Meter designed to operate with a maximum flow rate of greater than 11 cubic metres per hour[6].

Load Switch

A component or combination of components that can close or open (including on receipt of a Command to that effect) to Enable or Disable the flow of electricity to and from the Premises.

Local Time

The UTC date and time adjusted for British Summer Time.

Lock

To establish a state whereby the Supply is Disabled and the GSME or ESME cannot determine the Supply state; 'Locked' and 'Locking' shall be construed accordingly.

Message Authentication

The process by which the receiver of a message is provided with assurance that the sender is who they claim to be and that the message is in the form originally sent.

MPAN

Meter Point Administration Number.

MPRN

Meter Point Reference Number.

NCSC

The National Cyber Security Centre, the UK Government's national technical authority for information assurance.

Non-Disablement Period

A period of time during which the combined credit of the meter balance and Emergency Credit balance falling below the disablement threshold will not be cause the Supply to be Disabled when ESME or GSME is operating in Prepayment Mode.

Outcome

The result of executing a Command, expressed as success or failure.

Payment-based Debt Recovery

A means of recovering debt based on a percentage of a payment.

Personal Data

Any information comprising Personal Data as such term is defined in the Data Protection Act 1998 at the date the SMETS is brought into force.

Polyphase Electricity Metering Equipment

Electricity metering equipment containing three measuring elements suitable for a polyphase Supply with up to three phases and neutral.

PPMID Technical Specifications

PPMID Technical Specifications as described in SMETS.

[6] GAS ACT 1986 Standard conditions of gas supply licence page 26.

Prepayment Interface Device (PPMID)

A Type 1 Device that provides a User Interface for Prepayment Mode related information and Commands.

Premises

The premises which is Supplied.

Prepayment Mode

A mode of operation of GSME or ESME whereby payment is generally made in advance of Consumption.

Price

The amount of money in Currency Units charged for one kWh unit of gas Consumed for GSME or one kWh of electricity Consumed via the relevant measuring element for ESME.

Privacy PIN Protection

The prevention of the display of information and access to Commands on the User Interface of GSME or ESME.

Private Key

The Key in a Public-Private Key Pair which must be kept secure by the entity to which it relates.

Public Key

The Key in a Public-Private Key Pair which can be distributed to other parties.

Public-Private Key Pair

Two mathematically related numbers that are used in Cryptographic Algorithms.

Random Number Generator

A component used to generate a sequence of numbers or symbols that lack any predictable pattern.

Reactive Energy

The integral with respect to time of Reactive Power in units of volt-amperes reactive-hours (varh) or standard multiples thereof (for example, kvarh).

Reactive Power

The product of voltage and the out of phase component of current measured in units of volt-amperes reactive (var) or standard multiples thereof (for example, kvar).

Replay Attack

A form of attack on a Communications Link in which a valid information transmission is repeated through interception and retransmission.

Response

A response to a Command received or sent over any interface.

RMS

Root mean squared.

Role

The entitlement of a party to execute one or more Commands.

Season Profile

Rules defined in a Switching Table specifying a Week Profile for each week of a season.

SECAS

The Smart Energy Code Administrator and Secretariat.

Secure Perimeter

A physical border surrounding GSME, ESME or the PPMID.

Security Credentials

Information used to Authenticate a Device, party or system.

Sensitive Event

Each of the following events:

- a failed Authentication or Authorisation;
- a change in the executing Firmware version; and
- unusual numbers of malformed, out-of-order or unexpected Commands received.

SHA-256

The Hashing algorithm of that name approved by the NIST (see *http://csrc.nist.gov/groups/ST/toolkit/secure_hashing.html*).

Single Element Electricity Metering Equipment

Electricity metering equipment containing a single measuring element.

Smart Energy Code

The document of that name, as designated by the Secretary of State under Condition 22 of the DCC Licence.

Smart Metering Equipment Technical Specifications (SMETS)

These Smart Metering Equipment Technical Specifications that are contained within Schedule 9 of the Smart Energy Code.

Smart Metering Home Area Network

A communications network allowing the exchange of information between Devices.

Smart Meter Operational Integrity

The state of an ESME or GSME where its functionality is working as intended.

Special Day

A day defined in a Switching Table where allocation to Tariff Registers, setting the commanded state of Auxiliary Load Control Switches or HAN Connected Auxiliary Load Control Switches, or specifying Non-Disablement Periods is based on a specified Day Profile.

Sub GHz Bands

The 863 – 876 MHz and 915 – 921 MHz harmonised frequency bands.

Supplier

A person authorised by licence to Supply gas to Premises for GSME and a person authorised by licence to Supply electricity to Premises for ESME.

Supply

The supply of gas to Premises for GSME and the supply of electricity to Premises for ESME and 'Supplied' shall be construed accordingly.

Switching Table

Separate rules for:

- allocating Consumption to Tariff Registers for the purposes of Time-of-use Pricing;
- setting the commanded state of Auxiliary Load Control Switches or HAN Connected Auxiliary Load Control Switches; and
- the purposes of specifying Non-Disablement Periods.

Tariff

The structure of Prices and other charges relating to a Supply.

Tariff Register

Storage for recording Consumption for the purposes of Time-of-use Pricing.

Time-based Debt Recovery

A means of recovering debt based on an amount in Currency Units per unit time.

Time-of-use Band

A contiguous or non-contiguous number of Days for GSME or half-hour periods for ESME over which Tariff Prices are constant.

Time-of-use Pricing

A pricing scheme with one or more Time-of-use Bands.

Time-of-use Tariff

A Tariff for Time-of-use Pricing.

Timer

A mechanism for measuring a time period.

TOU

Time-of-use.

Transactional Atomicity

The order of the constituent parts of a Command.

Trusted Source

A source whose identity is confidentially and reliably validated.

Twin Element Electricity Metering Equipment

Electricity metering equipment containing two measuring elements.

Type 1 Device

A Device, other than GSME, ESME, Communications Hub Function or Gas Proxy Function, that stores and uses the Security Credentials of other Devices for the purposes of communicating with them via its HAN Interface.

Type 2 Device

A Device that does not store or use the Security Credentials of other Devices for the purposes of communicating with them via its HAN Interface.

Unauthorised

Not Authorised.

Unauthorised Physical Access

Unauthorised access to the internal components of GSME, ESME or the PPMID through its Secure Perimeter.

Unique Transaction Reference Number (UTRN)

A number used to convey credit to GSME or ESME operating in Prepayment Mode.

Unlock

To establish a state whereby the GSME or ESME can determine the Supply state, 'Unlocked' shall be construed accordingly.

User Interface

An interface for providing local human interaction with GSME, ESME, IHD or PPMID which supports input and visual output.

UTC

Coordinated Universal Time.

UTRN Counter

A number derived from a UTRN.

Valve

A component that can open or close (including on receipt of a Command to that effect) to Enable or Disable the flow of gas to Premises.

Week

The seven day period commencing 00:00:00 Monday Local Time and ending at 00:00:00 on the immediately following Monday.

Week Profile

Rules defined in the Switching Table specifying the Day Profile for each day of a week.

ZigBee Smart Energy Profile (SEP)

The version of the document ZigBee Smart Energy (ZSE) Profile Specification identified in the GBCS.

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