Department of Energy & Climate Change

Smart Metering Implementation Programme

Smart Metering Equipment Technical Specifications Version 2

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Department of Energy and Climate Change
3 Whitehall Place
London
SW1A 2AW

Telephone: 0300 068 4000
Website: www.gov.uk/decc

For further information on this consultation, contact:
Smart Metering Implementation Programme
Department of Energy and Climate Change
3 Whitehall Place
London
SW1A 2AW
Telephone: 0300 068 6083
Email: mailto: smartmetering@decc.gsi.gov.uk

The document can be found on DECC's website: www.gov.uk/decc

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2 Revision History

Version	Date of Issue	Status	Change Summary
1.0	18 December 2012	Final	First version (SMETS 1) designated by the Secretary of State
2.0	24 January 2013	Draft	Version notified to the European Commission as per the requirements of the Technical Standards and Regulations Directive (98/34/EC), as amended by Directive 98/48/EC.

3   Introduction

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

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

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

Section 6 of this document describes the minimum physical, functional and interface requirements of an In Home Display (IHD) installed to comply with condition 34 of the gas supply licence or condition 40 of the electricity supply licence.

This document has been designated by the Secretary of State on [   ] for the purposes of the relevant licence conditions. A draft version of these SMETS was notified to the European Commission on 24 January 2013 in accordance with Directive 98/34/EC, as amended by Directive 98/48/EC.

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[1].

Mutual recognition: Any requirement for metering equipment to comply with the SMETS shall be satisfied by compliance with:

> i.   a relevant standard or code of practice of a national standards body or equivalent body of any EEA State or Turkey; or
>
> ii.   any relevant international standard recognised for use in any EEA State or Turkey; or
>
> iii.   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 SMETS.

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[1] These regulations transpose the Measuring Instruments Directive (2004/22/EC).

4 Gas Smart Metering Equipment Technical Specification

4.1 Overview

Section 4 of this document sets out the minimum physical requirements, minimum functional requirements, minimum interface requirements and minimum data requirements of Gas Smart Metering Equipment (GSME) that a Gas Supplier is required to install to comply with condition 33 of its licence.

Any requirements to Enable, Disable or Arm Supply set-out in this *section 4*, only apply to Gas Smart Metering Equipment installed at Domestic Premises.

For the avoidance of doubt, GSME may comprise one or more Devices provided that together they meet the minimum requirements of this section.

4.2 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 User Interface, including a Keypad; and
  vi.   where installed at Domestic Premises, a Valve.

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 operating at a nominal voltage of 230VAC and consuming no more than an average of 1 watt of electricity under normal operating conditions.

GSME shall:

 vii.   display the *GSME Identifier(4.5.1.1)*; and
 viii. have a Secure Perimeter.

The HAN Interface of GSME shall be capable of:
  ix.   joining a ZigBee network utilising the 2400 – 2483.5 MHz harmonised frequency band; and
  x.   supporting Communications Links based on ZigBee SEP v1.

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:

  xi.   Personal Data;

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xii. Consumption data used for billing;
xiii. Security Credentials;
xiv. Random Number Generator;
 xv. Cryptographic Algorithms;
xvi. the Gas Meter; and
xvii. 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:

xviii. providing evidence of such an attempt through the use of tamper evident coatings or seals;

and where reasonably practicable:

xix. generating an entry to that effect in the *Security Log*(*4.5.4.17*);
 xx. sending an Alert to that effect via its HAN Interface; and
xxi. Disabling the Supply, in circumstances where the *Supply Tamper State (4.5.3.21)* is configured to require Disablement.

4.3 Functional requirements

This section sets out the minimum functions that GSME shall be capable of performing.

4.3.1 Clock

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

4.3.2 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 set-out in *section 4.3.9.5*.

When any Command is received via any Communications Link, and again when the Command is due to be executed, GSME shall be capable of:

i. using the Security Credentials the GSME holds, Authenticating to a Trusted Source the Command and on failure to so Authenticate, generating an entry in the *Security Log*(*4.5.4.17*) to that effect, discarding the Command without execution and without sending a Response, and sending an Alert to that effect via its HAN Interface;
ii. verifying that it is the intended recipient of the Command and if it is not the intended recipient, generating an entry in the *Security Log*(*4.5.4.17*) to that effect, discarding the Command without execution and without sending a Response, and sending an Alert to that effect via its HAN Interface;
iii. verifying in accordance with *section 4.3.9.2.3* that the sender of the Command is Authorised to execute the Command and, on failure, generating an entry in the *Security Log*(*4.5.4.17)* to that effect, discarding the Command without execution and without sending a Response, and sending an Alert to that effect via its HAN Interface;

iv.   verifying the validity of the contents and format of the Command and if invalid, sending a Response to that effect via its HAN Interface;

v.   where the Command is not due to be executed immediately, sending a Response via its HAN Interface to confirm successful receipt; and

vi.   where the Command is due to be executed immediately, executing the Command 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.

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

4.3.2.1   Communications Links with Type 1 Devices via its HAN Interface

GSME shall be capable of establishing Communications Links via its HAN Interface with a minimum of two Type 1 Devices.

GSME shall only be capable of establishing a Communications Link with a Type 1 Device with Security Credentials in the *Device Log*(*4.5.3.9*).

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

i.   receiving the Commands (set-out in *section 4.4.3*) from a Type 1 Device every 30 minutes;

ii.   sending the Responses (set-out in *section 4.4.3*) to a Type 1 Device;

iii.   sending the information (set-out in *section 4.4.1*) to a Type 1 Device; and

iv.   sending Alerts to a Type 1 Device.

4.3.2.2   Communications with a Gas Proxy Device via its HAN Interface

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

GSME shall only be capable of establishing a Communications Link with a Gas Proxy Device with Security Credentials in the *Device Log*(*4.5.3.9*).

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

i.   receiving the Commands (set-out in *section 4.4.3*) from, and sending the Commands (set-out in *section 4.4.4*) to, a Gas Proxy Device;

ii.   sending the Responses (set-out in *section 4.4.3*) to, and receiving the Responses (set-out in *section 4.4.4*) from, a Gas Proxy Device;

iii.   sending the information (set-out in *section 4.4.1*) to a Gas Proxy Device; and

iv.   sending Alerts to a Gas Proxy Device.

4.3.3   Data storage

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

4.3.4   Display of information

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

i.   the *Payment Mode*(*4.5.3.17*) currently in operation, being Prepayment Mode or Credit Mode;

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ii. the *Tariff TOU Register Matrix*(*4.5.4.20*) and the *Tariff Block Counter Matrix(4.5.4.19)*;
iii. the *Meter Balance*(*4.5.4.11*);
iv. the *Customer Identification Number(4.5.4.4)*;
v. whether Emergency Credit is available for activation;
vi. whether GSME has suspended the Disablement of Supply during a period defined in the *Non-Disablement Calendar*(*4.5.3.16*) (as set-out in *section 4.3.6.2*);
vii. the *Emergency Credit Balance*(*4.5.4.7*) where Emergency Credit is activated;
viii. any low credit condition;
ix. where GSME includes a Battery, any low battery condition;
x. the *Supply State*(*4.5.4.18*);
xi. any time-based debts and Time-based Debt Recovery rates;
xii. any payment-based debt;
xiii. any accumulated debt recorded in the *Accumulated Debt Register(4.5.4.1)*;
xiv. the *Meter Point Reference Number (MPRN)*(*4.5.3.15*);
xv. the *Local Time*(*4.5.4.10*)
xvi. any *Standing Charge(4.5.3.19)*;
xvii. the *Contact Details(4.5.3.3)*; and
xviii. the *Active Tariff Price*(*4.5.4.2*).

GSME shall be capable of restricting the display of Personal Data using the Privacy PIN and *Privacy PIN Hash*(*4.5.3.18*).

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

4.3.5 Monitoring

4.3.5.1 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*(*4.5.4.16*).

If the *Remaining Battery Capacity(4.5.4.16)* 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(4.5.4.8)*; and
ii. sending an Alert to that effect via its HAN Interface.

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

i. Disabling the Supply, in circumstances where the *Supply Depletion State*(*4.5.3.20*) is configured to require Disablement; and
ii. sending an Alert to that effect via its HAN Interface.

4.3.6 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.

4.3.6.1 Credit Mode
GSME, when operating in Credit Mode, shall be capable of maintaining a calculation of the *Meter Balance(4.5.4.11)* based on:

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   i.   the Consumption in the *Tariff TOU Register Matrix(4.5.4.20)* converted by *Calorific Value*(*4.5.3.2*) and *Conversion Factor*(*4.5.3.4*) and the Prices in the *Tariff TOU Price Matrix*(*4.5.3.27*) and, if operating Time-of-use with Block Pricing, the Consumption in the *Tariff Block Counter Matrix(4.5.4.19)* converted by *Calorific Value*(*4.5.3.2*) and *Conversion Factor(4.5.3.4)* and the Prices in the *Tariff Block Price Matrix*(*4.5.3.24*); and

  ii.   the *Standing Charge(4.5.3.19)*.

4.3.6.2   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(4.5.4.11)* (as set-out in *sections 4.4.2.2* and *4.4.3.3*) and reducing the amount of credit in the *Meter Balance(4.5.4.11)*.

GSME shall be capable of making Emergency Credit available to the Consumer (by means of the *Emergency Credit Balance(4.5.4.7)*) if the *Meter Balance(4.5.4.11)* is below the *Emergency Credit Threshold*(*4.5.3.12*). GSME shall be capable of displaying the availability of Emergency Credit on its User Interface and of 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*(*4.5.3.11*). GSME shall be capable of reducing the amount of credit in the *Emergency Credit Balance(4.5.4.7)* where Emergency Credit is activated by the Consumer (as set-out in *sections 4.4.2.1* and *4.4.3.1*) and the *Meter Balance*(*4.5.4.11*) is exhausted. Any Emergency Credit used shall be repaid when credit is added to GSME (as set-out in *sections 4.4.2.2* and *4.4.3.3*).

GSME shall be capable of reducing the *Meter Balance(4.5.4.11)* until exhausted followed by reducing the *Emergency Credit Balance(4.5.4.7)*, where activated, until exhausted, on the basis of:

   i.   the Consumption in the *Tariff TOU Register Matrix*(*4.5.4.20*) converted by *Calorific Value*(*4.5.3.2*) and *Conversion Factor*(*4.5.3.4*) and the Prices in the *Tariff TOU Price Matrix*(*4.5.3.27*) and, if operating Time-of-use with Block Pricing, the Consumption in the *Tariff Block Counter Matrix(4.5.4.19)* converted by *Calorific Value*(*4.5.3.2*) and *Conversion Factor*(*4.5.3.4*) and the Prices in the *Tariff Block Price Matrix*(*4.5.3.24*);

  ii.   the *Standing Charge*(*4.5.3.19*); and

  iii.   the recovery of debt through each of the *Time Debt Registers [1 … 2]*(*4.5.4.21*) at rates defined by the *Debt Recovery Rates [1 … 2]*(*4.5.3.7*),

and GSME shall be capable of recording debt recovered in the *Billing Data Log*(*4.5.4.3*).

GSME shall be capable of monitoring the *Meter Balance(4.5.4.11)* and where activated the *Emergency Credit Balance(4.5.4.7)* and:

  iv.   if the combined credit of the *Meter Balance(4.5.4.11)* and *Emergency Credit Balance(4.5.4.7)* falls below the *Low Credit Threshold*(*4.5.3.14*), displaying an

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Alert to that effect on its User Interface and sending an Alert to that effect via its HAN Interface;

v. if the combined credit of the *Meter Balance(4.5.4.11)* and *Emergency Credit Balance(4.5.4.7)* falls below the *Disablement Threshold*(*4.5.3.10*):

   a. receiving and executing *Add Credit*(*4.4.3.3*) and *Activate Emergency Credit*(*4.4.3.1*) Commands from a Type 1 Device and a Gas Proxy Device; and

   b. once any such Commands have been executed if the combined credit of the *Meter Balance(4.5.4.11)* and *Emergency Credit Balance(4.5.4.7)* remains below the *Disablement Threshold*(*4.5.3.10*), Disabling the Supply, displaying an Alert to that effect on its User Interface and sending an Alert to that effect via its HAN Interface; and

vi. if the Supply is Enabled, suspending the Disablement of Supply (as set-out in *v.b* above) during periods defined in the *Non-Disablement Calendar*(*4.5.3.16*), displaying on its User Interface an indication that the combined *Meter Balance(4.5.4.11)* and *Emergency Credit Balance(4.5.4.7)* is below the *Disablement Threshold*(*4.5.3.10*) and that Disablement of Supply due to insufficient credit has been suspended, and sending an Alert that Disablement of Supply due to insufficient credit has been suspended via its HAN Interface.

GSME shall be capable of controlling recovery of debt by:

vii. suspending debt recovery where Emergency Credit is in use if configured by *Suspend Debt Emergency*(*4.5.3.23*) to do so; and

viii. suspending debt recovery where the Supply is Disabled if configured by *Suspend Debt Disabled*(*4.5.3.22*) to do so.

In circumstances where the Supply is Disabled, GSME shall be capable of continuing to recover time-based debt (if so configured as set-out in *viii* above) and *Standing Charge(4.5.3.19)*, and recording the debt recovered in the *Accumulated Debt Register(4.5.4.1)*.

4.3.7 Pricing

GSME shall be capable of applying Time-of-use Pricing and Time-of-use with Block Pricing, as configured by *Tariff Type*(*4.5.3.28*).

When switching between Time-of-use Bands and Tariff Registers as set-out in this section GSME shall be capable of adjusting for Local Time.

GSME shall be capable of maintaining the *Active Tariff Price*(*4.5.4.2*).

4.3.7.1 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(4.5.4.20).*

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*(*4.5.3.25*).

4.3.7.2 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(4.5.4.20).*

GSME shall also be capable of accumulating Consumption in one of four Block Counters in the *Tariff Block Counter Matrix(4.5.4.19)* 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(4.5.3.26)*.

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(4.5.3.25)*.

4.3.8 Recording

4.3.8.1 Billing data
GSME shall be capable of taking a UTC date and time stamped copy of and storing the *Tariff TOU Register Matrix(4.5.4.20)*, *Consumption Register(4.5.4.5)* and the *Tariff Block Counter Matrix(4.5.4.19)* in the *Billing Data Log(4.5.4.3)* in accordance with the timetable set-out in the *Billing Calendar(4.5.3.1)*, and then immediately resetting the Block Counters in the *Tariff Block Counter Matrix(4.5.4.19)* and if operating in Credit Mode immediately resetting the *Meter Balance(4.5.4.11)*.

4.3.8.2 Consumption
GSME shall be capable of recording cumulative Consumption in the *Consumption Register(4.5.4.5)*.

4.3.8.3 Daily read data
GSME shall be capable of taking a copy of and storing the *Tariff TOU Register Matrix(4.5.4.20)*, the *Tariff Block Counter Matrix(4.5.4.19)* and the *Consumption Register(4.5.4.5)* together with a UTC date and time stamp in the *Daily Read Log(4.5.4.5)* every day at midnight UTC.

If operating in Prepayment Mode GSME shall be capable of recording the *Meter Balance(4.5.4.11)*, *Emergency Credit Balance(4.5.4.7)*, *Accumulated Debt Register(4.5.4.1)*, *Payment Debt Register(4.5.4.13)* and *Time Debt Registers [1 … 2](4.5.4.21)* in the *Prepayment Daily Read Log(4.5.4.14)* every day at midnight UTC.

4.3.8.4 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(4.5.4.15)*.

4.3.9 Security

4.3.9.1 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 *section 4.4* 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.

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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.

GSME shall be capable of logging in the *Security Log(4.5.4.17)* the occurrence and type of any Sensitive Event.

4.3.9.2 Security Credentials

4.3.9.2.1 Meter Private Keys

GSME shall be capable of generating Public-Private Key Pairs to support the Cryptographic Algorithms set-out in *section 4.3.9.3.*

GSME shall be capable of securely storing such Private Keys and shall be capable of formatting and sending via its HAN Interface Certificate Signing Requests containing the corresponding Public Keys and the *GSME Identifier(4.5.1.1)*.

GSME shall be capable of securely storing Key Agreement values.

4.3.9.2.2 Public Key Certificates

GSME shall be capable of securely storing Security Credentials from Public Key Certificates including for use in the Cryptographic Algorithms as set-out in *section 4.3.9.3*.

During any Security Credential replacement GSME shall be capable of ensuring that the Security Credentials being replaced remain usable until the successful completion of the update of Security Credentials (as set-out in *section 4.4.3.21*).

4.3.9.2.3 Role Based Access Control (RBAC)

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

4.3.9.3 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.

4.3.9.4 Firmware

GSME shall only be capable of activating its Firmware on receipt of an Activate Firmware Command (as set-out in *section 4.4.3.2*).

4.3.9.5 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(4.5.4.17)*; and
    x.   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(4.5.4.17)*.

4.4 Interface requirements

This section sets out the minimum required interactions which GSME shall be capable of undertaking via its HAN Interface and its User Interface.

4.4.1 HAN Interface information provision

GSME shall be capable, immediately upon establishment of a Communications Link with a Gas Proxy Device (as set-out in *section 4.3.2.2*), of providing the Constant, Configuration and Operational Data (set-out in *sections 4.5.1, 4.5.3* and *4.5.4*) to that Gas Proxy Device (and updates of any changes in the information every 30 minutes thereafter).

4.4.2 User Interface Commands

GSME shall be capable of executing immediately the Commands set-out in this *section 4.4.2* following their receipt via its User Interface.

GSME shall be capable of logging all such Commands received and Outcomes in the *Event Log(4.5.4.8)*.

4.4.2.1 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 4.3.6.2*).

In executing the Command, if the Supply is Disabled, GSME shall be capable of Arming and Enabling the Supply.

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4.4.2.2   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.   verifying the Authenticity of the UTRN;
ii.   verifying that the GSME is the intended recipient of the UTRN;
iii.   comparing the UTRN against the last 100 verified UTRNs and rejecting duplicate presentation of verified UTRNs; and
iv.   controlling the number of invalid UTRN entries processed.

GSME shall be capable of generating an entry in the *Security Log(4.5.4.17)*:

v.   on failure of *i* above;
vi.   on failure of *ii* above; and
vii.   where duplicates are rejected as set-out in *iii* above.

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

viii.   recovery of payment-based debt of an amount defined by *Debt Recovery per Payment*(*4.5.3.6*) from the *Payment Debt Register*(*4.5.4.13*) subject to the *Debt Recovery Rate Cap*(*4.5.3.8*);
ix.   recovery of debt accumulated in the *Accumulated Debt Register(4.5.4.1)*;
x.   repayment of Emergency Credit activated and used by the Consumer; and
xi.   adding remaining credit (the credit after deduction of *viii*, *ix* and *x* above) to the *Meter Balance(4.5.4.11)*.

In executing the Command, GSME shall be capable of Arming the Supply if the *Meter Balance(4.5.4.11)* rises above the *Disablement Threshold*(*4.5.3.10*) and displaying any such change in the *Supply State*(*4.5.4.18*) on its User Interface and sending an Alert that the Supply has been Armed via its HAN Interface.

In executing the Command, GSME shall be capable of:

xii.   recording the credit applied to the *Meter Balance(4.5.4.11)* in the *Billing Data Log(4.5.4.3)*; and
xiii.   sending an Alert containing the UTC date and time of the last update of the *Meter Balance(4.5.4.11)* via its HAN Interface.

4.4.2.3   Arm Supply

A Command to Arm Supply on input of an Arm Code. In executing the Command, GSME shall be capable of:

i.   verifying the Authenticity of the Arm Code;
ii.   verifying that GSME is the intended recipient of the Arm Code;
iii.   comparing the Arm Code against the last 100 verified Arm Codes and rejecting duplicate presentation of verified Arm Codes; and
iv.   controlling the number of invalid Arm Code entries processed.

GSME shall be capable of generating an entry in the *Security Log(4.5.4.17)*:

v.   on failure of *i* above;
vi.   on failure of *ii* above; and

vii. where duplicates are rejected as set-out in *iii* above.

Where GSME is in Prepayment mode and the combined *Meter Balance(4.5.4.11)* and *Emergency Credit Balance(4.5.4.7)* is below the *Disablement Threshold*(*4.5.3.10*), GSME shall be capable of not Arming the Supply, but of placing the Supply in such a state whereby Supply will be Armed where the combined *Meter Balance(4.5.4.11)* and *Emergency Credit Balance(4.5.4.7)* rises above the *Disablement Threshold*(*4.5.3.10*).

4.4.2.4   Check for HAN Interface Commands
A Command to check immediately for any pending *Add Credit*(*4.4.3.3*) and *Activate Emergency Credit*(*4.4.3.1*) Commands. If there are any such pending Commands GSME shall be capable of executing the Commands as set-out in *section 4.4.3*.

4.4.2.5   Display Personal Data on the User Interface
A Command to display Personal Data on verification of the Privacy PIN.

GSME shall be capable of verifying the Privacy PIN by calculating a Hash of the Privacy PIN and comparing this with the *Privacy PIN Hash*(*4.5.3.18*).

4.4.2.6   Enable Supply
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*(*4.5.3.29*) and where the flow rate is exceeded, of Disabling the Supply and then Arming the Supply and sounding an Alarm via its User Interface.

4.4.3   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(4.5.4.8)*.

GSME shall be capable of executing Commands immediately on receipt ("immediate Commands") and at a future date ("future dated Commands"). A future dated Command shall include a UTC date and time at which the Command shall be executed by GSME.

GSME shall be capable of cancelling a future dated Command by over-writing the future dated Command on receipt of a Command of the same type, with the types being listed in this *section 4.4.3*. A future dated Command shall be capable of being cancelled by an Authorised party, subject to RBAC. GSME shall be capable of sending a Response to the sender of the new Command acknowledging that a future dated Command has been successfully cancelled.

4.4.3.1   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 4.3.6.2*).

In executing the Command where the Supply is Disabled GSME shall be capable of Arming the Supply.

4.4.3.2   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(*4.5.4.9*).

4.4.3.3   Add Credit

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

i.   verifying the Authenticity of the UTRN;
ii.   verifying that GSME is the intended recipient of the UTRN;
iii.   comparing the UTRN against the last 100 verified UTRNs and rejecting duplicate presentation of verified UTRNs; and
iv.   controlling the number of invalid UTRN entries processed.

GSME shall be capable of generating an entry in the *Security Log(4.5.4.17)*:

v.   on failure of *i* above;
vi.   on failure of *ii* above; and
vii.   where duplicates are rejected as set-out in *iii* above.

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

viii.   recovery of payment-based debt of an amount defined by *Debt Recovery per Payment*(*4.5.3.6*) from the *Payment Debt Register*(*4.5.4.13*) subject to the *Debt Recovery Rate Cap*(*4.5.3.8*);
ix.   recovery of debt accumulated in the *Accumulated Debt Register*(*4.5.4.1*);
x.   repayment of Emergency Credit activated and used by the Consumer; and
xi.   adding remaining credit (the credit after deducting *viii*, *ix* and *x* above) to the *Meter Balance(4.5.4.11)*.

In executing the Command, GSME shall be capable of Arming the Supply if the *Meter Balance(4.5.4.11)* rises above the *Disablement Threshold(4.5.3.10)*, displaying any such change in the *Supply State*(*4.5.4.18*) on its User Interface 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(4.5.4.11)* in the *Billing Data Log(4.5.4.3)*.

In executing the Command from a Type 1 device, GSME shall be capable of sending an Alert containing a UTC date and time stamp of the last update of the *Meter Balance*(*4.5.4.11*) via its HAN Interface.

4.4.3.4   Add Device Security Credentials

A Command to add Security Credentials for a Type 1 Device or a Gas Proxy Device to the *Device Log*(*4.5.3.9*).

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(4.5.4.17)*.

4.4.3.5   Adjust Debt
A Command to apply positive and negative adjustments to the *Time Debt Registers [1 … 2](4.5.4.21)* and the *Payment Debt Register(4.5.4.13)* when operating in Prepayment Mode.

4.4.3.6   Adjust Meter Balance
A Command to apply positive and negative adjustments to the *Meter Balance(4.5.4.11)*.

In executing the Command where GSME is operating in Prepayment Mode and where, following any such adjustment, the *Meter Balance(4.5.4.11)* rises above the *Disablement Threshold(4.5.3.10)*, GSME shall be capable of Arming the Supply, displaying any such change in the *Supply State*(*4.5.4.18*) on its User Interface and sending an Alert that the Supply has been Armed via its HAN Interface.

4.4.3.7   Arm Supply
A Command to Arm the Supply.

Where GSME is in Prepayment mode and the combined *Meter Balance(4.5.4.11)* and *Emergency Credit Balance(4.5.4.7)* is below the *Disablement Threshold*(*4.5.3.10*) GSME shall be capable of not Arming the Supply, but of placing the Supply in such a state whereby Supply will be Armed where the combined *Meter Balance(4.5.4.11)* and *Emergency Credit Balance(4.5.4.7)* rises above the *Disablement Threshold*(*4.5.3.10*).

In executing the Command a GSME shall be capable of setting the *Supply State*(*4.5.4.18*) to Armed.

4.4.3.8   Clear Event Log
A Command to clear all entries from the *Event Log(4.5.4.8)*. GSME shall be capable of logging that the Command has been executed in the *Security Log*(*4.5.4.17*).

4.4.3.9   Disable Supply
A Command to Disable the Supply.

In executing the Command GSME shall be capable of:

i.   ignoring the *Non-Disablement Calendar(4.5.3.16);* and
ii.   setting the *Supply State*(*4.5.4.18*) to Disabled.

4.4.3.10   Issue Security Credentials
A Command to generate a Key Pair and issue a corresponding Certificate Signing Request.

4.4.3.11   Read Configuration Data
A Command to read the value of one or more of the configuration data items set-out in *section 4.5.3*.

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

4.4.3.12   Read Constant Data
A Command to read the value of one or more of the constant data items set-out in *section 4.5.1*.

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

4.4.3.13 Read Operational Data
A Command to read the value of one or more of the operational data items set-out in *section 4.5.4*.

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

4.4.3.14 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.

4.4.3.15 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(4.5.4.12)*.

4.4.3.16 Remove Device Security Credentials
A Command to remove Security Credentials for a Type 1 Device or a Gas Proxy Device from the *Device Log(4.5.3.9)*.

In executing the Command GSME shall be capable of recording the Command and Outcome to the *Security Log(4.5.4.17)*.

4.4.3.17 Restrict Data
A Command to restrict access to all items of Personal Data stored in GSME prior to the date specified in the Command so as to prevent its disclosure via its HAN Interface and its User Interface.

In executing the Command GSME shall be capable of issuing a *Restrict Gas Proxy Data*(*4.4.4.1*) Command.

4.4.3.18 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(4.5.3.17)*.

In executing the Command, GSME shall be capable of recording:

  i.   the *Tariff TOU Register Matrix*(*4.5.4.20*);
  ii.   the *Tariff Block Counter Matrix(4.5.4.19)*;
  iii. the *Consumption Register*(*4.5.4.5*)
  iv.   the *Meter Balance(4.5.4.11)*;
  v.   the *Emergency Credit Balance(4.5.4.7)*;
  vi.   the *Payment Debt Register(4.5.4.13)*;
  vii. the *Time Debt Registers [1 … 2](4.5.4.21)*; and
  viii. the *Accumulated Debt Register(4.5.4.1)*,

in the *Billing Data Log(4.5.4.3)*.

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4.4.3.19   Set Tariff

A Command to accept new values for *Tariff Type(4.5.3.28), Tariff TOU Price Matrix(4.5.3.27), Tariff Block Price Matrix(4.5.3.24), Tariff Switching Table(4.5.3.25)* and *Tariff Threshold Matrix(4.5.3.26).*

In executing the Command, GSME shall be capable of recording:

   i.   the *Tariff TOU Register Matrix(4.5.4.20)*;
   ii.   the *Tariff Block Counter Matrix(4.5.4.19)*;
   iii.   the *Consumption Register*(*4.5.4.5*)
   iv.   the *Meter Balance(4.5.4.11)*;
   v.   the *Emergency Credit Balance(4.5.4.7)*;
   vi.   the *Payment Debt Register(4.5.4.13)*;
   vii.   the *Time Debt Registers [1 … 2](4.5.4.21)*; and
   viii.   the *Accumulated Debt Register(4.5.4.1)*,

in the *Billing Data Log(4.5.4.3).*

4.4.3.20   Synchronise Clock

A Command to synchronise the Clock with UTC via its HAN Interface.

In executing the Command, GSME shall be capable of ensuring that any such adjustments do not cause calendar-based events or future-dated Commands to be missed or repeated. Where GSME successfully synchronises its clock by more than 10 seconds this should be recorded in the *Event Log*(*4.5.4.8*)*.*

4.4.3.21   Update Security Credentials

A Command to change Security Credentials held within GSME.

In executing the Command GSME shall be capable of:

   i.   maintaining the Command's Transactional Atomicity;
   ii.   maintaining the integrity of Security Credentials; and
   iii.   recording the Command and Outcome to the *Security Log*(*4.5.4.17*).

4.4.3.22   Write Configuration Data

A Command to record one or more new values of the configuration data items set-out in *section 4.5.3*.

In executing the Command, GSME shall be capable of logging all changes of values in the *Event Log(4.5.4.8)*.

4.4.4   HAN Interface Commands issued by GSME

GSME 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.

4.4.4.1   Restrict Gas Proxy Data

A Command to cause a Gas Proxy Device to restrict access to all items of Personal Data stored in the Gas Proxy prior to the date specified in the Command so as to prevent its disclosure via its HAN Interface.

4.4.4.2   Request GSME Commissioning

A Command to request that GSME is brought into operation.

4.4.4.3 Update Gas Proxy Security Credentials
A Command to update the Gas Proxy Device's Security Credentials.

4.5 Data requirements
This section describes the minimum information which GSME is to be capable of holding in its Data Store.

4.5.1 Constant data
Describes data that remains constant and unchangeable at all times.

4.5.1.1 GSME Identifier
A globally unique identifier used to identify GSME.

4.5.1.2 Manufacturer Identifier
An identifier used to identify the manufacturer of GSME.

4.5.1.3 Model Type
An identifier used to identify the model of GSME.

4.5.2 Internal data
Describes data that remains constant and unchangeable at all times and that is not available outside GSME.

4.5.2.1 Installation Credentials
Credentials unique to GSME used to authenticate GSME during the installation process.

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

4.5.3.1 Billing Calendar
A calendar defining billing dates for the storage of billing related information in the *Billing Data Log(4.5.4.3)*.

4.5.3.2 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.

4.5.3.3 Contact Details
The name and contact telephone number of the current gas supplier.

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

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

4.5.3.6 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.

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4.5.3.7 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.

4.5.3.8 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.

4.5.3.9 Device Log
The Security Credentials and device identity details for each of the Gas Proxy Device and Type 1 Devices with which GSME can communicate.

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

4.5.3.11 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.

4.5.3.12 Emergency Credit Threshold
The threshold in Currency Units below which *Emergency Credit Balance(4.5.4.7)* may be activated by the Consumer if so configured when GSME is operating in Prepayment Mode.

4.5.3.13 Local Time Change Calendar
A set of rules used to calculate Local Time from UTC.

4.5.3.14 Low Credit Threshold
The threshold in Currency Units below which a low credit Alert is signalled.

4.5.3.15 Meter Point Reference Number (MPRN)
The reference number identifying a gas metering point.

4.5.3.16 Non-Disablement Calendar
A calendar defining UTC times, days and dates that specify periods during which the Supply will not be Disabled when the meter is operating in Prepayment Mode.

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

4.5.3.18 Privacy PIN Hash
A Hash of the Privacy PIN.

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

4.5.3.20 Supply Depletion State
A setting to control the state of the Supply in the case of loss of power to GSME, being Disabled or unchanged.

4.5.3.21 Supply Tamper State
A setting to control the state of the Supply in the case of a Tamper Event being detected, being Disabled or unchanged.

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

4.5.3.23   Suspend Debt Emergency
A setting controlling whether debt should be collected when GSME is operating in Prepayment Mode and the *Emergency Credit Balance(4.5.4.7)* is below the *Emergency Credit Limit(4.5.3.11)*.

4.5.3.24   Tariff Block Price Matrix
A 4 x 1 matrix containing Prices for Block Pricing.

4.5.3.25   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 support 50 Time-of-use switching rules per annum.

The rules shall support allocation based on:

  i.   day, days and day ranges; and
  ii.   date, dates and date ranges.

All dates shall be specified as UTC.

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

4.5.3.27   Tariff TOU Price Matrix
A 1 x 4 matrix containing Prices for Time-of-use Pricing.

4.5.3.28   Tariff Type
The Tariff type in operation, being Time-of-use or Time-of-use with Block.

4.5.3.29   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.

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

4.5.4.1   Accumulated Debt Register
The debt resulting from the collection of *Standing Charge(4.5.3.19)* and/or time-based debt when no credit or Emergency Credit is available, when operating in Prepayment Mode.

4.5.4.2   Active Tariff Price
The Price currently active.

4.5.4.3   Billing Data Log
A log for storing the following UTC date and time stamped entries:

  i.   twelve entries comprising *Tariff TOU Register Matrix(4.5.4.20)*, the *Consumption Register*(*4.5.4.5*) and *Tariff Block Counter Matrix(4.5.4.19)*;
  ii.   five entries comprising prepayment credits;
  iii. ten entries comprising time-based debt payments;

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iv.   ten entries comprising payment-based debt payments; and

v.   twelve entries comprising *Meter Balance(4.5.4.11)*, *Emergency Credit Balance(4.5.4.7)*, *Accumulated Debt Register(4.5.4.1)*, *Payment Debt Register(4.5.4.13)* and *Time Debt Registers [1 … 2](4.5.4.21)*,

arranged as a circular buffer such that when full, further writes shall cause the oldest entry to be overwritten.

4.5.4.4   Customer Identification Number
A number issued to GSME for display on the User Interface.

4.5.4.5   Consumption Register
The register recording cumulative Consumption.

4.5.4.6   Daily Read Log
A log for storing fourteen UTC date and time stamped entries of the *Tariff TOU Register Matrix(4.5.4.20)*, the *Tariff Block Counter Matrix(4.5.4.19)* and the *Consumption Register*(*4.5.4.5*) arranged as a circular buffer such that when full, further writes shall cause the oldest entry to be overwritten.

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

4.5.4.8   Event Log
A log for 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.

4.5.4.9   Firmware Version
The active version of Firmware of GSME.

4.5.4.10   Local Time
The time calculated using the *Local Time Change Calendar*(*4.5.3.13)*.

4.5.4.11   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(4.5.4.7)*). 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.

4.5.4.12   Network Data Log
A log for 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.

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

4.5.4.14   Prepayment Daily Read Log

A log for storing fourteen UTC date and time stamped entries of *Meter Balance(4.5.4.11)*, *Emergency Credit Balance(4.5.4.7)*, *Accumulated Debt Register(4.5.4.1)*, *Payment Debt Register(4.5.4.13)* and *Time Debt Registers [1 … 2](4.5.4.21)* arranged as a circular buffer such that when full, further writes shall cause the oldest entry to be overwritten.

4.5.4.15   Profile Data Log

A log for 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.

4.5.4.16   Remaining Battery Capacity

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

4.5.4.17   Security Log

A log for 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.

4.5.4.18   Supply State

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

4.5.4.19   Tariff Block Counter Matrix

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

4.5.4.20   Tariff TOU Register Matrix

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

4.5.4.21   Time Debt Registers [1 … 2]

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

5 Electricity Smart Metering Equipment Technical Specification

5.1 Introduction

Section 5 of this document describes the minimum physical, minimum functional, minimum interface and minimum data requirements of Electricity Smart Metering Equipment that an electricity Supplier is required to install to comply with condition 39 of its 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 physical, functional, interface and data requirements described in Part D of this section 5.

Where a Boost Button is installed within ESME, an electricity Supplier must comply, in addition, with the minimum physical, functional, interface and data requirements described in Part E of this section 5.

For the avoidance of doubt, ESME may comprise one or more Devices provided that together they meet the minimum requirements of this section.

Part A - Single Element Electricity Metering Equipment

5.2   Overview

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

5.3   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; and
   vi.   a User Interface, including a Keypad.

ESME shall be mains powered and be capable of operating at a nominal voltage of 230VAC and consuming no more than an average of 3 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:

   vii.   display the *ESME Identifier(5.6.1.1)*; and
   viii.   have a Secure Perimeter.

The HAN Interface of ESME shall be capable of:

   ix.   joining a ZigBee network utilising the 2400 – 2483.5 MHz harmonised frequency band; and
   x.   supporting Communications Links based on ZigBee SEP v1 and DLMS COSEM.

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:

   xi.   Personal Data;
   xii.   Consumption data used for billing;
   xiii.   Security Credentials;
   xiv.   Random Number Generator;
   xv.   Cryptographic Algorithms;
   xvi.   the Electricity Meter; and
   xvii.   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:

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

and where reasonably practicable:

xix.   generating an entry to that effect in the *Security Log(5.6.4.31)*;
 xx.   sending an Alert to that effect via its HAN Interface; and
xxi.   Disabling the Supply, in circumstances where the *Supply Tamper State(5.6.3.40)* is configured to require Disablement.

5.4   Functional Requirements

This section sets out the minimum functions that ESME shall be capable of performing.

5.4.1   Clock

The Clock forming Part of ESME shall be capable of operating so as to be accurate to within 10 seconds of UTC under normal operating conditions.

5.4.2   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 set-out in *section 5.4.9.5*.

When any Command is received via any Communications Link, and again when the Command is due to be executed, ESME shall be capable of:

   i.   using the Security Credentials the ESME holds, Authenticating to a Trusted Source the Command and on failure to so Authenticate, generating an entry in the *Security Log(5.6.4.31)* to that effect, discarding the Command without execution and without sending a Response, and sending an Alert to that effect via its HAN Interface;
  ii.   verifying that it is the intended recipient of the Command and if it is not the intended recipient, generating an entry in the *Security Log(5.6.4.31)* to that effect, discarding the Command without execution and without sending a Response, and sending an Alert to that effect via its HAN Interface;
 iii.   verifying in accordance with *section 5.4.9.2.3* that the sender of the command is Authorised to execute the command and, on failure, generating an entry in the *Security Log(5.6.4.31)* to that effect, discarding the Command without execution and without sending a Response, and sending an Alert to that effect via its HAN Interface;
  iv.   verifying the validity of the contents and format of the Command and if invalid, sending a Response to that effect via its HAN Interface;
   v.   where the Command is not due to be executed immediately, sending a Response via its HAN Interface to confirm successful receipt; and
  vi.   where the Command is due to be executed immediately, executing the Command 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.

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

5.4.2.1 Communications Links with Type 1 Devices via its HAN Interface

ESME shall be capable of establishing Communications Links via its HAN Interface with a minimum of seven Type 1 Devices.

ESME shall only be capable of establishing a Communications Link with a Type 1 Device with Security Credentials in the *Device Log*(*5.6.3.12*).

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

i. receiving the Commands (set-out in *section 5.5.3*) from a Type 1 Device;
ii. sending the Responses (set-out in *section 5.5.3*) to a Type 1 Device;
iii. sending the Commands (set-out in *section 5.5.4*) to a Type 1 Device and acting on the corresponding Responses from a Type 1 Device;
iv. sending the information (set-out in *section 5.5.1*) to a Type 1 Device; and
v. sending Alerts to a Type 1 Device.

5.4.2.2 Communications Links with Type 2 Devices via its HAN Interface

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

ESME shall only be capable of establishing a Communications Link with a Type 2 Device with Security Credentials in the *Device Log*(*5.6.3.12*).

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

i. sending the information (set-out in *section 5.5.1*) to a Type 2 Device; and
ii. sending Alerts to a Type 2 Device.

5.4.3 Data storage

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

5.4.4 Display of information

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

i. the *Payment Mode*(*5.6.3.27*) currently in operation, being Prepayment Mode or Credit Mode;
ii. the *Tariff TOU Register Matrix*(*5.6.4.34*), the *Tariff TOU Block Register Matrix*(*5.6.4.35*) and the *Tariff Block Counter Matrix*(*5.6.4.33*);
iii. the *Meter Balance*(*5.6.4.24*);
iv. the *Customer Identification Number*(*5.6.4.12*);
v. whether Emergency Credit is available for activation;
vi. whether ESME has suspended the Disablement of Supply during a period defined in the *Non-Disablement Calendar*(*5.6.3.26*) *(*as set-out in *section 5.4.6.2*);
vii. the *Emergency Credit Balance*(*5.6.4.15*) where Emergency Credit is activated;
viii. any low credit condition;
ix. the *Supply State*(*5.6.4.32*);
x. any time-based debts and Time-based Debt Recovery rates;
xi. any payment-based debt;
xii. any accumulated debt recorded in the *Accumulated Debt Register*(*5.6.4.1*);
xiii. any *Standing Charge*(*5.6.3.39*);
xiv. the *Meter Point Administration Numbers (MPAN)*(*5.6.3.24*)*;*

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  xv.   the *Local Time(5.6.4.20)*;

 xvi.   the *Contact Details*(*5.6.3.7*); and

xvii.   the *Active Tariff Price*(*5.6.4.5*).

ESME shall be capable of restricting the display of Personal Data using the Privacy PIN and *Privacy PIN Hash*(*5.6.3.28*).

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

5.4.5   Load limiting

ESME shall be capable of determining when the *Active Power Import(5.6.4.4)* is above, for the *Load Limit Period(5.6.3.16)*, the *Load Limit Power Threshold*(*5.6.3.17*) and on such an occurrence ESME shall be capable of:

    i.   generating an entry to that effect in the *Event Log(5.6.4.16)*;

   ii.   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*(*5.6.4.19*); and

  iv.   ignoring the *Non-Disablement Calendar*(*5.6.3.26*) and Disabling the Supply in circumstances where the *Load Limit Supply State*(*5.6.3.19*) is configured to require Disablement, and then:

        a.   Immediately Arming the Supply such that it can be Enabled as set-out in *section 5.5.2.4*;

        b.   after the *Load Limit Restoration Period(5.6.3.18)* has elapsed Enabling the Supply, and setting the *Load Limit Supply State*(*5.6.3.19*) to unchanged; and

        c.   displaying any such change in the *Supply State*(*5.6.4.32*) on its User Interface and sending an Alert indicating the change in state via its HAN Interface.

Where ESME is in Prepayment mode and the combined *Meter Balance(5.6.4.24)* and *Emergency Credit Balance(5.6.4.15)* is below the *Disablement Threshold*(*5.6.3.13*), ESME shall be capable of not executing *a*, *b* and *c* above, but of placing the Supply in such a state whereby Supply will be Armed where the combined *Meter Balance(5.6.4.24)* and *Emergency Credit Balance(5.6.4.15)* rises above *Disablement Threshold(5.6.3.13)*.

5.4.6   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.

5.4.6.1   Credit Mode

ESME, when operating in Credit Mode, shall be capable of maintaining a calculation of the *Meter Balance(5.6.4.24)* based on:

    i.   the Consumption in the *Tariff TOU Register Matrix(5.6.4.34)* and the Prices in the *Tariff TOU Price Matrix*(*5.6.3.46*) and, if operating Time-of-use with Block Pricing, the Consumption in the *Tariff TOU Block Register Matrix*(*5.6.4.35*) and the Prices in the *Tariff Block Price Matrix*(*5.6.3.43*); and

   ii.   the *Standing Charge*(*5.6.3.39*).

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5.4.6.2 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(5.6.4.24)* (as set-out in *sections 5.5.2.2* and *5.5.3.3*) and reducing the amount of credit in the *Meter Balance(5.6.4.24)*.

ESME shall be capable of making Emergency Credit available to the Consumer (by means of the *Emergency Credit Balance(5.6.4.15)*) if the *Meter Balance(5.6.4.24)* is below the *Emergency Credit Threshold*(*5.6.3.15*). ESME shall be capable of displaying the availability of Emergency Credit on its User Interface and of 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*(*5.6.3.14*). ESME shall be capable of reducing the amount of credit in the *Emergency Credit Balance(5.6.4.15)* where Emergency Credit is activated by the Consumer (as set-out in *sections 5.5.2.1* and *5.5.3.1*) and the *Meter Balance*(*5.6.4.24*) is exhausted. Any Emergency Credit used shall be repaid when credit is added to ESME (as set-out in *sections 5.5.2.2* and *5.5.3.3*).

ESME shall be capable of reducing the *Meter Balance(5.6.4.24)* until exhausted followed by reducing the *Emergency Credit Balance(5.6.4.15)*, where activated, until exhausted, on the basis of:

  i.   the Consumption in the *Tariff TOU Register Matrix(5.6.4.34)* and the Prices in the *Tariff TOU Price Matrix*(*5.6.3.46*), and if operating Time-of-use with Block Pricing the Consumption in the *Tariff TOU Block Register Matrix*(*5.6.4.35*) and the Prices in the *Tariff Block Price Matrix*(*5.6.3.43*);
  ii. the *Standing Charge(5.6.3.39)*; and
  iii. the recovery of debt through each of the *Time Debt Registers [1 … 2](5.6.4.36)* at rates defined by the *Debt Recovery Rates [1 … 2]*(*5.6.3.10*),

and ESME shall be capable of recording debt recovered in the *Billing Data Log*(*5.6.4.9*).

ESME shall be capable of monitoring the *Meter Balance(5.6.4.24)* and where activated the *Emergency Credit Balance(5.6.4.15)* and:

  iv. if the combined credit of the *Meter Balance(5.6.4.24)* and *Emergency Credit Balance(5.6.4.15)* falls below the *Low Credit Threshold*(*5.6.3.21*), displaying an Alert to that effect on its User Interface and sending an Alert to that effect via its HAN Interface;
  v.   if the combined credit of the *Meter Balance(5.6.4.24)* and *Emergency Credit Balance(5.6.4.15)* falls below the *Disablement Threshold*(*5.6.3.13*), Disabling the Supply, displaying an Alert to that effect on its User Interface and sending an Alert to that effect via its HAN Interface; and
  vi. if the Supply is Enabled, suspending the Disablement of Supply (as set-out in *v* above) during periods defined in the *Non-Disablement Calendar*(*5.6.3.26*), displaying on its User Interface an indication that the combined *Meter Balance(5.6.4.24)* and *Emergency Credit Balance(5.6.4.15)* is below the *Disablement Threshold*(*5.6.3.13*) and that Disablement of Supply due to

insufficient credit has been suspended, and sending an Alert that Disablement of Supply due to insufficient credit has been suspended via its HAN Interface.

ESME shall be capable of controlling recovery of debt by:

vii.   suspending debt recovery where Emergency Credit is in use if configured by *Suspend Debt Emergency*(*5.6.3.42*) to do so; and

viii.   suspending debt recovery where the Supply is Disabled if configured by *Suspend Debt Disabled*(*5.6.3.41*) to do so.

In circumstances where the Supply is Disabled, ESME shall be capable of continuing to recover time-based debt (if so configured as set-out in *viii* above) and *Standing Charge(5.6.3.39)*, and recording the debt recovered in the *Accumulated Debt Register(5.6.4.1)*.

5.4.7   Pricing

ESME shall be capable of applying Time-of-use Pricing and Time-of-use with Block Pricing, as configured by *Tariff Type*(*5.6.3.47*).

When switching between Time-of-use Bands and Tariff Registers as set-out in this section ESME shall be capable of:

i.   applying the *Randomised Offset*(*5.6.3.29*); and

ii.   adjusting for Local Time.

ESME shall be capable of maintaining the *Active Tariff Price*(*5.6.4.5*).

5.4.7.1   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(5.6.4.34)*.

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*(*5.6.3.44*).

5.4.7.2   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(5.6.4.35)*.

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(5.6.3.44)*. 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(5.6.4.33)* and Consumption thresholds in the *Tariff Threshold Matrix*(*5.6.3.45*).

ESME shall also be capable of accumulating Consumption in one of four Block Counters in the *Tariff Block Counter Matrix(5.6.4.33)* 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*(*5.6.3.45*).

ESME shall be capable of resetting the counters in the *Tariff Block Counter Matrix(5.6.4.33)* once per Day and in accordance with the timetable set-out in the *Billing Calendar(5.6.3.6)*.

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5.4.8 Recording

5.4.8.1 Active Energy Imported
ESME shall be capable of recording cumulative Active Energy Imported in the *Active Import Register(5.6.4.3)*.

5.4.8.2 Active Energy Exported
ESME shall be capable of recording cumulative Active Energy Exported in the *Active Export Register*(*5.6.4.2*).

5.4.8.3 Billing data
ESME shall be capable of taking a UTC date and time stamped copy of and storing the *Tariff TOU Register Matrix(5.6.4.34)*, the *Tariff TOU Block Register Matrix*(*5.6.4.35*), the *Active Import Register*(*5.6.4.3*) and the *Active Export Register*(*5.6.4.2*) in the *Billing Data Log(5.6.4.9)* in accordance with the timetable set-out in the *Billing Calendar*(*5.6.3.6*), and:

    i.   sending an Alert via its HAN Interface containing the data stored; and
    ii.   if operating in Credit Mode, immediately resetting the *Meter Balance*(*5.6.4.24*).

5.4.8.4 Consumption data
ESME shall be capable of recording to:

    i.   the *Cumulative and Historical Value Store*(*5.6.4.11*) 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.   to the *Daily Consumption Log*(*5.6.4.14*) in kWh the Consumption on each of the 731 Days prior to such Day.

5.4.8.5 Cost of Consumption data
ESME shall be capable of calculating and recording in the *Cumulative and Historical Value Store*(*5.6.4.11*) 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(5.6.4.34)* and the Prices in the *Tariff TOU Price Matrix*(*5.6.3.46*) and, if operating Time-of-use with Block Pricing, the Consumption in the *Tariff TOU Block Register Matrix*(*5.6.4.35*) and the Prices in the *Tariff Block Price Matrix*(*5.6.3.43*); and
    viii.   the *Standing Charge*(*5.6.3.39*).

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5.4.8.6   Cost of Instantaneous consumption

ESME shall be capable of calculating and recording the *Cost of Instantaneous Active Power Import*(*5.6.4.10*) on the basis of:

i.   the *Active Power Import(5.6.4.4)*; and
ii.   the *Active Tariff Price*(*5.6.4.5*).

5.4.8.7   Daily read data

ESME shall be capable of taking a copy of and storing the *Tariff TOU Register Matrix(5.6.4.34)*, the *Tariff TOU Block Register Matrix*(*5.6.4.35*), the *Active Import Register*(*5.6.4.3*) and the *Active Export Register*(*5.6.4.2*) together with a UTC date and time stamp in the *Daily Read Log*(*5.6.4.13*) every day at midnight UTC.

If operating in Prepayment Mode ESME shall be capable of recording the *Meter Balance(5.6.4.24)*, *Emergency Credit Balance(5.6.4.15)*, *Accumulated Debt Register(5.6.4.1)*, *Payment Debt Register(5.6.4.25)* and *Time Debt Registers [1 … 2](5.6.4.36)* in the *Prepayment Daily Read Log*(*5.6.4.27*) every day at midnight UTC.

5.4.8.8   Daily Consumption data

ESME shall be capable of calculating and storing Consumption for the previous Day together with a UTC date stamp in the the *Daily Consumption Log*(*5.6.4.14*) every Day at midnight Local Time.

5.4.8.9   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*(*5.6.4.28*):

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

5.4.8.10   Maximum Demand Import data

ESME shall be capable of recording:

i.   to the *Maximum Demand Active Energy Import Value(5.6.4.21)*, the maximum value of Consumption 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 *Maximum Demand Active Energy Import Value(5.6.4.21)* was last reset (as set-out in *section 5.5.3.21*); and
ii.   to the *Maximum Demand (Configurable Time) Active Energy Import Value(5.6.4.22)*, the maximum value of Consumption 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*(*5.6.3.23*) (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 Energy Import Value(5.6.4.22)* was last reset (as set-out in *section 5.5.3.23*).

5.4.8.11   Maximum Demand Export data
ESME shall be capable of recording to the *Maximum Demand Active Energy Export Value*(*5.6.4.23*) the maximum value of Active Energy Exported recorded in any 30 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 data relates) since the *Maximum Demand Active Energy Export Value*(*5.6.4.23*) was last reset (as set-out in *section 5.5.3.22*).

5.4.8.12   Power Threshold Status
ESME shall be capable of comparing the *Active Power Import*(*5.6.4.4*) against thresholds and:

    i.   if the *Active Power Import*(*5.6.4.4*) is equal to or lower than the *Low Medium Power Threshold*(*5.6.3.22*), setting *Power Threshold Status*(*5.6.4.26*) to low;

    ii.   if the *Active Power Import*(*5.6.4.4*) is higher than the *Low Medium Power Threshold(5.6.3.22)* and equal to or lower than the *Medium High Power Threshold*(*5.6.3.25*), setting *Power Threshold Status*(*5.6.4.26*) to medium; and

   iii.   otherwise, setting the *Power Threshold Status*(*5.6.4.26*) to high.

5.4.8.13   Reactive Energy Imported
ESME shall be capable of recording cumulative Reactive Energy Imported in the *Reactive Import Register*(*5.6.4.30*).

5.4.8.14   Reactive Energy Exported
ESME shall be capable of recording cumulative Reactive Energy Exported in the *Reactive Export Register*(*5.6.4.29*).

5.4.9   Security

5.4.9.1   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 5.5* 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.

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.

ESME shall be capable of logging in the *Security Log(5.6.4.31)* the occurrence and type of any Sensitive Event.

5.4.9.2   Security Credentials

5.4.9.2.1 Meter Private Keys

ESME shall be capable of generating Public-Private Key Pairs to support the Cryptographic Algorithms set-out in *section 5.4.9.3*.

ESME shall be capable of securely storing such Private Keys and shall be capable of formatting and sending via its HAN Interface Certificate Signing Requests containing the corresponding Public Keys and the *ESME Identifier(5.6.1.1)*.

ESME shall be capable of securely storing Key Agreement values.

5.4.9.2.2 Public Key Certificates

ESME shall be capable of securely storing Security Credentials from Public Key Certificates including for use in the Cryptographic Algorithms as set-out in *section 5.4.9.3*.

During any Security Credential replacement ESME shall be capable of ensuring that the Security Credentials being replaced remain usable until the successful completion of the update of Security Credentials (as set-out in *section 5.5.3.30*).

5.4.9.2.3 Role-based Access Control (RBAC)

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

5.4.9.3 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.

5.4.9.4 Firmware

ESME shall only be capable of activating its Firmware on receipt of an Activate Firmware Command (as set-out in *section 5.5.3.2*).

5.4.9.5 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(5.6.4.31)*; and
x.   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(5.6.4.31)*.

5.4.10   Switching Auxiliary Loads (via the HAN Interface)

ESME shall be capable of monitoring the *Auxiliary Load Control Switch [n] Calendar*(*5.6.3.1*) and at times defined in the calendar:

i.   where the *Supply State*(*5.6.4.32*) is Disabled or Armed, taking no further action; and
ii.   where the *Supply State*(*5.6.4.32*) is Enabled, issuing a *Request calendar-based HAN Connected Auxiliary Load Control Switch [n] State Change*(*5.5.4.2*) Command.

On Disablement of Supply, ESME shall be capable of issuing a *Request ad-hoc HAN Connected Auxiliary Load Control Switch [n] State Change*(*5.5.4.1)* Command to request that all switches are opened.

On Enablement of Supply, ESME shall be capable of issuing a *Request calendar-based HAN Connected Auxiliary Load Control Switch [n] State Change*(*5.5.4.2*) Command to request that all switches are in the state specified by the *Auxiliary Load Control Switch [n] Calendar*(*5.6.3.1*).

When switching Auxiliary Loads as set-out in this *section 5.4.10*, ESME shall be capable of:

iii. applying the *Randomised Offset*(*5.6.3.29*); and
iv.   adjusting for Local Time.

5.4.11   Voltage quality measurements

5.4.11.1   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*(*5.6.3.5*) 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(5.6.4.8)*;

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    ii.   detecting when the value calculated is above the *Average RMS Over Voltage Threshold*(*5.6.3.3*), and on detection:
- a. generating an entry to that effect in the *Event Log*(*5.6.4.16*);
- b. counting the number of such occurrences in the *Average RMS Over Voltage Counter*(*5.6.4.6*); and
- c. sending an Alert to that effect via its HAN Interface;

    iii.   detecting when the value so calculated is below the *Average RMS Under Voltage Threshold*(*5.6.3.4*), and on detection:
- a. generating an entry to that effect in the *Event Log*(*5.6.4.16*);
- b. counting the number of such occurrences in the *Average RMS Under Voltage Counter*(*5.6.4.7*); and
- c. sending an Alert to that effect via its HAN Interface.

5.4.11.2   RMS extreme over voltage detection

ESME shall be capable of detecting when the RMS voltage is continuously above the *RMS Extreme Over Voltage Threshold*(*5.6.3.32*) for longer than the *RMS Extreme Over Voltage Measurement Period(5.6.3.31)* and on detection:

    i.   generating an entry to that effect in the *Event Log*(*5.6.4.16*); and
    ii.   sending an Alert to that effect via its HAN Interface.

5.4.11.3   RMS extreme under voltage detection

ESME shall be capable of detecting when the RMS voltage is continuously below the *RMS Extreme Under Voltage Threshold*(*5.6.3.34*) for longer than the *RMS Extreme Under Voltage Measurement Period*(*5.6.3.33*) and on detection:

    i.   generating an entry to that effect in the *Event Log*(*5.6.4.16*); and
    ii.   sending an Alert to that effect via its HAN Interface.

5.4.11.4   RMS voltage sag detection

ESME shall be capable of detecting when the RMS voltage is continuously below the *RMS Voltage Sag Threshold(5.6.3.37)* for longer than the *RMS Voltage Sag Measurement Period(5.6.3.35)* and on detection:

    i.   generating an entry to that effect in the *Event Log*(*5.6.4.16*); and
    ii.   sending an Alert to that effect via its HAN Interface.

5.4.11.5   RMS voltage swell detection

ESME shall be capable of detecting when the RMS voltage is continuously above the *RMS Voltage Swell Threshold(5.6.3.38)* for longer than the *RMS Voltage Swell Measurement Period*(*5.6.3.36*) and on detection:

    i.   generating an entry to that effect in the *Event Log*(*5.6.4.16*); and
    ii.   sending an Alert to that effect via its HAN Interface.

5.4.11.6   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 *Event Log*(*5.6.4.16*);
    ii.   following restoration of the Supply, sending an Alert to that effect via its HAN Interface; 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

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minutes, sending an Alert that Supply has been restored via its HAN Interface containing details of the UTC dates and times of interruption and restoration.

5.5 Interface Requirements

This section sets out the minimum required interactions which ESME shall be capable of undertaking via its User Interface and HAN Interfaces (including with Devices as set-out in *sections 5.4.2.1* and *5.4.2.2*).

5.5.1 HAN Interface information provision

ESME shall be capable, immediately upon establishment of a Communications Link with Type 1 Devices (as set-out in *section 5.4.2.1*) and Type 2 Devices (as set-out in *section 5.4.2.2*), of providing the Constant, Configuration and Operational Data (set-out in *sections 5.6.1*, *5.6.3* and *5.6.4*) to Type 1 Devices and Type 2 Devices (with timely updates of any changes to all data).

5.5.2 User Interface Commands

ESME shall be capable of executing immediately the Commands set-out in this *section 5.5.2* following their receipt via its User Interface.

ESME shall be capable of logging all such Commands received and Outcomes in the *Event Log*(*5.6.4.16*).

5.5.2.1 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 5.4.6.2*).

In executing the Command, if the Supply is Disabled, ESME shall be capable of Arming and Enabling the Supply.

5.5.2.2 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.   verifying the Authenticity of the UTRN;
 ii.   verifying that the ESME is the intended recipient of the UTRN;
iii.   comparing the UTRN against the last 100 verified UTRNs and rejecting duplicate presentation of verified UTRNs; and
 iv.   controlling the number of invalid UTRN entries processed.

ESME shall be capable of generating an entry in the *Security Log(5.6.4.31)*:

  v.   on failure of *i* above;
 vi.   on failure of *ii* above; and
vii.   where duplicates are rejected as set-out in *iii* above.

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

viii.   recovery of payment-based debt of an amount defined by *Debt Recovery per Payment*(*5.6.3.9*) from the *Payment Debt Register(5.6.4.25)* subject to the *Debt Recovery Rate Cap*(*5.6.3.11*);
 ix.   recovery of debt accumulated in the *Accumulated Debt Register(5.6.4.1)*;

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

   xi.   adding remaining credit (the credit after deduction of *viii*, *ix* and *x* above) to the *Meter Balance(5.6.4.24)*.

In executing the Command, ESME shall be capable of Arming the Supply if the *Meter Balance(5.6.4.24)* rises above the *Disablement Threshold*(*5.6.3.13*) and displaying any such change in the *Supply State*(*5.6.4.32*) on its User Interface and sending an Alert that the Supply has been Armed via its HAN Interface.

In executing the Command, ESME shall be capable of:

  xii.   recording the credit applied to the *Meter Balance(5.6.4.24)* in the *Billing Data Log(5.6.4.9)*; and

  xiii.   sending an Alert containing the UTC date and time of the last update of the *Meter Balance(5.6.4.24)* via its HAN Interface.

5.5.2.3   Arm Supply

A Command to Arm the Supply on input of an Arm Code. In executing the Command, ESME shall be capable of:

    i.   verifying the Authenticity of the Arm Code;

   ii.   verifying that ESME is the intended recipient of the Arm Code;

  iii.   comparing the Arm Code against the last 100 verified Arm Codes and rejecting duplicate presentation of verified Arm Codes; and

  iv.   controlling the number of invalid Arm Code entries processed.

ESME shall be capable of generating an entry in the *Security Log(5.6.4.31)*:

    v.   on failure of *i* above;

   vi.   on failure of *ii* above; and

  vii.   where duplicates are rejected as set-out in *iii* above.

Where ESME is in Prepayment mode and the combined *Meter Balance(5.6.4.24)* and *Emergency Credit Balance(5.6.4.15)* is below the *Disablement Threshold*(*5.6.3.13*) ESME shall be capable of not Arming the Supply, but of placing the Supply in such a state whereby Supply will be Armed where the combined *Meter Balance(5.6.4.24)* and *Emergency Credit Balance(5.6.4.15)* rises above the *Disablement Threshold*(*5.6.3.13*).

5.5.2.4   Display Personal Data on the User Interface

A Command to display Personal Data on input of a Privacy PIN.

ESME shall be capable of verifying the Privacy PIN by calculating a Hash of the Privacy PIN and comparing this with the *Privacy PIN Hash*(*5.6.3.28*).

5.5.2.5   Enable Supply

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

5.5.3   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*(*5.6.4.16*).

ESME shall be capable of executing Commands immediately on receipt ("immediate Commands") and at a future date ("future dated Commands"). A future dated

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Command shall include a UTC date and time at which the Command shall be executed by ESME.

ESME shall be capable of cancelling a future dated Command by over-writing the future dated Command on receipt of a Command of the same type, with the types being listed in this *section 5.5.3*. A future dated Command shall be capable of being cancelled by an Authorised party, subject to RBAC. ESME shall be capable of sending a Response to the sender of the new Command acknowledging that a future dated Command has been successfully cancelled.

5.5.3.1   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 5.4.6.2*).

In executing the Command where the Supply is Disabled ESME shall be capable of Arming the Supply.

5.5.3.2   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*(*5.6.4.17*).

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

  i.   verifying the Authenticity of the UTRN;
 ii.   verifying that ESME is the intended recipient of the UTRN;
iii.   comparing the UTRN against the last 100 verified UTRNs and rejecting duplicate presentation of verified UTRNs; and
 iv.   controlling the number of invalid UTRN entries processed.

ESME shall be capable of generating an entry in the *Security Log(5.6.4.31)*:

  v.   on failure of *i* above;
 vi.   on failure of *ii* above; and
vii.   where duplicates are rejected as set-out in *iii* above.

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

viii.   recovery of payment-baded debt of an amount defined by *Debt Recovery per Payment*(*5.6.3.9*) from the *Payment Debt Register(5.6.4.25)* subject to the *Debt Recovery Rate Cap(5.6.3.11)*;
 ix.   recovery of debt accumulated in the *Accumulated Debt Register(5.6.4.1)*;
  x.   repayment of Emergency Credit activated and used by the Consumer; and
 xi.   adding remaining credit (the credit after deduction of *viii, ix* and *x* above) to the *Meter Balance(5.6.4.24)*.

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In executing the Command, ESME shall be capable of Arming the Supply if the *Meter Balance(5.6.4.24)* rises above the *Disablement Threshold*(*5.6.3.13*), displaying any such change in the *Supply State*(*5.6.4.32*) on its User Interface 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(5.6.4.24)* in the *Billing Data Log(5.6.4.9)*.

In executing the Command from a Type 1 device, ESME shall be capable of sending an Alert containing a UTC date and time stamp of the last update of the *Meter Balance(5.6.4.24)* via its HAN Interface.

5.5.3.4   Add Device Security Credentials
A Command to add Security Credentials for a Type 1 Device or a Type 2 Device to the *Device Log*(*5.6.3.12*).

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(5.6.4.31)*.

5.5.3.5   Adjust Debt
A Command to apply positive and negative adjustments to the *Time Debt Registers [1 … 2](5.6.4.36)* and the *Payment Debt Register(5.6.4.25)* when operating in Prepayment Mode.

5.5.3.6   Adjust Meter Balance
A Command to apply positive and negative adjustments to the *Meter Balance(5.6.4.24)*.

In executing the Command where ESME is operating in Prepayment Mode and where, following any such adjustment, the *Meter Balance(5.6.4.24)* rises above the *Disablement Threshold*(*5.6.3.13*), ESME shall be capable of Arming the Supply and displaying any such change in the *Supply State*(*5.6.4.32*) on its User Interface and sending an Alert that the Supply has been Armed via its HAN Interface.

5.5.3.7   Arm Supply
A Command to Arm the Supply.

Where ESME is in Prepayment mode and the combined *Meter Balance(5.6.4.24)* and *Emergency Credit Balance(5.6.4.15)* is below the *Disablement Threshold*(*5.6.3.13*) ESME shall be capable of not Arming the Supply, but of placing the Supply in such a state whereby Supply will be Armed where the combined *Meter Balance(5.6.4.24)* and *Emergency Credit Balance(5.6.4.15)* rises above the *Disablement Threshold*(*5.6.3.13*).

In executing the Command ESME shall be capable of setting the *Supply State*(*5.6.4.32*) to Armed.

5.5.3.8   Clear Event Log
A Command to clear all entries from the *Event Log*(*5.6.4.16*). ESME shall be capable of logging that the Command has been executed in the *Security Log(5.6.4.31)*.

5.5.3.9   Disable Supply
A Command to Disable the Supply.

In executing the Command ESME shall be capable of:

i.   ignoring the *Non-Disablement Calendar*(*5.6.3.26*); and
ii. setting the *Supply State*(*5.6.4.32)* to Disabled.

5.5.3.10   Enable Supply
A Command to Enable the Supply. Where ESME is in Prepayment mode and the combined *Meter Balance(5.6.4.24)* and *Emergency Credit Balance(5.6.4.15)* is below the *Disablement Threshold*(*5.6.3.13*) ESME shall be capable of not Enabling the Supply, but of placing the Supply in such a state whereby Supply will be Armed where the combined *Meter Balance(5.6.4.24)* and *Emergency Credit Balance(5.6.4.15)* rises above the *Disablement Threshold*(*5.6.3.13*).

In executing the Command ESME shall be capable of setting the *Supply State*(*5.6.4.32*) to Enabled.

5.5.3.11   Issue Security Credentials
A Command to generate a Key Pair and issue a corresponding Certificate Signing Request.

5.5.3.12   Read Configuration Data
A Command to read the value of one or more of the configuration data items set-out in *section 5.6.3*.

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

5.5.3.13   Read Constant Data
A Command to read the value of one or more of the constant data items set-out in *section 5.6.1*.

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

5.5.3.14   Read Operational Data
A Command to read the value of one or more of the operational data items set-out in *section 5.6.4*.

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

5.5.3.15   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.

5.5.3.16   Remove Device Security Credentials

A Command to remove Security Credentials for a Type 1 Device or a Type 2 Device from the *Device Log*(*5.6.3.12*).

In executing the Command ESME shall be capable of recording the Command and Outcome to the *Security Log(5.6.4.31).*

5.5.3.17   Reset Load Limit Counter

A Command to reset the *Load Limit Counter*(*5.6.4.19*) to zero.

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

A Command to cause the identified HAN connected Auxiliary Load Control Switch [n] to revert to state defined in the *Auxiliary Load Control Switch [n] Calendar*(*5.6.3.1*).

In executing the Command ESME shall be capable of issuing a *Request calendar-based HAN Connected Auxiliary Load Control Switch [n] State Change*(*5.5.4.2*) Command to open or close as defined in the calendar.

5.5.3.19   Reset Average RMS Over Voltage Counter

A Command to reset the *Average RMS Over Voltage Counter*(*5.6.4.6*) to zero.

5.5.3.20   Reset Average RMS Under Voltage Counter

A Command to reset the *Average RMS Under Voltage Counter*(*5.6.4.7*) to zero.

5.5.3.21   Reset Maximum Demand Active Energy Import Value

A Command to reset the *Maximum Demand Active Energy Import Value(5.6.4.21).*

5.5.3.22   Reset Maximum Demand Active Energy Export Value

A Command to reset the *Maximum Demand Active Energy Export Value(5.6.4.23).*

5.5.3.23   Reset Maximum Demand (Configurable Time) Active Energy Import Value

A Command to reset the *Maximum Demand (Configurable Time) Active Energy Import Value(5.6.4.22).*

5.5.3.24   Reset Tariff Block Counter Matrix

A Command to reset the *Tariff Block Counter Matrix*(*5.6.4.33*) to zero.

5.5.3.25   Restrict Data

A Command to restrict access to all items of Personal Data stored in ESME prior to the date specified in the Command so as to prevent its disclosure via its HAN Interface and its User Interface.

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

A Command to ignore the state defined in *Auxiliary Load Control Switch [n] Calendar*(*5.6.3.1*) and to issue a *Request ad-hoc HAN Connected Auxiliary Load Control Switch [n] State Change*(*5.5.4.1)* Command to the HAN connected Auxiliary Load Control Switch [n].

ESME shall only be capable of issuing a Command to set the HAN connected Auxiliary Load Control Switch [n] as closed when the *Supply State*(*5.6.4.32*) is Enabled.

5.5.3.27   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(5.6.3.27)*.

In executing the Command, ESME shall be capable of recording:

i.   the *Tariff TOU Register Matrix(5.6.4.34)*;
ii.   the *Tariff TOU Block Register Matrix*(5.6.4.35);
iii. the *Active Import Register*(*5.6.4.3*);
iv.   the *Active Export Register*(*5.6.4.2*);
v.   the *Meter Balance*(*5.6.4.24)*;
vi.   the *Emergency Credit Balance(5.6.4.15)*;
vii. the *Payment Debt Register*(*5.6.4.25*);
viii. the *Time Debt Registers [1 … 2](5.6.4.36)*; and
ix.   the *Accumulated Debt Register(5.6.4.1)*,

in the *Billing Data Log(5.6.4.9)*.

5.5.3.28   Set Tariff

A Command to accept new values for *Tariff Type(5.6.3.47), Tariff TOU Price Matrix(5.6.3.46), Tariff Block Price Matrix(5.6.3.43)*, *Tariff Switching Table(5.6.3.44)* and *Tariff Threshold Matrix(5.6.3.45)*.

In executing the Command, ESME shall be capable of recording:

x.   the *Tariff TOU Register Matrix(5.6.4.34)*;
xi.   the *Tariff TOU Block Register Matrix*(*5.6.4.35*);
xii.   the *Active Import Register(5.6.4.3);*
xiii. the *Active Export Register(5.6.4.2)*
xiv.   the *Meter Balance(5.6.4.24)*;
xv.   the *Emergency Credit Balance(5.6.4.15)*;
xvi.   the *Payment Debt Register(5.6.4.25)*;
xvii. the *Time Debt Registers [1 … 2](5.6.4.36)*; and
xviii. the *Accumulated Debt Register(5.6.4.1)*,

in the *Billing Data Log(5.6.4.9)*.

5.5.3.29   Synchronise Clock

A Command to synchronise the Clock with UTC via its HAN Interface.

In executing the Command ESME shall be capable of ensuring that any such adjustments do not cause calendar-based events or future-dated Commands to be missed or repeated. Where ESME successfully synchronises its clock by more than 10 seconds this should be recorded in the *Event Log*(*5.6.4.16*).

5.5.3.30   Update Security Credentials

A Command to change Security Credentials held within ESME.

In executing the Command ESME shall be capable of:

i.   maintaining the Command's Transactional Atomicity;
ii.   maintaining the integrity of Security Credentials; and
iii. recording the Command and Outcome to the *Security Log(5.6.4.31)*.

5.5.3.31   Write Configuration Data

A Command to record one or more new values of the configuration data items set-out in *section 5.6.3*.

In executing the Command, ESME shall be capable of logging all changes of values in the *Event Log*(*5.6.4.16*).

5.5.4   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.

5.5.4.1   Request ad-hoc HAN Connected Auxiliary Load Control Switch [n] State Change

A Command requesting that a HAN connected Auxiliary Load Control Switch [n] either opens or closes its switch for a time period specified within the Command.

If the Response to the Command indicates that the Command has been successfully executed ESME shall be capable of:

i.   updating the corresponding *HAN Connected Auxiliary Load Control Switch [n] State(5.6.4.18)* to indicate whether the switch is now open or closed;
ii.   recording the Outcome to the *Event Log*(*5.6.4.16*); and
iii.   sending an Alert containing the Outcome via its HAN Interface.

If the Response indicates that the Command has failed, ESME shall be capable of:

iv.   recording the Outcome to the *Event Log*(*5.6.4.16*); and
v.   sending an Alert to that effect via its HAN Interface.

The Command shall include a time period. When this time period has elapsed, ESME shall be capable of sending a *Request calendar-based HAN Connected Auxiliary Load Control Switch [n] State Change(5.5.4.2)* Command to the identified HAN connected Auxiliary Load Control Switch [n] to request that the switch assumes the state defined in the *Auxiliary Load Control Switch [n] Calendar(5.6.3.1)*.

5.5.4.2   Request calendar-based HAN Connected Auxiliary Load Control Switch [n] State Change

A Command requesting that a HAN connected Auxiliary Load Control Switch [n] either closes its switch for a time period specified within the Command, or opens its switch.

If the Response to the Command indicates that the Command has been successfully executed ESME shall be capable of updating the corresponding *HAN Connected Auxiliary Load Control Switch [n] State(5.6.4.18)* to indicate whether the switch is now open or closed. If the Response indicates that the Command has failed, ESME shall be capable of:

i.   recording the Outcome to the *Event Log*(*5.6.4.16*); and
ii.   sending an Alert to that effect via its HAN Interface.

5.5.4.3   Request ESME Commissioning

A Command to request that ESME is brought into operation.

5.6 Data Requirements

This section describes the minimum information which ESME is to be capable of holding in its Data Store.

5.6.1 Constant data

Describes data that remains constant and unchangeable at all times.

5.6.1.1 ESME Identifier

A globally unique identifier used to identify ESME.

5.6.1.2 Manufacturer Identifier

An identifier used to identify the manufacturer of ESME.

5.6.1.3 Model Type

An identifier used to identify the model of ESME.

5.6.1.4 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.

5.6.1.5 Randomised Offset Number

A randomly generated value between 0 and 1.

5.6.2 Internal data

Describes data that remains constant and unchangeable at all times and that is not available outside ESME.

5.6.2.1 Installation Credentials

Credentials unique to ESME used to authenticate ESME during the installation process.

5.6.3 Configuration data

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

5.6.3.1 Auxiliary Load Control Switch [n] Calendar

A set of rules for setting the commanded state of up to five Auxiliary Load Control Switches as open and closed. The rules stored within the calendar shall support 200 Time-of-use switching rules per annum.

The rules shall support changes in state based on:

   i.   half-hour, half-hours and half-hour ranges;
  ii.   day, days and day ranges; and
 iii.   date, dates and date ranges.

All dates and times shall be specified in UTC.

5.6.3.2 Auxiliary Load Control Switch [n] Description

For each Auxiliary Load Control Switch, a description of the type of controlled load connected and the switch type.

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5.6.3.3 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.

5.6.3.4 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.

5.6.3.5 Average RMS Voltage Measurement Period
The length of time in minutes over which the RMS voltage is averaged.

5.6.3.6 Billing Calendar
A calendar defining billing dates for the storage of billing related information in the *Billing Data Log(5.6.4.9)*.

5.6.3.7 Contact Details
The name and contact telephone number of the Supplier.

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

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

5.6.3.10 Debt Recovery Rates [1 … 2]
Two debt recovery rates in Currency Units per unit time for when ESME is using Time-based Debt Recovery in Prepayment Mode.

5.6.3.11 Debt Recovery Rate Cap
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.

5.6.3.12 Device Log
The Security Credentials for each of the Type 1 Devices and each of the Type 2 Devices with which ESME can communicate.

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

5.6.3.14 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.

5.6.3.15 Emergency Credit Threshold
The threshold in Currency Units below which *Emergency Credit Balance(5.6.4.15)* may be activated by the Consumer if so configured when ESME is operating in Prepayment Mode.

5.6.3.16 Load Limit Period
The length of time in seconds which the *Active Power Import(5.6.4.4)* needs to continuously exceed the *Load Limit Power Threshold(5.6.3.17)* before a load limiting event is deemed to have occurred.

5.6.3.17   Load Limit Power Threshold
The Active Power threshold in kW above which the measurement of a *Load Limit Period*(*5.6.3.16*) is commenced.

5.6.3.18   Load Limit Restoration Period
The length of time in minutes after the Supply has been Armed following a Load Limiting Event before the Supply is Enabled by ESME.

5.6.3.19   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.

5.6.3.20   Local Time Change Calendar
A set of rules used to calculate Local Time from UTC.

5.6.3.21   Low Credit Threshold
The threshold in Currency Units below which a low credit Alert is signalled.

5.6.3.22   Low Medium Power Threshold
A value in kW defining the threshold between an indicative low and medium *Active Power Import(5.6.4.4)* level.

5.6.3.23   Maximum Demand Configurable Time Period
A calendar defining UTC times during which recording to the *Maximum Demand (Configurable Time) Active Energy Import Value*(*5.6.4.22*) is active.

5.6.3.24   Meter Point Administration Numbers (MPAN)
The reference numbers identifying an electricity metering point for Import and Export.

5.6.3.25   Medium High Power Threshold
A value in kW defining the threshold between an indicative medium and high *Active Power Import(5.6.4.4)* level.

5.6.3.26   Non-Disablement Calendar
A calendar defining UTC times, days and dates that specify periods during which the Supply will not be Disabled when the meter is operating in Prepayment Mode.

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

5.6.3.28   Privacy PIN Hash
A Hash of the Privacy PIN.

5.6.3.29   Randomised Offset
The product of the *Randomised Offset Limit(5.6.3.30)* and the *Randomised Offset Number*(*5.6.1.5*) rounded to the nearest second. This value is used to delay the Tariff Switching Table times and the Auxiliary Load Control Switch switching times.

5.6.3.30   Randomised Offset Limit
A value in seconds in the range 0 to 1799.

5.6.3.31   RMS Extreme Over Voltage Measurement Period
The duration in seconds used to measure an extreme over voltage condition.

5.6.3.32   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.

5.6.3.33   RMS Extreme Under Voltage Measurement Period
The duration in seconds used to measure an extreme under voltage condition.

5.6.3.34   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.

5.6.3.35   RMS Voltage Sag Measurement Period
The duration in seconds used to measure a voltage sag condition.

5.6.3.36   RMS Voltage Swell Measurement Period
The duration in seconds used to measure a voltage swell condition.

5.6.3.37   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.

5.6.3.38   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.

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

5.6.3.40   Supply Tamper State
A setting to control the state of the Supply in the case of a Tamper Event being detected, being Disabled or unchanged.

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

5.6.3.42   Suspend Debt Emergency
A setting controlling whether debt should be collected when ESME is operating in Prepayment Mode and the *Emergency Credit Balance(5.6.4.15)* is below the *Emergency Credit Limit(5.6.3.14)*.

5.6.3.43   Tariff Block Price Matrix
A 4 x 8 matrix containing prices for Block Pricing.

5.6.3.44   Tariff Switching Table
A set of switching 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 support 200 Time-of-use switching rules per annum.

The rules shall support allocation based on:

   i.   half-hour, half-hours and half-hour ranges;
   ii.   day, days and day ranges; and
   iii. date, dates and date ranges.

All dates and times shall be specified as UTC.

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

5.6.3.46 Tariff TOU Price Matrix
A 1 x 48 matrix containing prices for Time-of-use Pricing.

5.6.3.47 Tariff Type
The Tariff type in operation, being Time-of-use or Time-of-use with Block.

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

5.6.4.1 Accumulated Debt Register
The debt resulting from the collection of *Standing Charge(5.6.3.39)* and/or time-based debt when no credit or Emergency Credit is available, when operating in Prepayment Mode.

5.6.4.2 Active Export Register
The register recording the cumulative Active Energy Exported.

5.6.4.3 Active Import Register
The register recording the cumulative Active Energy Imported.

5.6.4.4 Active Power Import
The import of Active Power measured by ESME.

5.6.4.5 Active Tariff Price
The Price currently active.

5.6.4.6 Average RMS Over Voltage Counter
The number of times the average RMS voltage, as calculated in *section 5.4.11.1*, has been above the *Average RMS Over Voltage Threshold(5.6.3.3)* since last reset.

5.6.4.7 Average RMS Under Voltage Counter
The number of times the average RMS voltage, as calculated in *section 5.4.11.1*, has been below the *Average RMS Under Voltage Threshold(5.6.3.4)* since last reset.

5.6.4.8 Average RMS Voltage Profile Data Log
A log for 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*(*5.6.3.5*) arranged as a circular buffer such that when full, further writes shall cause the oldest entry to be overwritten.

5.6.4.9 Billing Data Log
A log for storing the following UTC date and time stamped entries:

  i.   twelve entries comprising *Tariff TOU Register Matrix(5.6.4.34)*, *Tariff TOU Block Register Matrix*(*5.6.4.35*), the *Active Import Register*(*5.6.4.3*) and the *Active Export Register*(*5.6.4.2*);
 ii.   five entries comprising prepayment credits;
iii.   ten entries comprising time-based debt payments;
iv.   ten entries comprising payment-based debt payments; and

v. twelve entries comprising *Meter Balance(5.6.4.24)*, *Emergency Credit Balance(5.6.4.15)*, *Accumulated Debt Register(5.6.4.1)*, *Payment Debt Register(5.6.4.25)* and *Time Debt Registers [1 … 2](5.6.4.36)*,

arranged as a circular buffer such that when full, further writes shall cause the oldest entry to be overwritten.

5.6.4.10   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.

5.6.4.11   Cumulative and Historical Value Store
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.

5.6.4.12   Customer Identification Number
A number issued to ESME for display on the User Interface.

5.6.4.13   Daily Read Log
A log for storing fourteen UTC date and time stamped entries of the *Tariff TOU Register Matrix(5.6.4.34)*, the *Tariff TOU Block Register Matrix*(*5.6.4.35*), the *Active Import Register(5.6.4.3)* and the *Active Export Register*(*5.6.4.2*) arranged as a circular buffer such that when full, further writes shall cause the oldest entry to be overwritten.

5.6.4.14   Daily Consumption Log
A log for 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.

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

5.6.4.16   Event Log
A log for 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.

5.6.4.17   Firmware Version
The active version of Firmware of ESME.

5.6.4.18   HAN Connected Auxiliary Load Control Switch [n] State
The commanded state of Auxiliary Load Control Switch [n], (where n is between 1 and 5) being open or closed.

5.6.4.19   Load Limit Counter
The number of times the *Active Power Import(5.6.4.4)* has exceeded, for the *Load Limit Period*(*5.6.3.16*), the *Load Limit Power Threshold*(*5.6.3.17*) since last cleared.

5.6.4.20 Local Time
The time calculated using the *Local Time Change Calendar*(*5.6.3.20*).

5.6.4.21 Maximum Demand Active Energy Import Value
A store capable of holding the largest UTC date and time stamped value of Consumption recorded in any 30 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 data relates) since the value was last reset (as set-out in *section 5.5.3.21*) arranged such that the recording of a larger value shall cause the previous entry to be overwritten.

5.6.4.22 Maximum Demand (Configurable Time) Active Energy Import Value
A store capable of holding the largest UTC date and time-stamped value of Consumption 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(5.6.3.23)* (including the UTC date and time at the end of the 30 minute period to which the data relates) since the log was last reset, together with the UTC date and time when the log was last reset (as set-out in *section 5.5.3.23*), arranged such that the recording of a larger value shall cause the previous entry to be overwritten.

5.6.4.23 Maximum Demand Active Energy Export Value
A store capable of holding the largest UTC date and time-stamped value of the Active Energy Export recorded in any 30 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 data relates) since the log was last reset, together with the UTC date and time when the log was last reset (as set-out in *section 5.5.3.22*), arranged such that the recording of a larger value shall cause the previous entry to be overwritten.

5.6.4.24 Meter Balance
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 (other than any *Emergency Credit Balance(5.6.4.15)*). 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.

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

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

5.6.4.27 Prepayment Daily Read Log
A log for storing fourteen UTC date and time stamped entries of *Meter Balance(5.6.4.24)*, *Emergency Credit Balance(5.6.4.15)*, *Accumulated Debt Register(5.6.4.1)*, *Payment Debt Register(5.6.4.25)* and *Time Debt Registers [1 … 2](5.6.4.36)* arranged as a circular buffer such that when full, further writes shall cause the oldest entry to be overwritten.

5.6.4.28   Profile Data Log
A log for 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.

5.6.4.29   Reactive Export Register
The register recording the cumulative Reactive Energy Exported.

5.6.4.30   Reactive Import Register
The register recording the cumulative Reactive Energy Imported.

5.6.4.31   Security Log
A log for 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.

5.6.4.32   Supply State
The status of Supply as controlled by ESME being Enabled, Disabled or Armed.

5.6.4.33   Tariff Block Counter Matrix
A 4 x 8 matrix for storing Block Counters for Block Pricing.

5.6.4.34   Tariff TOU Register Matrix
A 1 x 48 matrix for storing Tariff Registers for Time-of-use Pricing.

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

5.6.4.36   Time Debt Registers [1 … 2]
Two 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

5.7 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.

5.8 Physical Requirements

Physical Requirements(5.3) 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; and
vi. a User Interface, including a Keypad.

ESME shall be mains powered and be capable of operating at a nominal voltage of 230VAC and consuming no more than an average of 3 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:

vii. display the *ESME Identifier(5.6.1.1)*; and
viii. have a Secure Perimeter.

The HAN Interface of ESME shall be capable of:

ix. joining a ZigBee network utilising the 2400 – 2483.5 MHz harmonised frequency band; and
x. supporting Communications Links based on ZigBee SEP v1 and DLMS COSEM.

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:

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

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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:

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

and where reasonably practicable:

xix.   generating an entry to that effect in the *Security Log(5.6.4.31)*;
 xx.   sending an Alert to that effect via its HAN Interface; and
xxi.   Disabling the Supply, in circumstances where the *Supply Tamper State(5.6.3.40)* is configured to require Disablement.

5.9   Functional Requirements

5.9.1   Display of information

Display of information(*5.4.4*) 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*(*5.6.3.27*) currently in operation, being Prepayment Mode or Credit Mode;
  ii.   the *Tariff TOU Register Matrix*(*5.6.4.34*), the *Secondary Tariff TOU Register Matrix*(*5.11.2.10*), *Tariff TOU Block Register Matrix*(*5.6.4.35*) and the *Tariff Block Counter Matrix*(*5.6.4.33*);
 iii.   the *Meter Balance*(*5.6.4.24*);
  iv.   the *Customer Identification Number*(*5.6.4.12*);
   v.   whether Emergency Credit is available for activation;
  vi.   whether ESME has suspended the Disablement of Supply during a period defined in the *Non-Disablement Calendar*(*5.6.3.26*) *(*as set-out in *section 5.9.2.2*);
 vii.   the *Emergency Credit Balance*(*5.6.4.15*) where Emergency Credit is activated;
viii.   any low credit condition;
  ix.   the *Supply State*(*5.6.4.32*);
   x.   any time-based debts and Time-based Debt Recovery rates;
  xi.   any payment-based debt;
 xii.   any accumulated debt recorded in the *Accumulated Debt Register*(*5.6.4.1*);
xiii.   any *Standing Charge*(*5.6.3.39*);
xiv.   the *Meter Point Administration Numbers (MPAN)*(*5.6.3.24*)*;*
  xv.   the *Local Time(5.6.4.20)*;
xvi.   the *Contact Details*(*5.6.3.7*);
xvii.   the *Primary Active Tariff Price*(*5.11.2.6*); and
xviii.   the *Secondary Active Tariff Price*(*5.11.2.9*).

ESME shall be capable of restricting the display of Personal data using the Privacy PIN and *Privacy PIN Hash*(*5.6.3.28*).

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

5.9.2 Payment Mode

Payment Mode(5.4.6) 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.

5.9.2.1 Credit Mode

ESME, when operating in Credit Mode, shall be capable of maintaining a calculation of the *Meter Balance(5.6.4.24)* based on:

i. the Consumption in the *Tariff TOU Register Matrix(5.6.4.34)* and the Prices in the *Tariff TOU Price Matrix*(*5.6.3.46*) and if operating Time-of-use with Block Pricing, the Consumption in the *Tariff TOU Block Register Matrix*(*5.6.4.35*) and the Prices in the *Tariff Block Price Matrix*(*5.6.3.43*);

ii. the Consumption in the *Secondary Tariff TOU Register Matrix*(*5.11.2.10*) and the Prices in *Secondary Tariff TOU Price Matrix*(*5.11.1.2*); and

iii. the *Standing Charge*(*5.6.3.39*).

5.9.2.2 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(5.6.4.24)* (as set-out in *sections 5.5.2.2* and *5.5.3.3*) and reducing the amount of credit in the *Meter Balance(5.6.4.24)*.

ESME shall be capable of making Emergency Credit available to the Consumer (by means of the *Emergency Credit Balance(5.6.4.15))* if the *Meter Balance(5.6.4.24)* is below the *Emergency Credit Threshold*(*5.6.3.15*). ESME shall be capable of displaying the availability of Emergency Credit on its User Interface and of 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*(*5.6.3.14*). ESME shall be capable of reducing the amount of credit in the *Emergency Credit Balance(5.6.4.15)* where Emergency Credit is activated by the Consumer (as set-out in *sections 5.5.2.1* and *5.5.3.1*) and the *Meter Balance*(*5.6.4.24*) is exhausted. Any Emergency Credit used shall be repaid when credit is added to ESME (as set-out in *sections 5.5.2.2* and *5.5.3.3*).

ESME shall be capable of reducing the *Meter Balance(5.6.4.24)* until exhausted followed by reducing the *Emergency Credit Balance(5.6.4.15)*, where activated, until exhausted on the basis of:

i. the Consumption in the *Tariff TOU Register Matrix(5.6.4.34)* and the Prices in the *Tariff TOU Price Matrix*(*5.6.3.46*), and if operating Time-of-use with Block Pricing the Consumption in the *Tariff TOU Block Register Matrix*(*5.6.4.35*) and the Prices in the *Tariff Block Price Matrix*(*5.6.3.43*);

ii. the Consumption in the *Secondary Tariff TOU Register Matrix*(*5.11.2.10)* and the Prices in the *Secondary Tariff TOU Price Matrix(5.11.1.2)*;

iii. the *Standing Charge*(*5.6.3.39*); and

iv. the recovery of debt through each of the *Time Debt Registers [1 … 2](5.6.4.36)* at rates defined by the *Debt Recovery Rates [1 … 2](5.6.3.10)*,

and ESME shall be capable of recording debt recovered in the *Billing Data Log(5.11.2.3)*.

ESME shall be capable of monitoring the *Meter Balance(5.6.4.24)* and where activated the *Emergency Credit Balance(5.6.4.15)* and:

  v.   if the combined credit of the *Meter Balance(5.6.4.24)* and *Emergency Credit Balance(5.6.4.15)* falls below the *Low Credit Threshold*(*5.6.3.21*), displaying an Alert to that effect on its User Interface and sending an Alert to that effect via its HAN Interface;

  vi.   if the combined credit of the *Meter Balance(5.6.4.24)* and *Emergency Credit Balance(5.6.4.15)* falls below the *Disablement Threshold*(*5.6.3.13*), Disabling the Supply, displaying an Alert to that effect on its User Interface and sending an Alert to that effect via its HAN Interface; and

  vii. if the Supply is Enabled, suspending the Disablement of Supply (as set-out in *vi* above) during periods defined in the *Non-Disablement Calendar*(*5.6.3.26*), displaying on its User Interface an indication that the combined *Meter Balance(5.6.4.24)* and *Emergency Credit Balance(5.6.4.15)* is below the *Disablement Threshold*(*5.6.3.13*) and that Disablement of Supply due to insufficient credit has been suspended, and sending an Alert that Disablement of Supply due to insufficient credit has been suspended via its HAN Interface.

ESME shall be capable of controlling recovery of debt by:

  viii. suspending debt recovery when Emergency Credit is in use if configured by *Suspend Debt Emergency*(*5.6.3.42*) to do so; and
        suspending debt recovery when the Supply is Disabled if configured by *Suspend Debt Disabled*(*5.6.3.41*) to do so.

In circumstances where the Supply is Disabled, ESME shall be capable of continuing to recover time-based debt (if so configured as set-out in *viii* above) and *Standing Charge(5.6.3.39)*, and recording the debt recovered in the *Accumulated Debt Register(5.6.4.1)*.

5.9.3   Pricing

Pricing(*5.4.7*) 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, as configured by *Tariff Type*(*5.6.3.47*).

When switching between Time-of-use Bands and Tariff Registers as set-out in this section ESME shall be capable of:

  i.   applying the *Randomised Offset*(*5.6.3.29*); and
  ii.   adjusting for Local Time.

ESME shall be capable of maintaining the *Primary Active Tariff Price*(*5.11.2.6*) and the *Secondary Active Tariff Price*(*5.11.2.9*).

5.9.3.1   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(5.6.4.34)*.

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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*(*5.11.2.10*).

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*(*5.11.1.1*).

5.9.3.2   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(5.6.4.35).*

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*(*5.11.1.1*). 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(5.6.4.33)* and Consumption thresholds in the *Tariff Threshold Matrix*(*5.6.3.45*).

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(5.6.4.33)* 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*(*5.6.3.45*).

ESME shall be capable of resetting the counters in the *Tariff Block Counter Matrix(5.6.4.33)* once per Day and in accordance with the timetable set-out in the *Billing Calendar(5.6.3.6).*

5.9.4   Recording

Recording(*5.4.8)* in Part A shall not apply to ESME.

5.9.4.1   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*(*5.6.4.3*); and
   ii.   cumulative Active Energy Imported via the secondary measuring element of its Electricity Meter in the *Secondary Active Import Register*(*5.11.2.11*).

5.9.4.2   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*(*5.6.4.2*).

5.9.4.3   Billing data

ESME shall be capable of taking a UTC date and time stamped copy of and storing the *Tariff TOU Register Matrix(5.6.4.34)*, the *Secondary Tariff TOU Register Matrix*(*5.11.2.10*), the *Tariff TOU Block Register Matrix*(*5.6.4.35*), the *Active Import Register*(*5.6.4.3*), the *Secondary Active Import Register*(*5.11.2.11*) and the *Active Export*

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Register(*5.6.4.2*) in the *Billing Data Log(5.11.2.3)* in accordance with the timetable set-out in the *Billing Calendar*(*5.6.3.6*), and:

    i.   sending an Alert via its HAN Interface containing the data stored; and
    ii.   if operating in Credit Mode immediately resetting the *Meter Balance*(*5.6.4.24*).

5.9.4.4   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*(*5.6.4.11*) 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.   to the *Daily Consumption Log*(*5.6.4.14*) in kWh the Consumption on each of the 731 Days prior to such Day.

5.9.4.5   Cost of Consumption Data

ESME shall be capable of calculating and recording to the *Cumulative and Historical Value Store*(*5.6.4.11*) 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(5.6.4.34)* and the Prices in the *Tariff TOU Price Matrix*(*5.6.3.46*), and if operating Time-of-use with Block Pricing the Consumption in the *Tariff TOU Block Register Matrix*(*5.6.4.35*) and the Prices in the *Tariff Block Price Matrix*(*5.6.3.43*);
    viii.   the Consumption in the *Secondary Tariff TOU Register Matrix*(*5.11.2.10*) and the Prices in the *Secondary Tariff TOU Price Matrix*(*5.11.1.2*); and
    ix.   the *Standing Charge*(*5.6.3.39*).

5.9.4.6   Cost of Instantaneous Consumption

ESME shall be capable of calculating and recording the *Cost of Instantaneous Active Power Import*(*5.6.4.10*) on the basis of:

    i.   the *Primary Active Power Import*(*5.11.2.5*);
    ii.   the *Primary Active Tariff Price*(*5.11.2.6*);
    iii.   the *Secondary Active Power Import*(*5.11.2.8*); and
    iv.   the *Secondary Active Tariff Price*(*5.11.2.9*).

5.9.4.7   Daily read data

ESME shall be capable of taking a copy of and storing the *Tariff TOU Register Matrix(5.6.4.34)*, the *Secondary Tariff TOU Register Matrix*(*5.11.2.10*), the *Tariff TOU Block*

Register Matrix(*5.6.4.35*), the *Active Import Register(5.6.4.3)*, the *Secondary Active Import Register*(*5.11.2.11*) and the *Active Export Register*(*5.6.4.2*), together with a UTC date and time stamp in the *Daily Read Log(5.11.2.4)* every day at midnight UTC.

If operating in Prepayment Mode ESME shall be capable of recording the *Meter Balance(5.6.4.24)*, *Emergency Credit Balance(5.6.4.15)*, *Accumulated Debt Register(5.6.4.1)*, *Payment Debt Register(5.6.4.25)* and *Time Debt Registers [1 … 2](5.6.4.36)* in the *Prepayment Daily Read Log*(*5.6.4.27*) every day at midnight UTC.

5.9.4.8   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*(*5.11.2.7*):

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 measuring element 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.

5.9.4.9   Maximum Demand Import data
ESME shall be capable of recording:

i. to the *Maximum Demand Active Energy Import Value(5.6.4.21)*, the maximum value of Consumption via the primary and secondary measuring elements of its Electricity Meter 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 *Maximum Demand Active Energy Import Value(5.6.4.21)* was last reset (as set-out in *section 5.5.3.21*); and
ii. to the *Maximum Demand (Configurable Time) Active Energy Import Value(5.6.4.22)* the maximum value of Consumption via the primary and secondary measuring elements of its Electricity Meter 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*(*5.6.3.23*) (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 Energy Import Value(5.6.4.22)* was last reset (as set-out in *section 5.5.3.23*).

5.9.4.10   Maximum Demand Export data
ESME shall be capable of recording to the *Maximum Demand Active Energy Export Value*(*5.6.4.23*) the maximum value of Active Energy Export via the primary measuring element of its Electricity Meter recorded in any 30 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 data relates) since the *Maximum Demand Active Energy Export Value*(*5.6.4.23*) was last reset (as set-out in *section 5.5.3.22*).

5.9.4.11   Power Threshold Status

ESME shall be capable of comparing the *Active Power Import*(*5.11.2.1*) against thresholds and:

i.   if the *Active Power Import*(*5.11.2.1*) is equal to or lower than the *Low Medium Power Threshold*(*5.6.3.22*), setting *Power Threshold Status*(*5.6.4.26*) to low;

ii.   if the *Active Power Import*(*5.11.2.1*) is higher than the *Low Medium Power Threshold(5.6.3.22)* and equal to or lower than the *Medium High Power Threshold*(*5.6.3.25*), setting *Power Threshold Status*(*5.6.4.26*) to medium; and

iii.   otherwise, setting the *Power Threshold Status*(*5.6.4.26*) to high.

5.9.4.12   Reactive Energy Imported

ESME shall be capable of recording:

i.   cumulative Reactive Energy Imported via the primary measuring element of its Electricity Meter in the *Reactive Import Register*(*5.6.4.30*); and

ii.   cumulative Reactive Energy Imported via the secondary measuring element of its Electricity Meter in the *Secondary Reactive Import Register*(*5.11.2.12*).

5.9.4.13   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*(*5.6.4.29*).

5.10   Interface Requirements

5.10.1   HAN Interface Commands

5.10.1.1   Set Payment Mode

Set Payment Mode(*5.5.3.27*) 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(5.6.3.27).*

In executing the Command, ESME shall be capable of recording:

i.   the *Tariff TOU Register Matrix(5.6.4.34)*;
ii.   the *Secondary Tariff TOU Register Matrix*(*5.11.2.10*);
iii.   the *Tariff TOU Block Register Matrix(5.6.4.35)*;
iv.   the *Active Import Register*(*5.6.4.3*);
v.   the *Secondary Active Import Register*(*5.11.2.11*);
vi.   the *Active Export Register*(*5.6.4.2*);
vii.   the *Meter Balance(5.6.4.24)*;
viii.   the *Emergency Credit Balance(5.6.4.15)*;
ix.   the *Payment Debt Register(5.6.4.25)*;
x.   the *Time Debt Registers [1 … 2](5.6.4.36)*; and
xi.   the *Accumulated Debt Register(5.6.4.1),*

in the *Billing Data Log*(*5.11.2.3*).

5.10.1.2   Set Tariff

Set Tariff(*5.5.3.28*) in Part A shall not apply to ESME.

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A Command to accept new values for the *Tariff Type(5.6.3.47)*, the *Tariff TOU Price Matrix(5.6.3.46),* the *Secondary Tariff TOU Price Matrix*(*5.11.1.2*), the *Tariff Block Price Matrix(5.6.3.43)*, the *Tariff Switching Table*(*5.11.1.1*) and the *Tariff Threshold Matrix(5.6.3.45).*

In executing the Command, ESME shall be capable of recording:

    i.   the *Tariff TOU Register Matrix(5.6.4.34)*;
    ii.   the *Secondary Tariff TOU Register Matrix*(*5.11.2.10*);
    iii.   the *Tariff TOU Block Register Matrix*(*5.6.4.35*);
    iv.   the *Active Import Register*(*5.6.4.3*);
    v.   the *Secondary Active Import Register*(*5.11.2.11*);
    vi.   the *Active Export Register*(*5.6.4.2*);
    vii.   the *Meter Balance(5.6.4.24)*;
    viii.   the *Emergency Credit Balance(5.6.4.15)*;
    ix.   the *Payment Debt Register(5.6.4.25)*;
    x.   the *Time Debt Registers [1 … 2](5.6.4.36)*; and
    xi.   the *Accumulated Debt Register(5.6.4.1)*,

in the *Billing Data Log*(*5.11.2.3*).

5.11   Data Requirements

5.11.1   Configuration Data

5.11.1.1   Tariff Switching Table
Tariff Switching Table(*5.6.3.44*) in Part A shall not apply to ESME.

A set of switching 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*(*5.6.4.34*) if applying Time-of-use Pricing, and in the *Tariff TOU Block Register Matrix(5.6.4.35)* 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*(*5.11.2.10*).

The rules stored within the table shall support 200 Time-of-use switching rules per annum.

The rules shall support allocation based on:

    iii.   half-hour, half-hours and half-hour ranges;
    iv.   day, days and day ranges; and
    v.   date, dates and date ranges.

All dates and times shall be specified as UTC.

5.11.1.2   Secondary Tariff TOU Price Matrix
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.

5.11.2 Operational Data

5.11.2.1 Active Power Import

Active Power Import(5.6.4.5) in Part A shall not apply to ESME.

The sum of:

    i.   the *Primary Active Power Import(5.11.2.5)* on the primary measuring element of the Electricity Meter; and

    ii.   the *Secondary Active Power Import(5.11.2.8)* on the secondary measuring element of the Electricity Meter.

5.11.2.2 Active Tariff Price

Active Tariff Price(5.6.4.5) in Part A shall not apply to ESME.

5.11.2.3 Billing Data Log

Billing Data Log(5.6.4.9) in Part A shall not apply to ESME.

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

    i.   twelve entries comprising the *Tariff TOU Register Matrix(5.6.4.34)*, the *Secondary Tariff TOU Register Matrix(5.11.2.10)*, the *Tariff TOU Block Register Matrix(5.6.4.35)*, the *Active Import Register(5.6.4.3)*, the *Secondary Active Import Register(5.11.2.11)* and the *Active Export Register(5.6.4.2)*;

    ii.   five entries comprising prepayment credits;

    iii.   ten entries comprising time-based debt payments;

    iv.   ten entries comprising payment-based debt payments; and

    v.   twelve entries comprising *Meter Balance(5.6.4.24)*, *Emergency Credit Balance(5.6.4.15)*, *Accumulated Debt Register(5.6.4.1)*, *Payment Debt Register(5.6.4.25)* and *Time Debt Registers [1 … 2](5.6.4.36)*,

arranged as a circular buffer such that when full, further writes shall cause the oldest entry to be overwritten.

5.11.2.4 Daily Read Log

Daily Read Log(5.6.4.13) in Part A shall not apply to ESME.

A log for storing fourteen UTC date and time stamped entries of the *Tariff TOU Register Matrix(5.6.4.34)*, the *Secondary Tariff TOU Register Matrix(5.11.2.10)*, the *Tariff TOU Block Register Matrix(5.6.4.35)*, the *Active Import Register(5.6.4.3)*, the *Secondary Active Import Register(5.11.2.11)* and the *Active Export Register(5.6.4.2)* arranged as a circular buffer such that when full, further writes shall cause the oldest entry to be overwritten.

5.11.2.5 Primary Active Power Import

The import of Active Power measured via the primary measuring element of the Electricity Meter.

5.11.2.6 Primary Active Tariff Price

The Price currently active for Consumption via the primary measuring element of the Electricity Meter.

5.11.2.7 Profile Data Log

Profile Data Log(5.6.4.28) in Part A shall not apply to ESME.

A log for 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 measuring element of the Electricity Meter; and

    v.   3 months of Reactive Energy Exported via the primary measuring element of the Electricity Meter.

5.11.2.8 Secondary Active Power Import

The import of Active Power measured via the secondary measuring element of the Electricity Meter.

5.11.2.9 Secondary Active Tariff Price

The Price currently active for Consumption via the secondary measuring element of the Electricity Meter.

5.11.2.10 Secondary Tariff TOU Register Matrix

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.

5.11.2.11 Secondary Active Import Register

The register recording the cumulative Active Energy Imported via the secondary measuring element of the Electricity Meter.

5.11.2.12 Secondary Reactive Import Register

The register recording the cumulative Reactive Energy Imported via the secondary measuring element of the Electricity Meter.

Part C - Polyphase Electricity Metering Equipment

5.12 Overview

In this Part C ESME shall mean Polyphase Electricity Metering Equipment.

ESME shall comply with the requirements of Part A save as set-out in the remainder of this Part C.

5.13 Physical Requirements

Physical Requirements(5.3) 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; and
    vi.   a User Interface, including a Keypad.

ESME shall be mains powered and be capable of operating at a nominal voltage of 230VAC and consuming no 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:

    vii.   display the *ESME Identifier(5.6.1.1)*; and
    viii. have a Secure Perimeter.

The HAN Interface of ESME shall be capable of:

    ix.   joining a ZigBee network utilising the 2400 – 2483.5 MHz harmonised frequency band; and
    x.   supporting Communications Links based on ZigBee SEP v1 and DLMS COSEM.

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:

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

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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:

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

and where reasonably practicable:

xix. generating an entry to that effect in the *Security Log(5.6.4.31)*;
 xx. sending an Alert to that effect via its HAN Interface; and
xxi. Disabling the Supply, in circumstances where the *Supply Tamper State(5.6.3.40)* is configured to require Disablement.

5.14 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.

5.14.1 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 230-0-230 VAC phase-to-neutral-to-phase (460 VAC phase-to-phase); and

iv.   the sum of two distinct one phase two wire 230 VAC services with a common neutral.

5.14.2   Voltage Quality Measurements

Voltage quality measurements(*5.4.11*) in Part A shall not apply to ESME.

5.14.2.1   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*(*5.15.1.3*) 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*(*5.15.2.3*);
   ii.   detecting when the value calculated for phase [n] is above the *Phase [n] Average RMS Over Voltage Threshold*(*5.15.1.1*) and on detection:
      a.   generating an entry to that effect (including identification of the relevant phase) in the *Event Log*(*5.6.4.16*);
      b.   counting the number of such occurrences in the *Phase [n] Average RMS Over Voltage Counter*(*5.15.2.1*); and
      c.   sending an Alert to that effect (including identification of the relevant phase) via its HAN Interface;
   iii.   detecting when the value so calculated for phase [n] is below the *Phase [n] Average RMS Under Voltage Threshold(*5.15.1.2*)* and on detection:
      a.   generating an entry to that effect (including identification of the relevant phase) in the *Event Log*(*5.6.4.16*);
      b.   counting the number of such occurrences in the *Phase [n] Average RMS Under Voltage Counter*(*5.15.2.2*); and
      c.   sending an Alert to that effect (including identification of the relevant phase) via its HAN Interface.

5.14.2.2   RMS extreme over voltage detection

ESME shall be capable of detecting when the RMS voltage for phase [n] is continuously above the *RMS Extreme Over Voltage Threshold*(*5.6.3.32*) for longer than the *RMS Extreme Over Voltage Measurement Period(5.6.3.31)* and on detection:

   i.   generating an entry to that effect (including identification of the relevant phase) in the *Event Log*(*5.6.4.16*); and
   ii.   sending an Alert to that effect (including identification of the relevant phase) via its HAN Interface.

5.14.2.3   RMS extreme under voltage detection

ESME shall be capable of detecting when the RMS voltage for phase [n] is continuously below the *RMS Extreme Under Voltage Threshold*(*5.6.3.34*) for that phase for longer than the *RMS Extreme Under Voltage Measurement Period*(*5.6.3.33)* and on detection:

   i.   generating an entry to that effect (including identification of the relevant phase) in the *Event Log*(*5.6.4.16*); and
   ii.   sending an Alert to that effect (including identification of the relevant phase) via its HAN Interface.

5.14.2.4   RMS voltage sag detection

ESME shall be capable of detecting when the RMS voltage for phase [n] is continuously below the *RMS Voltage Sag Threshold(5.6.3.37)* for longer than the *RMS Voltage Sag Measurement Period(5.6.3.35)* and on detection:

    i.   generating an entry to that effect (including identification of the relevant phase) in the *Event Log*(*5.6.4.16*); and

    ii.   sending an Alert to that effect (including identification of the relevant phase) via its HAN Interface.

5.14.2.5   RMS voltage swell detection

ESME shall be capable of detecting when the RMS voltage for phase [n] is continuously above the *RMS Voltage Swell Threshold(5.6.3.38)* for longer than the *RMS Voltage Swell Measurement Period*(*5.6.3.36*) and on detection:

    i.   generating an entry to that effect (including identification of the relevant phase) in the *Event Log*(*5.6.4.16*); and

    ii.   sending an Alert to that effect (including identification of the relevant phase) via its HAN Interface.

5.14.2.6   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 the UTC date and time when the Supply via phase [n] is restored and:

    i.   generating entries to that effect in the *Event Log*(*5.6.4.16*);

    ii.   following restoration of the Supply via phase [n], sending an Alert to that effect via its HAN Interface; and

    iii.   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, sending an Alert that Supply via phase [n] has been restored via its HAN Interface containing details of the dates and times of interruption and restoration.

5.15   Data Requirements

5.15.1   Configuration Data

5.15.1.1   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.

5.15.1.2   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.

5.15.1.3   Phase [n] Average RMS Voltage Measurement Period

The length of time in minutes over which the RMS voltage is averaged for phase [n].

5.15.2   Operational Data

5.15.2.1   Phase [n] Average RMS Over Voltage Counter

The number of times the average RMS voltage for phase [n], as calculated in *section 5.14.2.1*, has been above the *Phase [n] Average RMS Over Voltage Threshold*(*5.15.1.1*) since this counter was last reset.

5.15.2.2   Phase [n] Average RMS Under Voltage Counter

The number of times the average RMS voltage for phase [n], as calculated in accordance with *section 5.14.2.1*, has been below the *Phase [n] Average RMS Under Voltage Threshold*(*5.15.1.2*) since this counter was last reset.

5.15.2.3   Phase [n] Average RMS Voltage Profile Data Log

A log for 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*(*5.15.1.3*) 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

5.16 Overview

This Part D sets out the minimum additional physical, functional, interface and data requirements of ESME where one or more Auxiliary Load Control Switches are installed within ESME.

5.17 Functional Requirements

5.17.1 Switching Auxiliary Loads

ESME shall be capable of monitoring the *Auxiliary Load Control Switch [n] Calendar*(*5.6.3.1*) 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 [n] Calendar*(*5.6.3.1*).

When switching Auxiliary Loads as set-out in this *section 5.17.1*, ESME shall be capable of:

  i. applying the *Randomised Offset*(*5.6.3.29*);
  ii. adjusting for Local Time; and
  iii. setting the *Auxiliary Load Control Switch [n] - Status*(*5.19.2.1*) to open and closed.

5.18 Interface Requirements

5.18.1 User Interface Commands

5.18.1.1 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 [n] Calendar*(*5.6.3.1*).

In executing the command ESME shall be capable of generating an entry to that effect in the *Event Log*(*5.6.4.16*).

5.18.2 HAN Interface Commands

5.18.2.1 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 [n] Calendar*(*5.6.3.1*).

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.

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In executing the Command, ESME shall be capable of updating the corresponding *Auxiliary Load Control Switch [n] - Status*(*5.19.2.1*) to indicate whether the switch is now open or closed.

5.18.2.2   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 [n] Calendar*(*5.6.3.1*).

In executing the Command, ESME shall be capable of updating the corresponding *Auxiliary Load Control Switch [n] - Status*(*5.19.2.1*) to indicate whether the switch is now open or closed.

5.18.2.3   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 [n] Calendar*(*5.6.3.1*).

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 updating the corresponding *Auxiliary Load Control Switch [n] - Status*(*5.19.2.1*) to indicate whether the switch is now open or closed.

5.19   Data Requirements

5.19.1   Configuration Data

5.19.1.1   Auxiliary Load Control Switch [n] Description

For each Auxiliary Load Controlled Switch [n], a description of the type of controlled load connected, and the switch type.

5.19.2   Operational Data

5.19.2.1   Auxiliary Load Control Switch [n] - Status

The current status (being "open" or "closed") of Auxiliary Load Control Switch [n] as commanded by ESME.

5.19.2.2   Auxiliary Load Control Switch [n] - Event Log

A log for storing UTC date and time stamped entries for switching events for Auxiliary Load Control Switch [n].

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Part E - Boost Button

5.20 Overview

This Part E sets out the minimum additional physical, functional, interface and data requirements of ESME where a Boost Button is installed within ESME.

5.21 Functional Requirements

5.21.1 User Interface Commands

In executing the Commands in this *section 5.21.1* ESME shall be capable of recording UTC date and time at the beginning and end of any Boost Period in the *Boost Button Event Log*(*5.22.3.1*).

5.21.1.1 Activate Boost Period

A Command to cause the Auxiliary Load Control Switch(es) specified in *Boost Button Control [n]*(*5.22.2.1*) to close for 15 minutes and then to revert to normal operation in accordance with the *Auxiliary Load Control Switch [n] Calendar*(*5.6.3.1*).

ESME shall only be capable of executing this Command if no Boost Period is currently active.

5.21.1.2 Cancel Boost Period

A command to cause the Auxiliary Load Control Switch(es) specified in *Boost Button Control [n]*(*5.22.2.1*) to revert to normal operation in accordance with the *Auxiliary Load Control Switch [n] Calendar*(*5.6.3.1*).

ESME shall only be capable of executing this Command if:

   i.   a Boost Period is active; and
  ii.   the duration of the active Boost Period prior to execution of the command is 60 minutes.

In executing the Command ESME shall be capable of generating an entry in the *Boost Button Event Log*(*5.22.3.1*) to the effect that the active Boost Period has been cancelled.

5.21.1.3 Extend Boost Period

A Command to cause the Auxiliary Load Control Switch(es) specified in *Boost Button Control [n]*(*5.22.2.1*) to remain closed for an additional 15 minutes, and then to revert to normal operation in accordance with the *Auxiliary Load Control Switch [n] Calendar*(*5.6.3.1*).

ESME shall only be capable of executing this Command if:

   i.   a Boost Period is active; and
  ii.   the duration of the active Boost Period prior to execution of the command is 15, 30 or 45 minutes.

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5.22 Data Requirements

5.22.1 Constant Data

5.22.1.1 Boost Button Availability
A data item to identify if ESME has a configured Boost Button.

5.22.2 Configuration Data

5.22.2.1 Boost Button Control [n]
A data item to identify whether Auxiliary Load Control Switch [n] is to be controlled by the Boost Button.

5.22.3 Operational Data

5.22.3.1 Boost Button Event Log
A single log for storing entries for the most recent 25 Boost Periods including the UTC date and time of the beginning and end of the Boost Period.

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6 In Home Display Technical Specification

6.1 Overview

This section defines the minimum physical requirements, minimum functional requirements, minimum interface requirements and minimum data requirements of an In-home Display installed to comply with the smart metering roll-out licence conditions (standard licence condition 34 of gas supply licences and standard licence condition 40 of electricity supply licences).

6.2 Physical requirements

An IHD shall as a minimum include the following components:

i. a Data Store;
ii. a HAN Interface; and
iii. a User Interface.

An IHD shall be mains powered and shall be capable of operating at a nominal voltage of 230VAC and consuming no more than an average of 0.6 watts of electricity under normal operating conditions.

An IHD shall:

iv. display the *IHD Identifier(6.5.1.1)*;

and be capable of:

v. joining a ZigBee network utilising the 2400 – 2483.5 MHz harmonised frequency band; and
vi. supporting Communications Links based on ZigBee SEP v1.

The IHD 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:

vii. Personal Data;
viii. Consumption data used for billing;
ix. Security Credentials;
x. Random Number Generator;
xi. Crytographic Algorithms; and
xii. Firmware and data essential for ensuring its integrity,

stored or executing on the IHD.

An 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:

xiii. sight;

xiv.   memory and learning ability;
 xv.   perception and attention; or
xvi.   dexterity.

6.3   Functional requirements

This section defines the minimum functions that an IHD shall be capable of performing.

6.3.1   Communications

An IHD shall be capable of establishing Communications Links via its HAN Interface.

An IHD shall be capable of ensuring that the security characteristics of all Communications Links it establishes meet the requirements set-out in *section 6.3.5.2*.

6.3.1.1   Communications Links with ESME and a Gas Proxy Device via the HAN Interface

An IHD shall be capable of establishing Communications Links via its HAN Interface with one ESME and one Gas Proxy Device.

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 Device.

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 6.3.2*, *6.3.3* and *6.3.4*) to indicate that the information may be out of date.

6.3.2   General Information

An IHD shall be capable immediately upon establishment of a Communications Link with ESME and a Gas Proxy Device (as set-out in *section 6.3.1.1*), of providing the following information on its User Interface and providing updates of any changes to the information every 10 seconds thereafter.

6.3.2.1   Connection Link Quality

The signal strength of its HAN Interface.

6.3.2.2   Local Time

Time as UTC with adjustment for British Summer Time.

6.3.3   Information pertaining to the Supply of gas to the Premises

An IHD shall be capable immediately upon establishment of a Communications Link with a Gas Proxy Device (as set-out in *section 6.3.1.1*), of providing the following information[2] on its User Interface and providing timely updates of any changes to the information thereafter.

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[2] 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.

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

6.3.3.1 Active Tariff Price [NUM]
The active Tariff Price for Consumption in Currency Units per kWh.

6.3.3.2 Aggregate Debt [NUM]
The sum of all time-based and payment-based debt registers when GSME is operating in Prepayment Mode.

6.3.3.3 Aggregate Debt Recovery Rate [NUM]
The sum of the Time-based Debt Recovery rates when GSME is operating in Prepayment Mode.

6.3.3.4 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.

6.3.3.5 Customer Identification Number [NUM]
A number issued to the IHD for display on the User Interface.

6.3.3.6 Emergency Credit Balance [NUM]
The emergency credit balance where Emergency Credit is activated (including a clear indication that Emergency Credit has been activated).

6.3.3.7 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.

6.3.3.8 Low Credit Alert
An indication that the combined *Meter Balance [NUM]*(*6.3.3.9*) and *Emergency Credit Balance [NUM]*(*6.3.3.6*) has fallen below a low credit threshold.

6.3.3.9 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](6.3.3.6)*). 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.

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

6.3.4   Information pertaining to the Supply of electricity to the Premises

An IHD shall be capable, upon establishment of a Communications Link with ESME (as set-out in *section 6.3.1.1*), of providing the following information[3] 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.

6.3.4.1   Active Tariff Price [NUM]
The active Tariff Price for Consumption in Currency Units per kWh.

6.3.4.2   Aggregate Debt [NUM]
The sum of all time-based and payment-based debt registers when ESME is operating in Prepayment Mode.

6.3.4.3   Aggregate Debt Recovery Rate [NUM]
The sum of the Time-based Debt Recovery rates when ESME is operating in Prepayment Mode.

6.3.4.4   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.

6.3.4.5   Customer Identification Number [NUM]
A number issued to the IHD for display on the User Interface.

6.3.4.6   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).

6.3.4.7   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.

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[3] 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.

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.

6.3.4.8   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.

6.3.4.9   Low Credit Alert
An indication that the combined *Meter Balance [NUM]*(*6.3.4.10*) and *Emergency Credit Balance [NUM]*(*6.3.4.6*) has fallen below a low credit threshold.

6.3.4.10   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 [NUM]*(*6.3.4.6*)). 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.

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

6.3.4.12   Power Threshold Status [AMB]
An indication of the level of Active Power Import as high, medium or low.

6.3.5   Security

6.3.5.1   General
An 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.

6.3.5.2   Communications
An 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.

6.4   Interface Requirements
This section sets out the minimum required interactions which an IHD shall be capable of undertaking with ESME and a Gas Proxy Device as appropriate via its HAN Interface.

6.4.1   Receipt of information via the HAN Interface
An IHD shall be capable, immediately upon establishment of a Communications Link with ESME and a Gas Proxy Device (as set-out in *section 6.3.1.1*) of:

i.   receiving information (and updates of any changes of this information every 10 seconds thereafter) required to meet the display requirements set-out in *section 6.3.2*;

ii. receiving information (and timely updates of any changes to the information thereafter) required to meet the display requirements set-out in *section 6.3.3*; 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 6.3.4*.

6.5   Data requirements

This section describes the minimum information which an IHD is to be capable of holding in its Data Store.

6.5.1   Constant data

Describes data that remains constant and unchangeable at all times.

6.5.1.1   IHD Identifier

A globally unique identifier used to identify the IHD.

7   Glossary

7.1.1.1   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).

7.1.1.2   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).

7.1.1.3   Alarm
A short-lived audible signal.

7.1.1.4   Alert
A message generated by a Device including in response to a problem or the risk of a potential problem.

7.1.1.5   Ambient
The representation of information in a form that can be understood at a glance.

7.1.1.6   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.

7.1.1.7   Arm Code
A cryptographic code used to convey an Arm Supply Command through to GSME or ESME.

7.1.1.8   Authentication
The method used to confirm the identity of entities or Devices wishing to communicate and "Authenticated" and "Authenticity" shall be construed accordingly.

7.1.1.9   Authorisation
The process of granting access to a resource and "Authorised" shall be construed accordingly.

7.1.1.10   Auxiliary Load Control Switch
A switch controlling a load on the Supply.

7.1.1.11   Battery
A component that produces electricity from a chemical reaction.

7.1.1.12   Block Counter
Storage for recording Consumption for the purposes of combined Time-of-use and Block Pricing.

7.1.1.13   Block Pricing
A pricing scheme used in conjunction with Time-of-use Pricing where Price varies based on Consumption over a given time period.

7.1.1.14 Block Register
A Tariff Register for recording Consumption for the purposes of combined Time-of-use and Block Pricing.

7.1.1.15 Block Tariff
A Tariff for Block Pricing.

7.1.1.16 Certificate
An electronic document that binds an identity, and possibly other information, to a Public Key.

7.1.1.17 Certification Authority (CA)
A trusted entity which issues Certificates.

7.1.1.18 Certificate Signing Request
A message requesting the issue of a Certificate by a Certification Authority.

7.1.1.19 Clock
A timing mechanism operating the UTC primary time standard which has a minimum resolution of 1 second.

7.1.1.20 Command
An instruction to perform a function received via the User Interface or received or sent via the HAN Interface or any other interface.

7.1.1.21 Communications Link
The 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.

7.1.1.22 Confidentiality
Ensuring that information, in transit or at rest, is not accessible by Unauthorised parties through either unintentional means or otherwise.

7.1.1.23 Contact Details
The name and contact telephone number of the current gas or electricity supplier (as appropriate).

7.1.1.24 Consumer
A person who lawfully resides at the premises that is being Supplied.

7.1.1.25 Consumption
Means in the context of GSME Gas Consumption and in the context of ESME Electricity Consumption.

7.1.1.26 Credit Mode
A mode of operation of GSME or ESME whereby Consumers are billed for some or all of their Consumption retrospectively.

7.1.1.27 Critical Commands
Those Commands which relate to supply being affected, financial fraud or the compromise of Consumer Premises equipment security.

7.1.1.28 Cryptographic Algorithm
An algorithm for performing one or more cryptographic functions which may include Encryption; Decryption; digitally signing or Hashing of information, data, or messages; or exchange of Security Credentials.

7.1.1.29 Currency Units
The units of monetary value in major and minor units.

7.1.1.30 Customer Identification Number
A number used to verify that an individual requesting a service is present in the Consumer Premises.

7.1.1.31 Data Integrity
The state of data where there is assurance that it has not been altered by Unauthorised parties.

7.1.1.32 Data Store
An area of GSME or ESME capable of storing information for future retrieval.

7.1.1.33 Day
The period commencing 00:00:00 Local Time and ending at the next 00:00:00.

7.1.1.34 Decryption
The process of converting Encrypted information by an Authorised party to recover the original information and like terms shall be construed accordingly.

7.1.1.35 Device
A physically distinct part of a system.

7.1.1.36 Digital Signature
A piece of information appended to a message which is created using the sender's Private Key, 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 is as sent by the sender and that the sender sent the message.

7.1.1.37 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.

7.1.1.38 Domestic Premises
Shall in the context of GSME have the meaning given to that term in standard condition 1 of gas supply licences, and in the context of ESME shall have the meaning given to that term in standard condition 1 of electricity supply licences.

7.1.1.39 Electricity Consumption
The Active Energy Imported into the Premises and "Consumed" shall be construed accordingly.

7.1.1.40 Electricity Meter
An instrument used to measure, store and display the amount of electrical energy passing through an electrical circuit or circuits.

7.1.1.41   Elliptic Curve DSA
Means the Elliptic Curve Digital Signature Algorithm forming part of the NSA Suite B standard (see *http://www.nsa.gov/ia/programs/suiteb_cryptography/index.shtml*).

7.1.1.42   Elliptic Curve DH
Means the Elliptic Curve Diffie–Hellman forming part of the NSA Suite B standard (see *http://www.nsa.gov/ia/programs/suiteb_cryptography/index.shtml*).

7.1.1.43   Emergency Credit
Credit that can be made available to ensure that the Supply is not interrupted in circumstances (including situations of emergency) defined by the Supplier to the Premises.

7.1.1.44   Enable
In the context of GSME the act of restoring the flow of gas to the Premises by opening the Valve and in the context of ESME the act of restoring the flow of electricity to the Premises by closing the Load Switch and like terms shall be construed accordingly.

7.1.1.45   Encryption
The process of converting information in order to make it unintelligible other than to Authorised parties and like terms shall be construed accordingly.

7.1.1.46   Energy Consumption
The amount of gas in kWh or electricity in kWh supplied to the Premises.

7.1.1.47   ESME
Electricity Smart Metering Equipment.

7.1.1.48   Export
The flow of electricity out of the Premises, and like terms shall be construed accordingly.

7.1.1.49   Firmware
The embedded software programmes and/or data structures that control electronic Devices.

7.1.1.50   Gas Consumption
The volume of gas in cubic metres (m^3) supplied to the Premises and "Consumed" shall be construed accordingly.

7.1.1.51   Gas Meter
An instrument designed to measure, memorise and display the quantity of gas (volume or mass) that has passed through it.

7.1.1.52   Gas Proxy Device
A Device used to store GSME and related data.

7.1.1.53   GSME
Gas Smart Metering Equipment.

7.1.1.54   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.

7.1.1.55   Home Area Network Interface (HAN Interface)

A component of GSME, ESME, IHD or other Consumer Device that is capable of sending and receiving information.

7.1.1.56   Key

Data used to determine the output of a cryptographic operation.

7.1.1.57   Keypad

Separate buttons for the entry of digits 0 to 9 and the symbols # and *.

7.1.1.58   Key Agreement

A means to calculate a shared key between two parties.

7.1.1.59   IHD

In-home Display.

7.1.1.60   IHD Source Device

An ESME or Gas Proxy Device.

7.1.1.61   Import

The flow of electricity into the Premises, and like terms shall be construed accordingly.

7.1.1.62   Installation Credentials

Information sufficient for a remote party to confirm that a Device is the device with the identity it asserts during the installation process.

7.1.1.63   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.

7.1.1.64   Local Time

Time as UTC with adjustment for British Summer Time.

7.1.1.65   Message Authentication

The process by which the 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.

7.1.1.66   MPAN

Meter Point Administration Number.

7.1.1.67   MPRN

Meter Point Reference Number.

7.1.1.68   Outcome

The result of executing a Command, expressed as success or failure.

7.1.1.69   Payment-based Debt Recovery

A means of recovering debt based on a percentage of a payment.

7.1.1.70   Personal Data

Any information comprising Personal Data as such term is defined in the Data Protection Act 1998 at the date the SMETS is designated by the Secretary of State.

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7.1.1.71 Polyphase Electricity Metering Equipment
Electricity metering equipment containing three measuring elements suitable for a polyphase supply with up to three phases and neutral.

7.1.1.72 Premises
The premises which is Supplied.

7.1.1.73 Prepayment Mode
A mode of operation of GSME or ESME whereby payment is generally made in advance of Consumption.

7.1.1.74 Privacy PIN
A number used by the Consumer to access Personal Data on the User Interface of ESME and GSME.

7.1.1.75 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.

7.1.1.76 Private Key
The key in a Public-Private Key Pair which must be kept secure by the entity to which it relates.

7.1.1.77 Public-Private Key Pairs
Two mathematically related numbers that are used in Cryptographic Algorithms.

7.1.1.78 Public Key
The key in a Public-Private Key Pair which can be distributed to other parties.

7.1.1.79 Random Number Generator
A component used to generate a sequence of numbers that can be interpreted as numbers, letters or symbols that lack any predictable pattern.

7.1.1.80 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).

7.1.1.81 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).

7.1.1.82 Replay Attack
A form of attack on a Communications Link in which a valid information transmission is repeated through interception and retransmission.

7.1.1.83 Response
Sent on, or received from the User Interface or HAN Interface or any other interface containing information in response to a Command.

7.1.1.84 RMS
Root mean squared.

7.1.1.85 Role
The entitlement of a party to execute one or more Commands.

7.1.1.86   Secure Perimeter
A physical border surrounding GSME or ESME which is capable of preventing and detecting physical access from Unauthorised persons, and is capable of preventing Unauthorised communications.

7.1.1.87   Security Credentials
Information used to identify and/or Authenticate a Device, party or system.

7.1.1.88   Sensitive Event
Each of the following events:

   i.   a failed Authentication or Authorisation;
   ii.   a change in the executing Firmware version;
   iii.   the detection of Unauthorised Physical Access or any other occurrence that has the potential to put Supply at risk and/or compromise the integrity of ESME or GSME;
   iv.   unusual numbers of malformed, out-of-order or unexpected Commands received;
   v.   a change of credit which is not reflective of normal Consumption; and
   vi.   any other threat to its security detected by GSME or ESME.

7.1.1.89   SHA-256
The Hashing algorithm of that name approved by the NIST (see *http://csrc.nist.gov/groups/ST/toolkit/secure_hashing.html*).

7.1.1.90   Single Electricity Metering Equipment
Electricity metering equipment containing a single measuring element.

7.1.1.91   Smart Metering Equipment Technical Specifications (SMETS)
The document designated by the Secretary of State to describe the minimum capabilities of equipment installed to satisfy the roll-out licence conditions.

7.1.1.92   Supplier
Means 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.

7.1.1.93   Supply
The supply of gas to Premises for GSME and the supply of electricity to Premises for ESME and "Supplied" shall be construed accordingly.

7.1.1.94   Tamper Event
The detection of Unauthorised Physical Access or any other occurrence that has the potential to put Supply at risk and/or compromise the Integrity of GSME or ESME.

7.1.1.95   Tariff
The structure of Prices and other charges relating to a Supply.

7.1.1.96   Tariff Register
Storage for recording Consumption for the purposes of Time-of-use Pricing.

7.1.1.97   Time-based Debt Recovery
A means of recovering debt based on an amount in Currency Units per unit time.

7.1.1.98 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.

7.1.1.99 Time-of-use Pricing
A pricing scheme with one or more Time-of-use Bands.

7.1.1.100 Time-of-use Tariff
A Tariff for Time-of-use Pricing.

7.1.1.101 TOU
Time-of-use.

7.1.1.102 Transactional Atomicity
A description of the type and order of the consitiuent parts of a Command.

7.1.1.103 Trusted Source
A source whose identity is confidently and reliably validated**.**

7.1.1.104 Twin Element Electricity Metering Equipment
Electricity metering equipment containing two measuring elements.

7.1.1.105 Type 1 Device
A Device connected to the HAN that is allowed to issue or perform a range of HAN Interface Commands and can access the information stored in GSME, ESME or a Gas Proxy Device.

7.1.1.106 Type 2 Device
An IHD or any other Device connected to the HAN that provides Consumer access to the information stored in GSME, ESME or a Gas Proxy Device.

7.1.1.107 Unauthorised
Means not Authorised.

7.1.1.108 Unauthorised Physical Access
Unauthorised access to the internal components of any Device within GSME or ESME through the physical outer casing.

7.1.1.109 Unique Transaction Reference Number (UTRN)
A cryptographic code used to convey credit to GSME or ESME operating in Prepayment Mode.

7.1.1.110 User Interface
An interface for providing local human interaction with GSME, ESME or IHD which supports input, visual and audible output.

7.1.1.111 UTC
Coordinated Universal Time.

7.1.1.112 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.

7.1.1.113 Week

The seven Day period commencing 00:00:00 Monday Local Time and ending at 00:00:00 on the immediately following Monday.