ENA Functional Requirements for Electricity Smart Meters

Introduction

This document provides a high-level summary of the functionality that will be required from a domestic / SME smart meter in order to maximise opportunities arising from a wide-scale roll-out of smart metering in terms of providing an enhanced more efficient network management capability and a significantly improved level of service to connected customers. The general presumption here is that SMEs (profile classes 3 and 4) will generally be provided with a smart meter of similar functionality to a domestic smart meter though it is acknowledged that some SMEs will be permitted to opt for an Advanced Meter (as prescribed for larger businesses (profile classes 5 – 8) by April 2014).

The overall functionality specified within the tables below is based on the ENA - Summary of Electricity Network Operator Functionality Requirements for a Domestic Smart Metering System as included in ENA's response to the DECC consultation in 2009.

However, since that response was submitted, ENA has undertaken a significant programme of work in conjunction with Engage Consulting Ltd. in order to thoroughly review these Requirements (for both electricity and gas) using Use Case Analyses to examine from first principles the requirement for functionality in terms of:

- business need and overall benefits;
- data flows; parties involved;
- actions triggered by the data; and
- the expected impact of those actions.

In specifying the Requirements of the smart metering system, it has been acknowledged that due consideration must necessarily be given to the possible bandwidth and latency requirements of the communications system (which will ultimately depend on the technical solution). A Data Traffic Analysis study has therefore been conducted which has provided an assessment of:

- average and likely peak data volumes;
- the degree of concurrency in terms of the volumes of data likely to be transmitted simultaneously;

- the degree to which volumes might be concentrated within a given area at any given time (which might be critical in terms of the communications technical solution); and
- the required latency to ensure that the intended functionality will be effective.

Applications which might be expected to require excessive and/or disproportionately high incremental costs of communication bandwidth and latency have been excluded. Overall, the Data Traffic Analysis indicates that the incremental requirements for data volumes, frequency and immediacy (and hence the requirements in terms of bandwidth and latency) will not be unduly onerous. Security and Privacy requirements arising from the data types and flows have also been studied.

This comprehensive analysis has led to a more detailed and refined set of Requirements which it is expected will support both the issue by Ofgem E-Serve of a prospectus during 2010 and the development of a full technical specification for the smart metering system. The related documents can be accessed via the ENA website:

http://2010.energynetworks.org/

In parallel with the work undertaken through Engage Consulting Ltd. ENA has commissioned a study through Imperial College / SEDG to assess the 'Benefits of Advanced Smart Metering for Demand Response based Control of Distribution Networks'. This study has identified very significant benefits, in terms of avoided electricity network investment, if smart meters are provided with the functionality specified by the ENA (electricity) Requirements and DNOs (in conjunction with other relevant parties such as Suppliers) are able to access and act upon the data and customers respond as anticipated. The report is also available via the above ENA website link.

These Requirements are subject to confirmation of costs of providing the functionality as specified. The updated Requirements have therefore been shared with meter manufacturers (through BEAMA) in order to provide an indication of the incremental costs of providing the required functionality. In one particular case (DNO 17 below) the Requirement will also be subject to a technical feasibility study. However in all other cases these Requirements have been informed by reference to the functionality which is understood to be possible to incorporate within a smart meter at low or zero incremental cost.

The following is a highly summarised view of the updated Requirements that have been derived from the above work. However, the necessary cross-references to the more detailed Requirements and Use Cases which provide the necessary detail to inform the technical specification of the smart metering system are included.

Summary of Updated ENA Functional Requirements for Smart Metering

Updated DNO Refs:	DNO: 02.01, 02.02, 02.04, 02.05, 02.06, 02.07, 02.08, 02.12 COM: 01.02, 01.03, 01.04	Original ENA Ref:	DNO 01
Description:	The meter will have 4-quadrant measurement capability.		
Rationale:	With the anticipated increase in demand-side energy resources and new types of domestic appliances which are expected to give rise to lower power factors - such as: heat pumps, domestic air cooling systems and compact fluorescent lighting, it will be increasingly important to be able to measure real and reactive power flows in terms both of import and export. Requirements apply to profile classes 1, 2, 3 & 4. For polyphase meters supporting maximum demand tariffs (typically profile classes 5 – 8) it must be possible to also separately derive maximum (average half-hour) kVA for import and export.		
Context:	Each register will record average (half-hourly) period readings of either average RMS real and reactive current or equivalent average kW / kVAr. Notwithstanding network management information requirements, DNOs may need to apply differential DUoS and GDUoS charges and may wish to apply power factor penalty charges.		
Key Benefits:	• Supports application of import/export tariffs • Supports tariffs incorporating reactive power charges (or penalties) to reflect network impact of poor power factor and/or encourage power factor correction • Provides basis for introducing more dynamic (and localised) DUoS tariffs to incentivise demand response as an alternative to system reinforcement • Facilitates higher utilisation / more efficient use of existing networks		
Use Case Ref:	1, 2, 3, 4, 5, 20		
Version:	3	Date:	Apr 2010

Updated DNO Refs:	DNO: 02.01, 02.02, 02.05, 02.07 COM: 01.01, 02.01, 02.02, 02.04	Original ENA Ref:	DNO 02
Description:	The meter will have the capability to support Feed-in Tariffs insofar as these might depend on measurement of output from demand side energy sources – including micro-generation and (in future) mobile battery storage (e.g. BEV / PHEV vehicles) and ultimately fuel cells.		
Rationale:	In order to support Feed-in Tariffs it will be essential to measure (or otherwise derive) electrical energy produced by 'demand-side' energy resources (which will not be subject to ROC metering). Since such energy may be wholly or partially absorbed by demand side appliances, it will not be possible to detect this quantity directly from the import/export registers. Moreover, it will be increasingly important for DNOs to be able to track growth in 'latent' demand, which is the additional demand (normally supplied by demand-side generation or other energy sources) that would be immediately placed on a network upon re-energisation following an outage (i.e. following automatic disconnection of demand-side generation or other energy source through 'loss-of-mains' protection).		
Context:	Feed-in Tariffs are assumed to require a separate meter to measure DG / micro-generation output.		
Key Benefits:	• Confirmation of installed parallel connected energy source • Ability to assess latent demand • Ability to quickly assess network impact of proposed micro-generation installations • Improved service to customers installing micro-generation • Identification of potential need for active network management measures (including localised automatic voltage control) • Ability to understand and manage risks associated with mass disconnection of DG under various scenarios ranging from local network faults to system low frequency events		
Use Case Ref:	2, 3, 4, 5, 8, 9, 10, 20		
Version:	3	Date:	Apr 2010

Updated DNO Refs:	DNO: 02.01, 02.02, 02.05, 02.07	Original ENA Ref:	DNO 03
Description:	The metering system will provide demand (import/export) and demand-side generation power flow profile data to authorised parties via the communications system		
Rationale:	With the anticipated increase in distributed generation and demand side energy resources (including micro-generation) and with the anticipated electrification of heat and transport in the longer term, monitoring load profiles will become increasingly important in order to ensure that network capacity is fully utilised and that network reinforcement and/or demand relief measures (including possibly DSM) can be put in place before network components become overloaded. Extended periods of negligible demand would be a possible indication of an idle service prompting the DNO to take appropriate action; including disconnection of the service in order to avoid danger if the property is abandoned.		
Context:	Data is required primarily for planning purposes but 'near-real-time' access may become necessary if DNOs are to transition to DSOs acting as technical aggregators. Half-hourly period average RMS real and reactive current (or equivalent kW / kVAr) profiles for import and export will be captured and maintained by the metering system for a period of 3 months. This will permit systematic transfer of load (import / export) and generation (from demand-side energy sources) profiles into DNO network management systems (if required) for archiving purposes (i.e. in order for annual profiles to be studied). In addition, hi/lo excursion events (a function of magnitude and duration of excursion above a de-minimus limit) will be time-stamped.		
Key Benefits:	• Ability to capture highly disaggregated load profiles which will be necessary to identify localised stresses on LV (tapered) networks • Avoidance of unnecessary reinforcement due to enhanced assessment and management of capacity headroom • More informed identification and forecasting of reinforcement need leading to efficient and timely network investment • Identification of opportunities for power factor management as a cost-efficient means of releasing network capacity • Faster, better informed, responses to requests for additional demand / generation and new connections • Avoidance of unnecessary reinforcement due to enhanced assessment of capacity headroom • Ability to actively manage networks including perform system balancing (constraint management) actions • Enables provision of ancillary services (e.g. to NETSO) to optimise operation of wider end-to-end electricity supply chain		
Use Case Ref:	1, 2, 3, 4, 5, 7, 10, 20		
Version:	4	Date:	Apr 2010

Updated DNO Refs:	DNO 06.05 COM: 01.01, 02.01, 02.02, 02.04	Original ENA Ref:	DNO 04
Description:	The metering system will support: 1. reliable two-way communication, via the WAN, between the meter and authorised parties (including DNOs) of periodic (half-hourly) data and other defined information within defined timescales; and 2. secure two-way communication, via the HAN, between the meter and in-premise devices connected via the HAN interface		
Rationale:	The requirement is for the metering system to be able to support communication functions such as: active network management, demand-side management, planned power outage notification, meter status, alarm / alert functions, etc.		
Context:	A smart meter might typically be provided with 4 channels as standard. Depending on the design of the CCP system, in order to support the above functions one or more dedicated 'DNO' channels might be necessary (alternatively DNOs would have unencumbered access to the relevant data at a 'centrally' located head-end). It will be essential that the smart metering system provides adequate communication functionality in terms of: latency, bandwidth, reliability, integrity and real-time accessibility.		
Key Benefits:	• Access to network loading and voltage information to support both planning and active network management functions • Enablement of alarm functionality (e.g. statutory voltage limits, power outage, tamper, etc.) • Enablement of demand response as a means both of controlling peak demands (and hence minimising reinforcement need) and of residual balancing support • Enablement of localised automatic voltage control (accessing voltage measurements from the smart meter) • Messaging capability (via the IHD) – for example information regarding planned electricity maintenance works / shutdowns • Enablement of meter polling to ascertain energisation status (for example to check supply restoration) • Access to power outage duration data (e.g. to assess GSS performance and support IIS reporting)		
Use Case Ref:	8, 9, 10, 12		
Version:	4	Date:	Apr 2010

Updated DNO Refs:	COM: 01.05, 02.03, 02.04	Original ENA Ref:	DNO 05
Description:	The meter will be able to interface with the full range of communication technologies embraced by the overall communications system		
Rationale:	Various communication options are available, all of which have strengths and weaknesses. For example, PLC provides a potentially low-cost option for low priority data transfer and has some important synergies for DNOs in terms of data aggregation and integration with upstream measurement systems (for example at data concentrators, especially if sited at distribution substations). On the other hand, PLC may not be suitable for all two-way communications – especially high priority signals such as those initiating rapid demand reductions; for example where a responsive demand contract/tariff is in place. In practice it is anticipated that a range of LAN/WAN communication technologies will be utilised reflecting geographic variations in terrain and existing (or viable) communications systems coverage. BPL, GPRS, UHF radio are all likely to be adopted as part of the overall communications system.		
Context:	The objective is not to prescribe the communication systems(s) but to ensure that viable systems are not precluded in terms of the capability of the meter interface. If PLC is adopted for the 'last mile', then potential interference with 'demand side' communications would need to be managed through strict adherence to BS EN 50065 which provides for frequency banding to separate 'demand' and 'supply' side communication systems. If PLC is adopted as part of the overall communications system then an industry standard will need to be agreed. It is anticipated that the smart meter communication gateway will be modular permitting local variations and facilitating replacement to cater for an evolving communications system		
Key Benefits:	• Ability to adopt the optimum communications system irrespective of geography • Avoids lock-in to the initial comms solution which might prevent evolution • Provides for greater options in the design of the central comms system and hence cost-benefit optimisation		
Use Case Ref:	N/A		
Version:	3	Date:	Apr 2010

Updated DNO Refs:	DNO 01.01, 01.02, 01.03	Original ENA Ref:	DNO 05a
Description:	The smart metering system will permit mapping of the smart meter and associated information flows to the electricity network.		
Rationale:	A key 'smart grid' benefit is being able to relate smart metering data to specific elements of the electricity network; for example mapping meters (MPANs) and their load profiles to individual LV cables and HV/LV substations. Ideally it would be possible to associate MPANs to individual phases of a 3 (or 2) phase system and this might be expedited through close co-ordination with DNOs during roll-out.		
Context:	Ease of mapping might be determined by the chosen WAN communications system. For example PLC might facilitate this requirement, especially if local data concentrators were to be sited within local HV/LV electricity distribution substations where an interface to the DNO telecommunications / SCADA system might be more easily facilitated. If PLC is not adopted then alternative means of mapping MPANs to LV networks will be need to be facilitated, for example by the setting location (GPS derived co-ordinates) on registration Note: some additional investment in DNOs' GIS/CRM systems might be necessary to obtain the full benefit of this functionality and network reconfigurations (temporary and permanent) will need to be accommodated through the DNO's systems (e.g. GIS / NMS / Network Models).		
Key Benefits:	• Network connectivity (mapping of meters to network nodes and ideally individual phases of multi-phase systems) is fundamental to all DNO functional requirements; for example it enables: – aggregated network demand profile data to be derived from individual meters (i.e. to derive power flows on individual network branches) – voltage profiles to be mapped to individual network nodes – identification of extent of localised network outages by meter polling – derivation of capacity headroom and/or need for reinforcement or active network management actions		
Use Case Ref:	Non specifically but an enabler of all Use Case functionalities		
Version:	3	Date:	Apr 2010

<table>
<tr><td>Updated DNO Refs:</td><td colspan="2">DNO 04.03</td><td>Original ENA Ref:</td><td>DNO 06</td></tr>
<tr><td>Description:</td><td colspan="4">The meter will support power outage detection by remote interrogation of meter energisation status via the communications system.</td></tr>
<tr><td>Rationale:</td><td colspan="4">A key customer service benefit to be derived from a smart metering system will be the ability to identify customers off supply due to a network fault. Especially under severe storm conditions where there may be multiple over-laying network events it is not always possible to positively identify all faults from customer calls which may in any case be constrained by very high telephone traffic volumes. A consequence is that when identified faults are repaired there may be customers who remain off supply due to an undetected downstream fault. The ability to selectively poll meters following a post-fault repair and restoration would enable DNOs to confirm supply restoration or identify any further potential downstream outages.</td></tr>
<tr><td>Context:</td><td colspan="4">The modus operandi is that the DNO would poll a selection of meters associated with a network which had been re-energised following a repaired fault. Assuming the meter is energised a positive indication would be received. In the event that a meter failed to respond it would be indicative of a potential downstream network fault (or a communications system failure) requiring further investigation. Note: some additional investment in DNOs' GIS/CRM systems might be necessary to obtain the full benefit of this functionality.

A further use of meter polling would be to check meter energisation status following a single reported loss of supply. This would enable the DNO to ascertain if the incoming supply was energised (indicating a possible fault on the customer's installation or a prepayment meter running out of credit) and/or, by polling a number of electrically adjacent meters, whether other premises were affected. (Note: this sets a practical limit on acceptable latency of the communication action – i.e. a maximum of 1 minute latency would be required to address a customer telephone enquiry).</td></tr>
<tr><td>Key Benefits:</td><td colspan="4">• Confirmation of outages not reported through SCADA systems (i.e. LV outages and fuse/auto-sectionaliser protected HV OHL spurs)
• Positive identification of masked faults during storm conditions
• Identification of extent of localised network outages enabling fast response and more effective use of the DNO resources
• Positive confirmation of outages affecting vulnerable customers (e.g. those reliant on artificial ventilators or dialysis machines)
• Positive confirmation of supply restoration (including during sleeping hours when disturbing customers would be unacceptable)
• Improved overall IIS performance</td></tr>
<tr><td>Use Case Ref:</td><td colspan="4">13, 15</td></tr>
<tr><td>Version:</td><td>4</td><td>Date:</td><td colspan="2">Apr 2010</td></tr>
</table>

<table>
<tr><td>Updated DNO Refs:</td><td colspan="2">DNO 05.01, 05.02, 05.04,05.05, 08.01, 08.02, 08.03, 11.01</td><td>Original ENA Ref:</td><td>DNO 07</td></tr>
<tr><td>Description:</td><td colspan="4">The metering system will provide synchronised time-stamped power outage / restoration information to authorised parties via the communications system.</td></tr>
<tr><td>Rationale:</td><td colspan="4">Subject to the necessary complementary development of Information Systems, a future customer service / regulatory reporting benefit to be derived from a smart metering system will be the ability to positively identify occasions and periods of supply interruption. This will also facilitate the accurate reporting of both customer interruptions and customer minutes lost (and short duration interruptions). A further future potential benefit will be positive confirmation of GSS Failures (e.g. >18 hour restorations) to verify customers claims.</td></tr>
<tr><td>Context:</td><td colspan="4">The data must be held within the meter system for at least 3 months allowing sufficient time for periodic transfer of the data into a DNO data archiving system.

Note: benefit realisation depends on virtually complete (at least from a network specific perspective) roll out of smart meters.</td></tr>
<tr><td>Key Benefits:</td><td colspan="4">• Accurate and consistent regulatory reporting of IIS and GSS performance
• Positive confirmation of >18 hour GSS failures
• Identification of worst-served customers at a granular level</td></tr>
<tr><td>Use Case Ref:</td><td colspan="4">15, 16, 20</td></tr>
<tr><td>Version:</td><td>4</td><td>Date:</td><td colspan="2">Apr 2010</td></tr>
</table>

<table>
<tr><td>Updated DNO Refs:</td><td>DNO 05.01, 05.03</td><td>Original ENA Ref:</td><td>DNO 08</td></tr>
<tr><td>Description:</td><td colspan="3">The meter will have the capability if specified as an option (and assisted as necessary by an external auxiliary supply) to transmit a power outage signal to authorised parties via the communications system.</td></tr>
<tr><td>Rationale:</td><td colspan="3">Albeit not anticipated to be an extensively used function (since large scale outages would lead to communications systems being swamped with power outage signals) there is high value in being able to positively and immediately identify outages to vulnerable customers (e.g. those reliant on artificial ventilators or dialysis machines). Receipt of such a signal at the control / call centre would prompt further investigation including polling of electrically adjacent meters to ascertain the extent and nature of the outage. Armed with this information, the control / call centre operative would be able to determine the appropriate deployment of field resources and whether there was a need to alert social / support services.</td></tr>
<tr><td>Context:</td><td colspan="3">The meter would need to have a ‘last gasp’ signalling capability of sufficient capacity to ensure reliable transmission of the signal to the control / call centre. This might entail the connection of an auxiliary battery or super-capacitor if the standard battery back-up is of insufficient capacity. A suitable facility to connect such a device must be incorporated. (Note that while alternative arrangements such as plug-in devices using the customer’s telephone line for communication have been trialled previously, there have been issues with the power outage device being unplugged and sending a false alarm).
Note 1: consideration will need to be given both to effecting time-delays in signalling to enable automation / auto-reclose operations to complete before sending the alarm and to the communications system impact of simultaneous signalling in the event of a wide-scale system outage.
Note 2: some additional investment in DNOs’ GIS/CRM systems might be necessary to obtain the full benefit of this functionality.</td></tr>
<tr><td>Key Benefits:</td><td colspan="3">• Signalling of outages not reported through SCADA systems (i.e. LV outages and fuse/auto-sectionaliser protected HV OHL spurs)
• Immediate identification of extent of localised network outages enabling even faster response (compared with DNO 06)
• Immediate identification of outages affecting vulnerable customers (e.g. those reliant on artificial ventilators or dialysis machines)</td></tr>
<tr><td>Use Case Ref:</td><td colspan="3">14</td></tr>
<tr><td>Version:</td><td>4</td><td>Date:</td><td>Apr 2010</td></tr>
</table>

Updated DNO Refs:	DNO 04.04, 04.11	Original ENA Ref:	DNO 09
Description:	The metering system will store, and provide on demand, voltage profile data to authorised parties via the communications system.		
Rationale:	DNOs have a statutory obligation to maintain voltage levels at customers' LV terminals within specified limits (as defined in ESQC Regulation 27(3)(b)). With the anticipated increase in distributed generation and demand side energy resources (including micro-generation) and with the anticipated electrification of heat and transport in the longer term, monitoring voltage profiles will become an increasingly important of active network management. Studies have shown that with high localised penetrations electric vehicle charging systems and heat pumps, voltage regulation issues on LV networks will be a more common driver of reinforcement or active network management actions than thermal rating constraints while localised penetrations of micro-generation may give rise to localised voltages exceeding statutory limits and even operation of G83 protection. The ability to monitor voltage profiles and even utilise this information for active voltage control of LV networks where necessary is therefore an essential functional requirement.		
Context:	Voltage (average RMS half-hourly) profiles will be captured and maintained by the metering system for 3 months. In addition, the meter will have the capacity to continuously store a specified minimum number of time-stamped high/low voltage excursion events (on a write-over basis if the buffer capacity is exceeded). High/low thresholds are to be defined but would be a function of magnitude and duration above/below a de-minimus limit.		
Key Benefits:	• Confirmation that voltages are within the prescribed statutory limits and/or identification of contraventions • Enablement of voltage optimisation to minimise energy consumption and losses • Maximisation of voltage headroom to accommodate increased demand / generation and/or minimise requirement for reinforcement • Identification of opportunities for efficient application of localised voltage control - including through distribution transformer on-load tapchangers, in-line voltage regulators, d-statcoms and general power factor management (esp. on OHL systems).		
Use Case Ref:	1, 2, 3, 4, 7, 8, 9, 10		
Version:	4	Date:	Apr 2010

Updated DNO Refs:	DNO 04.1, 04.07, 04.08, 04.12, 04.14	Original ENA Ref:	DNO 10
Description:	The meter will have the capability of detecting a potentially dangerous over or under voltage condition and will be capable of configuration to either (or both) transmit an alarm or (and) initiate disconnection through the meter's integral automatic cut-off switch (if fitted – see Ref. DNO 14).		
Rationale:	In addition to a voltage profile monitoring capability which will enable DNOs to detect a gradually deteriorating and/or non-statutory voltage condition, there are circumstances under which potentially dangerous under or over voltages can occur which might damage apparatus and, under extreme conditions, give rise to a fire hazard. Extreme low voltage conditions can arise due to open circuit HV fault conditions (and HV non-ganged fuse operations) while, exceptionally, both extreme low and high voltage conditions can arise due to 'run away' EHV/HV tapchangers and (especially) due to open-circuit LV neutral faults. (This alarm / disconnection functionality would also serve as back-up protection for G83 micro-generation installations and prevent potentially high voltage conditions arising under light load conditions with heavy network penetrations of DG).		
Context:	The high / low voltage alarm disconnection settings must be fully and remotely configurable in terms both of magnitude and duration of the abnormal voltage condition.		
Key Benefits:	• Immediate automatic notification of extremes of voltage • Auto-disconnection to make safe at meter • Reduced risk of damage to customers' appliances • Reduced claims for damage to appliances • Avoided inconvenience to customers associated with damage to appliances • Reduced danger of fire-risk associated with appliance failure		
Use Case Ref:	19		
Version:	4	Date:	Apr 2010

<table>
<tr><td>Updated DNO Refs:</td><td>DNO 04.06, 04.13, 04.15</td><td>Original ENA Ref:</td><td>DNO 11</td></tr>
<tr><td>Description:</td><td colspan="3">The meter will provide basic (voltage sag / swell) power quality monitoring functionality which may be interrogated by authorised parties via the communications system.</td></tr>
<tr><td>Rationale:</td><td colspan="3">DNOs have a statutory obligation to ensure that at the time of connecting new load / generation, power quality is maintained within specified levels at points of common coupling. These requirements are set out in Engineering Recommendations, in particular G5/4 (harmonic distortion) and P28 (voltage flicker)). With increasing levels of inverter connected loads (such as heat pumps with DC motors, some types of micro-generation, and electric vehicle chargers) levels of harmonic distortion will need to be more carefully monitored and controlled. Heat pumps may also be equipped with variable speed motor drives which will generate harmonics; while those equipped with DC motors might have very high starting currents leading to excessively severe and frequent voltage dips.</td></tr>
<tr><td>Context:</td><td colspan="3">As part of the voltage profile monitoring functionality, the meter will have the capability to record time-stamped voltage dips (parameters to be defined) up to a specified minimum number of events. The record will be continuously maintained by the meter on a ‘write-over’ basis and be remotely accessible.</td></tr>
<tr><td>Key Benefits:</td><td colspan="3">• Excessive voltage fluctuations determined at an early stage improving the chances of identifying the root cause (for example a recent installation or change of use) and securing agreement by the customer to rectify the issue

• Early identification and resolution of the issue leading to earlier relief from the nuisance of voltage flicker – e.g. reducing source impedance by installing a lower impedance transformer to increase fault level and reduce depth of the voltage sag

• Early identification of any general increase in voltage quality issues that might require a change in the policy surrounding connections of disturbing loads and/or to the standards governing equipment (such as heat pumps) so that the issue is designed-out

• Sound evidence to support enactment of powers under the ESQC Regulations where necessary to disconnect supply until the issue is resolved (avoiding prolonged nuisance to adjacent customers)

• Evidence to support engagement with manufacturers (or their trade associations - e.g. BEAMA) to highlight disturbing load effects of appliances with a view to revising design specifications</td></tr>
<tr><td>Use Case Ref:</td><td colspan="3">6</td></tr>
<tr><td>Version:</td><td>4</td><td>Date:</td><td>Apr 2010</td></tr>
</table>

Updated DNO Refs:	DNO 03.01, 03.02	Original ENA Ref:	DNO 12
Description:	The meter will support multi-rate (TOD / CPP / Dynamic Pricing) tariff structures and a configurable combination of register types.		
Rationale:	Both Suppliers and DNOs will have an increasing need to use DSM products; Suppliers to balance their positions and DNOs to balance their networks (and manage constraints). DNOs may also become ancillary service providers to GBSO by offering balancing services; for example managing imports/exports at GSPs. The introduction of electric (BEV / PHEV) vehicles will create an increasing need for demand management. However, unlike space and water (storage) heating, the nature of this demand may preclude strictly controlled time-of-day (i.e. off-peak) charging; i.e. at the very least an over-ride capability would be required for 'emergency' recharging. The increasing contribution from intermittent wind generation (up to 34GW by 2020) will create a need for responsive demand. It follows that a flexible multi-rate tariff system, comprising elements of both energy and DUoS pricing will be required in order to provide a range of TOD / CPP or even real-time price signals.		
Context:	The meter must provide time of day / week / seasonal pricing, critical peak pricing (CPP) and real-time pricing options. Functionality would typically include four-season / weekend / specified days, and at least 8 separate daily (day/night) periods. Tariff changes must be capable of enactment by authorised parties via the communications system		
Key Benefits:	• Provision of necessary incentive for customers to embrace demand response • Ability for DNO to reflect cost-reflective use of system pricing signals • Encouragement of customer avoidance of peak demand periods thereby improving load factor and minimising need for peak driven network reinforcement • Support for the necessary adoption of 'smart' EV charging infrastructure to maximise utilisation of demand troughs		
Use Case Ref:	11, 20		
Version:	2	Date:	April 2010

Updated DNO Refs:	DNO 06.01, 06.02, 06.03, 07.01 Com 01.01, 02.01, 02.02, 02.04	Original ENA Ref:	DNO 13
Description:	The meter will be capable of initiation by authorised parties of consumer appliance load switching in support of remote load management.		
Rationale:	The dynamic time control of non time-critical and/or heavy demands will become an increasingly important aspect of smart grid management. While TOU/CPP tariffs will provide appropriate price signals, some direct control of demand is likely also to be necessary; for example to manage network constraints and/or as part of providing an ancillary balancing service. This might extend to 'despatching' of some demand side energy sources as well as constraining (or time-shifting) demand. The capability to limit demand might facilitate more rapid restoration of supplies from adjacent circuits following a network outage (for example via HV or LV backfeeds). A further potential application is to constrain demand in the event of a requirement for system demand reduction due to a shortfall of generation or temporary transmission constraint. Limiting demand might reduce or avoid the need for rota disconnection.		
Context:	The functionality may be provided by direct switching of appliances or through an energy management system (or a combination of both) via the HAN interface. The meter must be equipped with at least one suitably rated switch. It may be appropriate for certain applications to permit customer over-ride of the demand constraint signal. This over-ride facility would not apply to certain applications (such as electrical storage heating) but might be applicable to other applications such as EV charging.		
Key Benefits:	• Enabling voltages to be maintained within prescribed limits and ensuring distribution equipment thermal ratings are not exceeded • Maximisation of load factors (and loss load factors) to minimise losses and optimise network utilisation • Facilitation of distribution system balancing and constraint management and system balancing ancillary services to NETSO • Facilitation of system or local network peak avoidance and provision of STOR through authorised parties (including Aggregators) • Enabling faster and/or wider restoration of supplies following a local network outage by limiting demand to increase backfeed capability • More refined emergency load reduction / disconnection functionality by limiting requirement for rota disconnection • Fundamental enabler of transition to smart gird operation		
Use Case Ref:	8, 9, 10, 11, 17		
Version:	3	Date:	Apr 2010

Updated DNO Refs:	DNO 06.04			Original ENA Ref:	DNO 14
Description:	As an optional requirement (if specified) the meter will include a configurable (and remotely controllable) cut-off switch designed to operate automatically if the customer's load exceeds a predefined limit and duration.				
Rationale:	Although service cables are generally fully rated and protected by a suitable cut-out fuse which will protect the service cable and termination from potentially dangerous overloads, under a future where demand control may become more critical from a network balancing and constraint management perspective, the capability to limit demands (in excess of normal or declared maximum power requirements) may become increasingly important.				
Context:	The switch must be able to safely break (disconnect) a load of 100 amps at 0.5 pf (TBC) and make (connect) a short-circuit current of 20kA (TBC). The protection characteristic must be such that discrimination with the customer's protective devices (such as consumer unit circuit breakers / fuses) is assured in the event of a fault on the customer's electrical installation.				
Key Benefits:	• Prevention of excessive demand which may be created by unauthorised connection of additional load • Prevention of service equipment or network overloads due to inappropriately specified EV charging systems • Back-up support for adoption of by DNOs of higher network utilisation levels and consequently enhanced risk of network overloads				
Use Case Ref:	8, 10, 11				
Version:	3	Date:	Apr 2010		

Updated DNO Refs:	DNO 10.01, 10.02	Original ENA Ref:	DNO 15
Description:	The meter will incorporate measures to detect and guard against tampering and unauthorised access to the meter terminals.		
Rationale:	As well as being a Supplier requirement, DNOs are directly penalised through the Regulatory incentive for losses (technical and non-technical). Prevention of tamper is also important from a public safety perspective; for example interference with live contacts and to service alterations by unqualified personnel which may lead to untested installations and potentially dangerous cross-polarity connections.		
Context:	While total immunity to tampering is impractical, a minimum requirement is detection of removal of the terminal cover and a degree of resilience to external magnetic fields. Consideration should also be given to the meter being programmable to initiate disconnection through the automatic cut-off switch if incorporated (as per DNO 14) which could be either a programmable option or a de-programmable default option. Note: this would provide only a limited level of safety protection since the incoming meter tails from the cut-out would remain live. However, it would either immediately alert the DNO if a power outage signal is transmitted (as per DNO 08) or otherwise force the customer to report the outage resulting in a visit by a DNO operative (or meter operator) who would then be able to detect a tamper attempt.		
Key Benefits:	• Reduced non-technical losses • Enhanced safety at the customers premises by discouraging or preventing illegal access • Reduced call-outs to attend premises to rectify dangerous conditions		
Use Case Ref:	18		
Version:	3	Date:	Apr 2010

Updated DNO Refs:	DNO 11.01	Original ENA Ref:	DNO 16
Description:	The meter will have the functionality to respond to daily synchronisation signals to ensure continued accurate time-stamping of information.		
Rationale:	Notwithstanding Suppliers' requirements, several DNO benefits depend on accurate time stamping in order to be able to both accurately aggregate load profile data (including integration with data from upstream measurement systems) and accurately report interruption and restoration information. The accurate calculation of network losses will depend on accurate time stamping of demand data.		
Context:	The accuracy requirement is not anticipated to be in excess of that required by Suppliers.		
Key Benefits:	• Enabler of various dependent functional requirements including: – time-stamping of power outages and restorations – including for regulatory reporting – synchronisation of half-hourly demand data to establish aggregated network power flows – enablement of multi-rate tariffs		
Use Case Ref:	20		
Version:	2	Date:	April 2010

Updated DNO Refs:	DNO 02.10, 02.11, 04.02, 04.10	Original ENA Ref:	DNO 17 (New)
Description:	Subject to technical feasibility and economic viability the meter will support safety features including detection of excessive contact temperature and reverse polarity.		
Rationale:	Reverse polarity is a known and potentially dangerous condition. Notwithstanding the need for very high levels of quality control and the requirements for training of meter operatives (especially to facilitate 'dual-fuel' meter replacements) the scale of the smart metering programme is such that the risk of introducing cross polarity at a very small proportion of premises must be regarded as significant. Similarly, there might be an enhanced risk of contacts being left insufficiently tightened leading to high resistance connections at meter terminals. This can lead to risk of fires which might be enhanced as a consequence of both: anticipated higher demands due to heat pumps and electric vehicle charging loads; and a reduced inspection regime as a result of discontinuance of physical meter reads.		
Context:	The functionality is subject to technical feasibility and economic viability which in turn will require a risk based cost-benefit assessment.		
Key Benefits:	• Detection of crossed polarity at the meter • Detection of excessive heat (parameters to be determined)		
Use Case Ref:	18		
Version:	1	Date:	April 2010