AusNet Electricity Services Pty Ltd

Electricity Distribution Price Review 2016–20

Appendix 17A: Distribution Network Benefits from AMI Assets

Submitted: 30 April 2015

1 Context

The availability of power system measurements within the AusNet Services electricity distribution network has previously been limited to that provided by zone substation-based protection, control and measurement devices, and 22kV Feeder-based automatic circuit re-closers and sectionalising switches. Prior to the advent of AMI infrastructure, there have been no permanent or networked measurement devices within the low voltage (LV) networks – only a relatively small number of power quality monitoring devices that were deployed to investigate or validate specific power quality concerns.

In recent years the penetration of distributed energy resources like solar PV generation has significantly increased. The LV networks in particular are being subjected to different operating conditions to that for which they were designed. Better information also generates opportunities to improve the asset management and operation of the network. Thus, it has become important to be able to have LV network based measurement data available, preferably but not essentially in near-real time, so that the electricity distribution networks can be adequately planned and operated to comply with the respective regulatory requirements.

2 Strategic Purpose

Separate to the prescribed energy metering functions, the AusNet Services AMI meters, communications network and the applied Meter Management System are being utilised as an instrument to obtain a comprehensive set of analogue measurement data from the LV fringe of the reticulation network (including five minute interval based simultaneous sampling of voltage, current, frequency, power factor at every deployed, communicating smart meter). This data set is being applied, in a similar manner to traditional electricity network secondary systems assets, to assist with network planning, operational control and response, maintaining NER compliance, providing key inputs for asset management actions, and detecting and removing public safety hazards.

In addition to providing LV network end-point analogue measurements, it has been demonstrated and proven that, where applicable, the LV measurement data can be accurately referenced to the 22kV distribution network and can thus provide valuable asset management and operational information which was previously unavailable.

3 Specific Functionality

A list of the specific “network” related functions for which the applied AMI smart meter, communications module, communications network and Meter Management System are utilised is included in the following table. It is to be noted that many of these applications or “use cases” are not yet in full “BAU” production, as they rely on other network ICT infrastructure which is in the process of being placed into operation.

Additionally, in future, it is anticipated that, where applicable, the AMI communications network could also be utilised as an alternative to the existing SCADA communications for network monitoring and control purposes.

Table 3.1: Electricity Distribution Network Functions using AMI Assets

Name	Function/Benefit	Status
Meter to Substation connection topology	Determines to which distribution substation the meter is connected / incorrectly connected. Provides more accurate planning analysis as well as customer notification and tracking for network outages.	Current
Meter to LV network phase connection topology	Determines to which phase group of the three phase network the meter is connected. Provides better planning of phase load balance as well as tracking and analysis of phase loading on distribution transformers.	Current
Detection of poorly installed poly phase meters	Detection of poly phase meters installed on single phase premise supplies. Allows better allocation of resources to match customer needs.	Current
Detection of faulty meters	Analysis of a cluster of meters allows detection of incorrectly setup meters or meters that are not performing adequately.	Current
Detection of overloaded meters	An overloaded meter will under-register the energy sales and presents a safety risk. This detection allows rapid corrective action.	Current
Detection of incorrectly wired meters	Incorrect wiring that leads to inconsistent readings is detected allowing rapid corrective action.	Current
Detection of “non-technical” losses	Detection of “non-technical” losses (energy theft) including "assessment” of energy lost and detection / estimation of when theft started.	Current
Detection of “un-authorised” generation	This covers situations where the generation system is unregistered or the meter is not correctly programmed for solar. These conditions may cause incorrect readings but also inaccurate planning data.	Current
Detection of “un-authorised” augmented generation	This covers situations where a registered generator augments the installed system to increase the capacity without seeking approval. This corrects inaccurate planning data and may identify quality of supply issues.	Current
Spatial representation of Network	Spatial representation of above (eg Voltage heat maps, Meter stats, Network fault locations, etc). Allows better planning which enables lower risk margins to be applied to designs.	Current
Transformer overall load profiles (PUF)	Optimises sizing and maintenance. (Aggregation of data to feeder level: HV Plant Utilisation Factor (PUF) for Conductors - Optimise maintenance based on Maximum Demand per conductor). Improves planning accuracy and better condition monitoring leading to more efficient lifecycle asset management.	Current (in Part)
Detection of supply “brown-out” condition at meter	Detection of supply “brown-out” condition and automatic isolation of premise supply to prevent damage to customer appliances. Better customer protection from damaging low voltages which also leads to lower compensation payouts.	Current (in part)
Transformer phase load profiles	Transformer per phase load profiles and load unbalance calculation. Allows more accurate planning and better condition monitoring of assets.	Current (in part)

Name	Function/Benefit	Status
LV Network reticulation monitoring	LV Network reticulation monitoring (identifying problem LV network connections, loss of transformer neutral / earth, etc). Location identification of fault to closest pole / pillar in priority sequence. Enables much more rapid restoration of supply to customers and better safety outcomes.	Current (in part)
LV Fuse operation	Enables much more rapid restoration of supply to customers as location is quickly and accurately identified.	Current (in part)
Electricity 22kV / 240V Brownout / Fuse blown operation	Accurate detection of 22kV or 415/240V fuses blown on the network with automated reporting back to CEOT via DOMS alarm. Enables much more rapid restoration of supply to customers as location is quickly and accurately identified.	Current (in part)
Voltage regulator operation monitoring / asset management	Voltage regulator (22kV Feeder located) operation monitoring and related predictive asset management (No. of tap changes, hunting behaviour, tap position statistics, run away/loss of regulation alarms, etc.). Enables more accurate condition monitoring, thereby reducing life-cycle costs.	Current (in part)
Wire down / broken conductor location	Electricity 22kV Wire Down confirmation and location detection. Enables much more rapid restoration of supply to customers and better safety outcomes.	Current (in part)
Detection of HV fuse “candling”	Identification of the specific fuse and location with near real time interface to DOMS for reporting alarm and location to CEOT staff. A significant contributor to “fire starts” and, therefore, this reduces the risk of a bushfire from the network.	Current (in part)
Network Load / Revenue Forecasting	Use detailed AMI data to enhance various consumption / revenue forecasting, both short and long term, for both Electricity and Gas networks including: Maximum demand per feeder – 3 days ahead. Enables better long and short term planning of the network.	Current (in part)
Finding "lost" communicating meters	Identifying the installation position of a meter where either the paperwork got lost or data was not correctly entered into the asset management system. Allows a more resilient system and, therefore, reduces errors and costs.	Future
Outage notifications	Outage notifications (Notification of outages back to base in Near Real Time). Enables much more rapid restoration of supply to customers.	Future
Automatic supply restoration	Automatic supply restoration to customers after restoration of normal supply conditions. Enables much more rapid restoration of supply to customers.	Future
Demand Management through Smart Meters	Provide CEOT with the capability to control the on/off status of loads through the meters. Enables significant opportunities for efficient demand management.	Future
Electric Vehicle charging control / management	EV charging control / management has the potential to avoid significant network expenditure to accommodate large numbers of EVs.	Future

Name	Function/Benefit	Status
Vehicle to Grid support	EV charging control / management has the potential to avoid significant network expenditure to accommodate large numbers of EVs.	Future
Transformer load power factor calculation	Transformer load power factor calculation. (Power factor of the composite loading on the transformer). Improves planning accuracy and better condition monitoring leading to more efficient lifecycle asset management.	Future
Detection of LV network transformer parallels	Detection of LV network transformer parallels. Avoids unwanted customer outages if a fault occurs and major safety risk if undetected during line work.	Future
Distribution substation transformer failure / abnormal operation detection	Distribution substation transformer failure / abnormal operation detection. More responsive management of assets leading to lower lifecycle costs.	Future
Management of LV Network cumulative solar PV export levels	Management of LV Network cumulative solar PV export levels (this function enables distributers to accommodate increased levels of distributed generation without compromising the network or breaching Distribution Code requirements).	Future
HV Plant Utilisation Factor (PUF) for Conductors	Use the existing substation PUF calculations to determine the actual maximum demand transported in the conductors. A dashboard of overloaded network segments will be delivered in order of priority	Future
HV Fault location	HV Fault location (to the nearest distribution transformer network segment). Enables much more rapid restoration of supply to customers.	Future
Network voltage monitoring in near real time	Network voltage monitoring in near real time. Enables much more rapid identification and restoration of supply to customers.	Future
Voltage Control zone	Voltage Control zone - Voltage histograms and compliancy statistics. Better management of quality of supply events.	Future