SP Energy Networks 2015–2023 Business Plan

Updated March 2014

Annex

Report on Network Size P3 & 4 Assets

PA Consulting

March 2014

SP ENERGY NETWORKS

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Network Size Assurance

Priority 3 & Priority 4 Asset Groups

March 2014

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EXECUTIVE SUMMARY

SP Energy Networks (SPEN) owns and operates electricity distribution networks in Central and Southern Scotland and Merseyside and North Wales.

SPEN has a regulatory obligation to report key attributes associated with the size of its regulated asset bases. As part of the Network Data Improvement Programme to improve the quality of asset information systems and data, SPEN has now completed the second stage review of the asset volumes employed within its distribution networks.

PA Consulting was engaged to undertake an independent assessment of the processes adopted to improve the accuracy of network size reporting for SPEN's Priority 3 & 4 asset groups, having completed a similar review of Priority 1 & 2 assets in June 2013.

Scope & approach

PA's review has considered SPEN's electricity distribution assets and does not include the electricity transmission assets owned by Scottish Power Transmission Limited (SPTL).

The assessment of SPEN's Priority 3 & 4 asset groups has been undertaken through detailed interactions with SPEN's Network Data Improvement Programme' (NDIP). It has included a desk-top review of various information sources containing distribution asset data. PA has not undertaken any operational site visits or inspected physical infrastructure as part of the review.

PA's approach to this asset volume assurance exercise included:

- a review of the high-level approach adopted by SPEN to provide a revised assessment of the size of the regulated asset base (a review of process); and
- detailed reviews of particular asset groups where asset volume changes were most significant.

Although the objectives of this assurance project were similar to those for the Priority 1 & 2 asset groups, the approaches adopted for the Priority 3 & 4 asset groups differed in terms of the assessment methodologies implemented by SPEN. Consequently, for the purposes of this review PA concentrated on assessing the new validation methodologies which resulted in the most significant Priority 3 & 4 asset volume changes.

SPEN's NDIP team developed a range of bespoke network size measurement and estimation techniques by forming Expert Panels. PA undertook 'deep-dive' reviews to confirm whether the processes adopted and corresponding network size adjustments were sufficiently robust for regulatory reporting purposes. Deep-dive investigations were undertaken for the following asset groups:

- 33 kV Switchgear (pole-mounted)
- LV switchboards and pillars
- Pilot wires
- Submarine cables
- LV services, including Rising and Lateral Mains

For each of the Priority 3 & 4 asset groups investigated, it was apparent that the original network size information contained anomalies within the relevant asset registers.

Conclusions

Overall, PA can confirm that the amendments made to asset volumes in the Priority 3 & 4 asset groups have significantly improved the accuracy of SPEN network size information. The resultant asset volumes, to be presented to Ofgem in 2014, are significantly more robust than those reported in 2013.

PA can also confirm that SPEN has achieved this improvement to the overall accuracy of network size reporting using actual asset data wherever available; i.e. estimation approaches have only been pursued where information has not historically been recorded.

Reconciling asset volumes in some of the Priority 3 & 4 asset groups (particularly Pilot Wires), revealed legacy information sources not previously utilised for network size reporting which have increased asset volumes significantly. Consequently, SPEN will need to evaluate whether this information can be consolidated within SPEN's main asset information systems in a cost-effective manner.

In relation to the number of LV Services and particularly Rising and Lateral Mains (RLM), PA observed that the reported 'Number of Services Associated with RLMs' and the 'Number of RLMs' are more now representative of the customer bases in the SPD & SPM network areas and align with SPEN's RLM modernisation programme. PA notes that the estimated asset volumes in the two RLM asset categories can vary significantly according to model input assumptions and therefore it will be important for SPEN to undertake reviews using RLM modernisation programme feedback. PA believes that the Expert Panel estimation assumptions adopted by the NDIP Data Quality team are pragmatic and justifiable.

For the Priority 3 & 4 asset categories evaluated using Expert Panel derived methodologies, PA notes that the revised asset volumes now need to be reflected in SPEN's corporate information systems. PA believes that corrected asset volume information should be updated within corporate systems promptly to maintain the accuracy of this information in future. It is anticipated that most of the required asset volume changes can be accommodated by SPEN's Data Management processes although work will need to be prioritised to occur in parallel with 'Business-as-Usual' activities.

PA Consulting agrees that accuracy of network size information could be enhanced through refinements to operational inspection procedures and improved guidance to field staff. However, changes to corporate systems will be necessary to capture the additional asset information. Detailed analysis will be required to evaluate the costs and benefits of including all identified asset information in corporate systems.

PA Consulting can confirm that the approach adopted to reconcile asset volumes based on SPEN's proven asset data exception reporting processes as employed for Priority 1 & 2 assets remains robust. The accuracy of reported submarine cable lengths and pole-mount 33 kV switchgear has been improved accordingly. A benefit of the exception reporting approach is that all inaccuracies identified are reconciled in corporate systems as part of the validation process.

PA Consulting can confirm that the changes made in the Priority 3 & 4 asset categories, as approved by SPEN's senior management, provide a more accurate basis for regulatory reporting in relation to the total size of the SPD & SPM networks.

The investigations undertaken by the NDIP team and Expert Panels have also provided critical insights that will enable SPEN to prioritise options to improve accuracy of Priority 3 & 4 asset data in future, through a range of operational and system improvements.

Recommendations

PA's review of the processes employed by the Network Data Improvement Programme identified a range of initiatives to simplify network size reporting and improve the accuracy of asset data. PA recommends the following next steps which will enable SPEN to simultaneously improve data accuracy and reporting efficiency:

- Ensure that Expert Panel derived asset information is promptly updated SPEN's corporate information systems.
- Develop SPEN's corporate asset information systems to hold all relevant asset information required for regulatory reporting.
- Ensure that SPEN retains the knowledge and expertise amassed by the Network Data Improvement Programme.
- Ensure that all asset information identified by Expert Panels, residing outside SPEN corporate systems, is retained in future.
- Promptly implement system changes in corporate systems to improve the granularity of asset information.
- Enhance operational inspection procedures to capture additional asset information as part of routine site-visits by field staff.

Additional information regarding each of these recommendations can be found in Section 6 of the report.

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1 INTRODUCTION

SP Energy Networks submits annual reports to Ofgem regarding the key attributes of its regulated asset bases. As part of the ongoing Network Data Improvement Programme to improve asset information systems, SPEN established a project to review and improve the accuracy of asset data contained within these asset information systems.

In 2013, PA Consulting undertook an assurance project to confirm adjustments to the assets volumes classified by SPEN as Priority 1 & 2 were robust. In January 2014, PA Consulting was appointed to provide similar assurance regarding corresponding adjustments to the asset volumes classified as Priority 3 & 4 (P3 & P4). Both of these assurance projects evaluated the network size adjustments to the SPD and SPM asset bases as determined by SPEN's Network Data Improvement Programme (NDIP).

The objectives of both assurance projects were similar and the approaches developed by the NDIP team for the Priority 3 & 4 asset groups followed those employed in the Priority 1 & 2 asset groups wherever possible. However, alternative approaches using Expert Panels and asset specialist feedback were developed where it was not possible to synchronise asset data across corporate systems.

For the Priority 1 & 2 asset groups, asset numbers were largely reconciled by identifying and then resolving unsynchronised asset records held on different SPEN systems. Identification of unsynchronised assets was achieved by comparing asset information on operational systems to highlight missing or inaccurate records through a process of exception reporting.

Although a continuation of this approach was possible for a subset of the Priority 3 & 4 assets, the NDIP team developed alternative approaches with relevant asset experts where exception reporting was not possible. This was largely due to asset data residing in one IT system for most of the Priority 3 & 4 asset groups, thus precluding exception reporting. From a systems perspective, the majority of these assets were classified as 'unsynchronisable'

and therefore required alternative asset volume validation processes to be developed.

1.1 Background and context

Scottish Power Energy Networks (SPEN) owns and operates distribution networks in both Central and Southern Scotland (Scottish Power Distribution – SPD) and also Merseyside and North Wales (Scottish Power Manweb – SPM)[1].

SPEN has a regulatory obligation to report on a number of key attributes associated with its regulated power network. A reporting template, in the form of a Regulatory Report Pack (RRP), is issued by Ofgem for completion and annual submission by SPEN.

As part of its drive to improve the quality of asset information systems, SPEN has recently embarked upon a project to improve the management of data within SPEN. The Network Data Improvement Programme has been operational within SPEN since late 2011 and comprises six principal work streams[2]. A key aspect of this work is to improve data quality and to align, confirm and cleanse the asset data contained within its asset information systems as required. This initiative has identified discrepancies associated with the number of assets employed in the SPD & SPM distribution networks.

The "Data Quality" workstream of the 'Networks Data Improvement Programme' was established to prioritise network size validation activities according to four prioritised asset groups suitable for inclusion in annual reports to Ofgem. Priority 1 ("P1") and Priority 2 ("P2") asset groups were reviewed by PA in the summer of 2013 and the focus of this assurance exercise was to review the work undertaken by the NDIP Data Quality team to improve the accuracy of Priority 3 ("P3") and Priority 4 ("P4") asset data. .

1.2 Scope of the assignment

The Data Quality workstream of the Network Data Improvement Programme has recently completed a validation exercise to improve the accuracy of P3 and P4 asset numbers in the SPD and SPM network areas. SPEN has sought third-party assurance that the processes adopted were robust and independent confirmation that the revised asset information provides a more accurate record of SPEN's distribution asset bases for inclusion in future regulatory reports to Ofgem.

PA was requested to determine whether the processes used to determine the correct numbers of P3 and P4 assets employed in the SPD and SPM networks were robust, effectively implemented and have resulted in a more accurate statement of network size. PA's review was focussed solely on distribution assets and excluded the transmission assets owned by Scottish Power Transmission Limited (SPTL).

PA has undertaken this data assurance assignment as a desk-top exercise to validate the processes adopted by the NDIP Data Quality team. PA has not undertaken any operational site visits or inspected physical infrastructure as part of the review. On-site time has been spent reviewing material produced by the NDIP Data Quality team, interrogating reports and validating decision-making processes. It should also be noted that any technical (IT) investigation or assessment of the various SPEN information systems is beyond the scope of this review of asset information. The PA review team comprised two consultants working on-site with the NDIP team over a 4 week period.

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1 The SP Manweb network includes the Manweb 132kV network, which is defined as a distribution voltage in England and Wales. The 132kV network in Southern Scotland is owned and operated by Scottish Power Transmission Limited (SPTL).

2 The six work streams which make-up the SPEN Network Data Improvement Programme are: Data Governance, Data Models, Data Quality, Data Capture, Data Reporting and Data Culture

1.3 Priority 3 & 4 asset groups

The Priority 3 & 4 assets groups assessed by the NDIP team are summarised in Table 1. Each asset group is represented in both the SPD and SPM network areas except for 132 kV assets which are only relevant in the SPM network area (marked 'SPM only'). The NDIP Data Quality workstream was therefore tasked with reviewing and revising asset volumes in 75 asset groups, which comprised 27 Priority 3 and 48 Priority 4 asset groups overall. Of the 75 asset groups reviewed, only 13 were suitable for asset volume validation by exception reporting (as undertaken for the Priority 1 & 2 asset groups) identified as 'Synchronisable' in Table 1. Asset volumes in the remaining 62 'Unsynchronisable' asset groups have been subject to asset specialist and Expert Panel validation techniques.

Table 1 – Priority 3 & 4 Assets assessed by Network Data Improvement Programme

Priority	Asset description	Assessment
3	33kV Switch (Pole Mounted)	Exception reporting
4	33kV Switchgear – Other	Expert Panel
3	6.6/11kV Switch (Pole Mounted)	Exception reporting
3	6.6/11kV Switchgear - Other (Pole Mounted)	Exception reporting
3	Cable Bridges (DNO owned)	Expert Panel
3	Cable Tunnels (DNO owned)	Expert Panel
4	Cut Out (Metered)	Expert Panel
4	LV Service (Overhead Line – OHL))	Expert Panel
4	LV Service (Underground – UG)	Expert Panel
4	LV Service associated with Rising & Lateral Mains	Expert Panel
4	LV Transformers/Regulators	Expert Panel
4	Rising & Lateral Mains	Expert Panel
4	Switching Points with Remote Control/Automation Facility	Expert Panel
4	132kV Fittings (SPM only)	Exception reporting
4	132kv UG Cable (Oil & Gas) – Decommissioned (SPM only)	NA
4	33kV Fittings	Exception reporting
3	Batteries at 132kV Substations (SPM only)	Expert Panel
3	Batteries at 33kV Substations	Expert Panel
3	Batteries at Ground Mounted HV Substations	Expert Panel
4	EHV UG Cable (Oil & Gas) - Decommissioned	NA

4	Fuses (Ground Mounted – GM) (TM)	Expert Panel
4	Fuses (Pole Mounted – PM)	Expert Panel
3	HV Submarine Cable	Exception reporting
4	LV Circuit Breaker	Expert Panel
4	LV Main (UG Consac)	Expert Panel
3	LV UGB & LV Pillars (Outdoor (OD) not at Substation)	Exception reporting
4	Percentage of Poles Shared (HV)	Expert Panel
4	Percentage of Poles Shared (LV)	Expert Panel
4	Percentage of Poles/Towers Shared 132 kV (SPM only)	Expert Panel
4	Percentage of Poles/Towers Shared EHV	Expert Panel
4	Shared Poles (HV)	Expert Panel
4	Shared Poles (LV)	Expert Panel
4	Shared Poles/Towers 132kV (SPM only)	Expert Panel
4	Shared Poles/Towers EHV	Expert Panel
3	LV Board (WM)	Expert Panel
3	LV Board (X-type Network) (WM)	Expert Panel
3	LV Pillar (Indoor – ID)	Expert Panel
3	LV Pillar (Outdoor (OD) at Substation)	Expert Panel
4	Pilot Wire Overhead	Expert Panel
4	Pilot Wire Underground	Expert Panel

2 ASSURANCE APPROACH

PA has reviewed the processes adopted by SPEN to improve reported asset volumes for the Priority 3 & 4 asset groups in the SPD & SPM network areas. This section describes the approach adopted by PA in its review of each asset category. PA's approach comprised:

- a review of the high-level approach adopted by SPEN to provide a revised assessment of the size of the regulated asset base (a review of process); and
- a targeted examination of the most significant changes to asset numbers.

2.1 High-level review

The over-arching process and approach adopted by SPEN in revisiting its asset information is central to the assurance review undertaken by PA. Our high-level assessment of approaches adopted by the NDIP Data Quality team included the following elements:

- an explanation of the aims and objectives of the network data improvement initiative from SPEN management;
- the overall approaches and philosophy adopted by the SPEN team to improve the accuracy and quality of its reporting capability – both internal (management) reporting and reporting to external parties, such as Ofgem;
- a review of process charts associated with the high-level data improvement process; and
- a review of recent presentations to internal SPEN management setting out a preliminary view on potential changes to asset information; and

As part of this high-level review, PA has also explored the following:

- SPEN data tables showing 'before' and 'after' asset volumes and associated Modern Equivalent Assets Values (MEAV) for affected asset categories.

These initial, high-level assessments also informed selection of the specific asset categories for 'Deep-dive reviews.

2.2 Detailed reviews of specific asset categories

Having reviewed SPEN's high-level approach to the validation of Priority 3 & 4 asset volumes, PA has undertaken a more focused review of a number of specific asset categories. The purpose of this more detailed review of the asset volume determination process was twofold:

1. To confirm that the high-level process has been implemented as described; and

2. To confirm that the revised asset volumes in the specific asset categories are reasonable.

PA selected 14 asset categories for ‘Deep dive’ reviews with asset volumes being validated in the SPD & SPM network areas. The asset groups chosen for these reviews were selected according to the largest differences between the revised (NDIP) information and the previously submitted 2012/13 RRP data – both in terms of asset volume[3] and asset value (MEAV). For each Deep-dive exercise, the corresponding revisions to asset volumes were assessed in the SPD and SPM network areas.

For each of the selected asset categories the following items were explored:

1. How the initial asset volumes were generated for the Priority 3 & 4 asset groups including the systems and asset attributes used in the assessment process?
2. Details of business rules applied to determine asset volumes.
3. Level of engagement with asset experts and business stakeholders outside the NDIP Data Quality team to validate the proposed revisions to asset volumes.
4. Details of the processes adopted to ensure the revised asset volumes are accurately updated in SPEN asset information systems.
5. Measures to minimise the likelihood of inaccurate data records occurring in the future.

During each review, PA's approach has been to work closely with the NDIP team and to 'walk-through' the process adopted to validate and revise asset volumes in each Priority 3 & 4 asset category, exploring the issues, anomalies and business decisions as addressed by the project team.

The asset categories selected for the Deep-dive assessments are summarised in Table 2. Given the previous validation of Priority 1 & 2 assets using ‘synchronisable’ exception reports, PA chose to concentrate on the unsynchronisable Priority 3 & 4 asset groups as part of this assurance work, i.e. those requiring Expert Panel input using system generated information wherever possible, or data held outside corporate systems. The Expert Panels were used to evaluate the completeness of corporate system asset information, to identify alternative data sources, propose calculation methodologies and develop corresponding business rules. The Terms of Reference for the Expert Panels are provided in Appendix A

PA’s selection was influenced by the magnitude of the asset volume changes which were more significant for the ‘unsynchronisable’ asset categories. However, two ‘synchronisable’ Priority 3 asset categories were included in the deep-dive reviews for completeness, namely HV Submarine Cable and 33 kV Pole-mount Switchgear.

[3] 'Number of assets' is either circuit length (km) or asset count.

Table 2 – Asset categories selected for detailed 'Deep-dive' reviews in SPD & SPM areas

Asset Group	Asset Name	Validation Methodology
LV Pillars	LV Pillar (ID)	Expert Panel Review
	LV Pillar (OD at Substation)	Expert Panel Review
LV Boards	LV Board (WM)	Expert Panel Review
	LV Board (X-type Network) (WM	Expert Panel Review
LV Services	LV Service (OHL)	Expert Panel Review
	LV Service (UG)	Expert Panel Review
	LV Service associated with RLM	Expert Panel Review
	Cut Out (Metered)	Expert Panel Review
Rising and Lateral Mains	Rising and Lateral Mains	Expert Panel Review
Protection	Pilot Wire Overhead	Expert Panel Review
	Pilot Wire Underground	Expert Panel Review
33kV Switchgear	33kV Switchgear – Other (PM)	Exception Reporting
	33kV Switchgear (PM)	Exception Reporting
Cable	HV Submarine Cable	Exception Reporting

2.2.1 Key assumptions

The following assumptions were applied to each asset category review:

- the physical attributes of assets are as recorded in source IT systems; PA did not undertake any physical inspection of assets; and
- that the reporting tools developed by the NDIP Data Quality team to generate asset information are an accurate reflection of the source data contained within SPEN's asset information systems.

3 NETWORK SIZE REVIEW PROCESS

This section describes how SPEN has reassessed asset volumes in the SPD & SPM network areas. It also provides PA's observations and findings on each asset volume assessment methodology in terms of approach adopted and its application.

3.1 Historic approach to reporting network size

To comply with Ofgem's initial regulatory reporting requirements to provide detailed asset volume information in 2004/05, a best estimate of network size was developed. Information was sourced from various SPEN systems - including cable and line lengths 'associated with', but not determined from, legacy 'raster[4]' images. SPEN has recognised for some time that the veracity of this network information was approximate due to both the limited representation of assets in asset registers and functionality constraints in legacy asset information systems.

Since 2004/05 SPEN has made a number of investments to improve asset information systems and the quality of the asset data recorded. Cable and line records previously limited to paper records have been electronically captured and vector images created, or 'vectorised'[5].

However. the legacy processes and information sources continued to be used to establish baselines for reported asset volumes.. Consequently, asset volume information provided in annual RRP was determined for each RRP asset category using the following approach:

1. take the annual opening balance from the previous year's agreed closing balance; and
2. adjust according to known asset additions and disposals from the year in question.

As part of its review of assurance processes and an assessment of the robustness of its network information, SPEN identified that the process used to date to determine the size of its regulated network, required review.

3.2 SPEN organisation & processes to reassess network size

The Network Data Improvement Programme (NDIP) was established in late 2011 to deliver improvements in the management of data within SPEN. A key focus of NDIP[6] has been to establish

[4] A raster graphics imagine, or bit map, is a dot matrix data structure representing, generally, a rectangular grid of pixels or points of colour viewable via a monitor, paper or other display medium. When scaled, raster images exhibit a loss of quality.

[5] A higher quality alternative to raster images is the use of 'vector graphics'. Vector-based graphics can be scaled by any amount without degrading quality.

[6] It is noted that this is not the only focus of the Network Data Improvement Programme.

accurate records of network size. This initiative has been undertaken in parallel with business as usual processes. Providing an up-to-date and accurate count of the SPEN distribution network assets is the main priority of the NDIP Data Quality Workstream. In addition to providing a more accurate assessment of network size, PA also supports the objective of resolving data issues in key information systems and to implement mitigations to minimise the likelihood of data errors re-occurring in future.

The objectives of the NDIP team are as follows:

1. Provide an updated and more accurate determination of the number and type of assets which collectively comprise SPEN's distribution networks for regulatory reporting purposes;
2. For the synchronisable asset categories, to accurately reflect the validated asset information, remediation actions or 'fixes' in the source asset data systems;
3. For the unsynchronisable assets where revised asset volumes have been determined through Expert Panel estimation techniques, to confirm details of the approaches adopted with the enduring Data Management function in order that asset information system updates can be implemented via business as usual change management procedures in the remainder of 2014; and
4. Identify preventative measures and/or business process improvements to address identified shortcomings in processes, policies or procedures in the broader network business.

The NDIP has six workstreams addressing Data Governance, Data Models, Data Quality, Data Capture, Data Reporting and Data Culture. Reassessment of asset volumes for network size reporting has been the responsibility of the Data Quality workstream which is described in greater detail below.

3.2.1 Data Governance

The Data Governance workstream involves a monthly review of data chaired by the ASNP Director with involvement of Connections, Operations, Business Change and the Customer Services Director. The monthly review addresses the following.

- Monthly KPIs for data returns from across the whole business associated with speed and quantities of data returns for asset additions and disposal;
- The overall vision for data;
- Terms of reference and the plan for each of the other workstreams; and
- A review of progress/success of all other data workstreams.

3.2.2 Data Models

The Data Models workstream ensures that the data requirements meet the Asset Management requirements. Cross-business groups have reviewed the data requirements for each asset group.

3.2.3 Data Capture

The Data Capture workstream is where initiatives have been implemented to improve the data returns from specific business areas (for example, PA has been advised that SPEN zones have established processes for the return of cable sketches for LV fault repairs through the roll out of ‘toughbooks’ to SPEN cable jointers. This has enabled improved tracking of this work with clear measures of performance, KPIs and targets.

Furthermore, PA has been advised that SPEN is in the early stages of implementing improvements in its processes to capture site condition information associated with Asset Health to better embed site condition data into its corporate systems, e.g. work undertaken regarding overhead line pole inspections.

3.2.4 Data Reporting

The Data Reporting workstream is responsible for establishing an IT project through the implementation of SAP Business Warehouse product to enable improved volume reporting for asset

counts and additions and disposals. This is expected to reduce the dependence on a small number of specialised IT staff who are currently engaged in providing this data.

3.2.5 Data Culture

The Data Culture workstream is responsible for communications with field staff: recognising and rewarding good behaviours, and focussing on training and messages associated with the importance and benefits of quickly capturing quality data associated with additions and disposals of assets on the network.

3.2.6 Data Quality

The Data Quality workstream comprises a dedicated project team responsible for validating asset volumes and improving the accuracy of SPEN's network size reporting. This team was established in January 2013 to supplement a small internal group that was initially responsible for improving the accuracy of Priority 1 asset records during 2012. However, it was realised that additional resources were required to complete the review of the Priority 1 – 4 asset groups in 2014.

Data Quality project team

The Data Quality workstream comprises dedicated project team to provide additional resource to address network size and asset volume inaccuracies as part of a focused effort to validate the size of SPEN's regulated asset base.

The project team comprises 25 team members, largely resourced by contract staff with GIS experience[7]. The project is led by an independent consultant with DNO asset management experience. The team has a number of Team Leaders. Two SPEN engineers provide specialist technical input to the team regarding features of the SPD and SPM networks.

SPEN's Data Management function is responsible for 'business-as-usual' asset information updates and holds regular interface meetings with the NDIP Data Quality workstream to monitor progress of the network size validation process and to confirm network size adjustment priorities. Data Management undertook several information validation exercises prior to the commencement of the NDIP Data Quality process which provided a valuable starting point for the validation of specific asset categories.

The Data Quality workstream has sought to use the information contained within its core asset information systems wherever possible to determine SPEN asset volumes..

3.3 Core asset information systems

A key assumption underpinning the validation process is that data contained within SPEN's core asset information systems provides a reliable basis to determine asset volumes according to Ofgem asset category definitions. The three core information systems used by the NDIP team to improve the accuracy of such reporting are:

- ESRI: a fully layered Geographic Information System containing vectorised geo-schematic images of 'as-installed' cables, lines and items of plant equipment;
- PowerOn: SPEN's real-time operational control & SCADA system; and
- SAP: SPEN's principal asset management system and register containing asset technical attribute data and also used to schedule asset inspections, maintenance and work orders.

Established business processes regularly synchronise information across the three systems. This is essential for SAP and PowerOn where electrical attributes of plant and equipment must be available to SPEN control room staff to ensure safe real-time operation of the network.

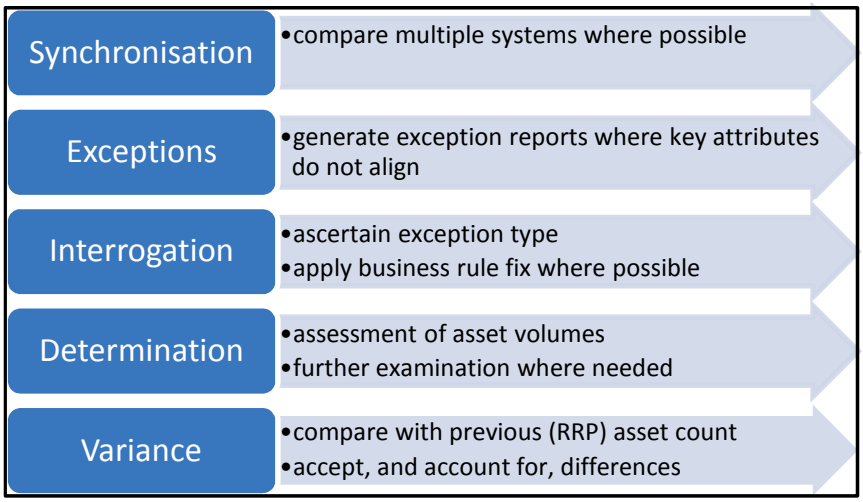
[7]One member of the NDIP team is a permanent member of SPEN staff and has been seconded to the programme to provide specialist technical network knowledge.

The SPEN network size assessment process uses these three key asset systems as part of a cross-reference (synchronization) process in order to validate asset information. A further key assumption of the NDIP Data Quality workstream is that asset information which matches across more than one information system is valid.

3.4 'Synchronisable' Asset Categories

For synchronisable assets, where asset data is contained on more than one SPEN information system, the stages of the validation methodology are shown in Figure 1. Each asset type has a 'master' system within which its key attributes are stored. For example, the master system for plant (transformers and switchgear) is SAP, whereas the master information system for 'linear assets' (cables and overhead lines) is the GIS system, ESRI. Furthermore, network information on plant items is stored in multiple systems (e.g. SAP and PowerOn).

Figure 1 - The key methodology steps in the SPEN data validation process



Plant & equipment

For items of plant and equipment mastered in SAP, the initial validation stage is to compare the key asset attributes stored in SAP with those stored in PowerOn for the same asset.

For example, in the case of 33 kV ground-mounted switchgear, three field comparison keys are used. These are:

- Energy Network Identifier (ENID) for the asset;
- the recorded location of the asset; and
- the recorded commissioned status of the asset.

If all three attributes agree across SAP and PowerOn then the asset information is deemed 'synchronised' and a 'valid' asset count is generated and recorded. No further investigation or validation of asset information associated with 'valid' assets is undertaken as part of the NDIP Data Quality improvement process.

Figure 2 shows how an alignment of key asset information across SPEN systems leads to 'synchronisation' of the asset and a 'valid' asset count. An 'exception' is generated when selected data fields do not align and these 'invalid' assets form the basis for further review.

Overhead lines & cables

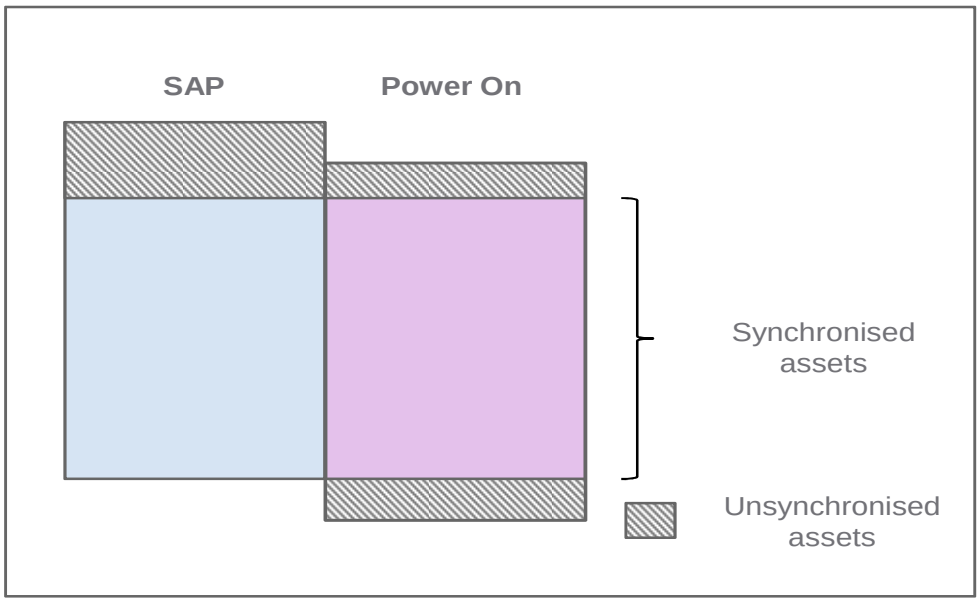
In the case of lines and cables, where information is predominantly stored in the master GIS (ESRI), an inter-system comparison of data attributes is not possible and the validation process focusses on the veracity and accuracy of information contained within the single source system. In this case the initial asset count is determined by confirming the status of a number of key information fields.

The following ESRI fields are interrogated:

- Cable ownership: is the cable recorded as being owned by Scottish Power or by a third party (consumer-owned)?
- Commissioned status: is the cable recorded as being in service and operational (commissioned)?
- Does the cable asset have a valid 'Feeder ID' within the system?[8]

In this example, if the answer to all three questions is 'yes' then the asset is deemed to be 'valid' and contributes to the initial asset count. Assets where the answer to any one of the three questions is 'no' are added to an 'invalid' list for further investigation.

Figure 2 - Synchronisation across systems is part of the validation process for plant and equipment



Business rules

Many of the exceptions identified through these processes have been resolved through the application of business rules. The business rules provide an internally consistent means of making a decision as to whether an exception is deemed 'valid', and therefore counted in the asset register, or 'invalid', and discounted from the asset base. The business rules have been developed with the Data Management team as standardised responses to common exceptions that arose during NDIP Data Quality investigations[9].

The Business Rules set out the required actions (decisions) associated with a number of plausible scenarios associated with identifying the asset. Typically, these decision-making rules are captured, manually, in spreadsheet tables. They provide guidance to NDIP Data Quality team on the validity, or otherwise, of the inclusion of an individual asset in the regulated asset count. Some business rule outcomes require further investigation; in which case, a 'site visit' action is determined and a new entry created on the 'site visit' log.

PA observes that the numerous business rules are captured, manually in a variety of spreadsheet formats and that there may be value in consolidating the rules in a common format and in a single repository. This could help minimize the likelihood of errors, promote alignment of approach across asset classes (where possible) and also provide a more robust basis for future promulgation of the business rules through the broader SPEN business.

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[8] The feeder ID is the key field within the connectivity model linking customers to substations to provide IIS reporting. It also enables customer service to link customers to substations and onwards to HV feeders. At LV and HV the ESRI “Feeder Manager” module addresses network connectivity from the Primary circuit breaker to LV customer.

[9] For the Priority 1 and 2 asset groups 336 business rules were developed.

3.5 'Unsynchronisable' Asset Categories

Where exception reporting has not been possible to correct volumes of Priority 3 & 4 assets, the NDIP team developed alternative bespoke approaches with relevant experts for each asset category. Such approaches were pursued for 62 Priority 3 & 4 asset types where relevant asset data was either not available or resided on a single IT system, and thus precluded exception reporting.

The NDIP process to validate 'unsynchronisable' asset volumes has used asset information from a variety of current and legacy data sources which is combined with Expert Panel estimation and allocation techniques establish reliable asset volumes for each Priority 3 & 4 asset category.

In preparation for submission of the RIIO-ED1 business plan in March 2014, SPEN has sought to validate all Priority 3 & 4 asset volumes for inclusion in the RIIO-ED1 Business Plan Data Tables, being formally reported within the 2013/14 RRP. The NDIP Data Quality Workstream is ongoing and is scheduled to continue into Quarter 3 2014. It is anticipated that asset volumes in the few remaining asset groups will be validated during this period[10].

The 62 'unsynchronisable' Priority 3 & 4 asset types were grouped in the following categories:

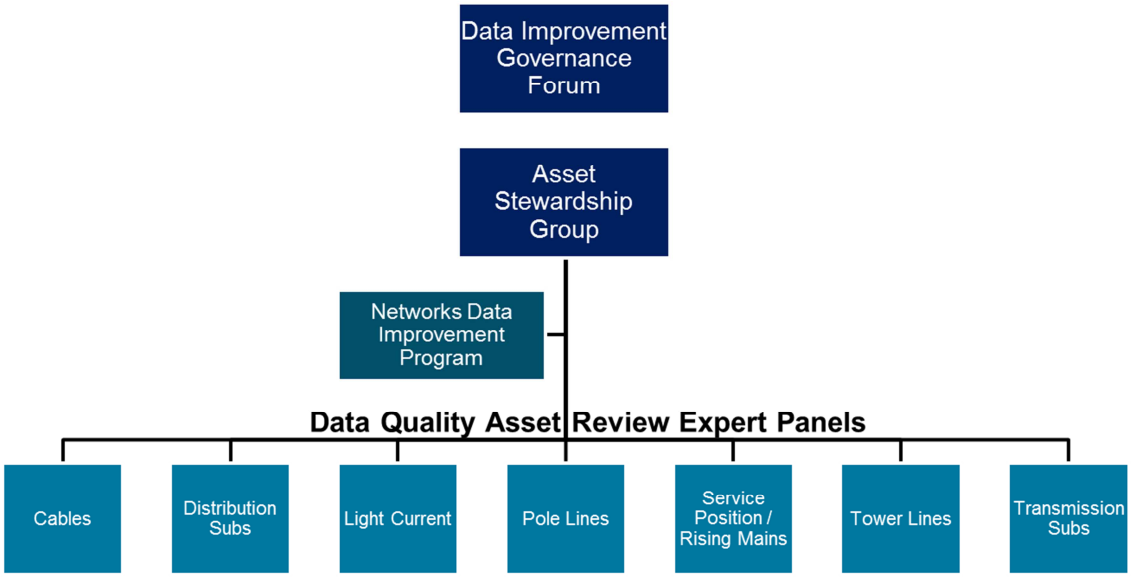
- Cables
- Distribution Subs
- Light Current
- Pole Lines
- Service Position / Rising Mains
- Tower Lines
- Transmission Subs

These groupings provided the basis for each Data Quality Asset Review Expert Panel, and contained individuals with deep knowledge of SPEN's asset base and the availability of different asset data sources. This expertise could then be passed onto NDIP team members for further investigations and subsequent checking.

These Expert Panels were created as temporary groups to improve asset volume quantification for particular asset categories. The Panels worked in partnership with SPEN's enduring Asset Stewardship Group, which has responsibility to review asset volume adjustments before being submitted to the Governance Forum for final approval. The Stewardship Group reports to the senior Data Improvement Governance Forum, who takes ultimate accountability for the integrity of asset data as shown in Figure 3.

[10] The NDIP Data Quality team's next priority will be to review the 6.6 kV & 11 kV Switchgear group

Figure 3 – Data improvement governance structure for Expert Panels



3.5.1 Data Quality Asset Review Expert Panels

The primary objective of each Expert Panel is to establish reliable network size information, with asset volumes aligned with OFGEM reporting definitions. Of the 62 asset types, the panel will identify where there the most complete and accurate data within the business exists, or otherwise suggest business rules from which to best estimate asset volumes.

Aims and Objectives

The objectives of the Data Quality Asset Review Expert Panels were to ensure that:

- Establish reliable network asset volume for each relevant asset type in SPD & SPM.
- Develop agreed approaches to improve the accuracy of asset volumes for regulatory reporting purposes.
- Identify data sources for the different asset types that may exist outside of the corporate data systems.
- Review the analysis and findings undertaken by the NDIP team according to the agreed validation approach.
- Provide recommendations on implementing the embedding missing asset data attributes into the Corporate Systems where asset information is not recorded within a corporate database.
- Provide the Asset Stewardship Group with recommendations for new processes to maintain the accuracy of validated asset data in SPEN's asset information systems.

Where no reliable data sources exist for a particular asset type, each Panel was required to propose solutions as to how this data could be quantified or collected from the field.

Expert Panel membership

Membership of each Data Quality Asset Review Expert Panel comprised:

- Expert Panel Chairman
- Asset Stewardship Group Representative (if not covered by Expert Panel Chair)
- NDIP Data Quality Project Manager
- NDIP Data Quality Technical Team Lead

- Asset Management Representative
- Investment Planning Representative

Members on a required basis only:

- Systems UK Representative
- Data Management Network Updates Representative (North & South)
- NDIP Programme Manager
- Asset Subject Matter Experts

Responsibilities and Activities

Expert Panel activities consisted of workshops and informal meetings to establish representative asset volumes in each asset group. Preliminary pre-workshop fact finding questionnaires were developed for completion by Expert Panel members to inform the workshop discussions and guide the review process. An example of such a questionnaire for LV Pillars (Indoor) is provided in Appendix 1.

Each Data Quality Asset Review Expert Panel typically met on 3 separate occasions to establish RRP Network Asset Volumes for inclusion in the 2013-2014 RRP submission for each asset type. The workshops sought to resolve outstanding issues and assign actions to the appropriate owners within the panel.

Items requiring approval were submitted to the Asset Stewardship Group, or if not practicable the Data Improvement Governance Forum which meets monthly and is represented by SPEN directors.

Once the Expert Panel had agreed the validation approaches to be adopted, the NDIP took implementation responsibility to validate Network Asset Volumes. Upon completion of the validation the Expert Panel members reconvened to review and agree the Network Asset Volumes proposed by the NDIP for ultimate approval by SPEN directors.

Outputs and Deliverables

Outputs and deliverables varied across the different Expert Panels. However, standard deliverables following investigations included the following options :

1. **Accept current process for reporting** – Having gone through the process the Expert Panel concluded that whilst the data existed in one corporate system, the process for recording, maintaining and reporting Network Asset Volume was under adequate control and acceptable for future reporting.

2. **Business decision required -** In the instances where no data was found within the business, the Expert Panel recommended that the business carry out a cost benefit analysis and risk assessment to determine the exposure of the business of not collecting and maintaining the asset type data.

3. **Use an estimating system for network size –** Where data existed but was not maintainable within an existing corporate system, an estimation methodology based on sound business logic that could be applied to create a best estimate of network size was recommended.

4. **Implement Data into a Corporate System**
    a. **Implementation feasible within current corporate system –** Where data was readily available and fit within the current data model adopted by the corporate system, the Expert panel recommended implementation of specific activities, either as a separate project or as an ongoing data improvement schedule with suitable processes put in place for the management of the data on an ongoing basis.

b. **Requiring a system Data Change for implementation** – Where data was readily available for asset types within the business but which did not fit within the existing data model adopted by the corporate system, the Expert Panel recommended changes to the Data Change Forum, to enable this data to be inputted into the system and suitable processes be put in place for the management of the data on an ongoing basis.

c. **Full Site Survey required for confirmation before implementation -** For asset types which were eligible (i.e. non-buried assets) to be Site Surveyed in an expedient manner and could be implemented into the existing corporate systems, either as a separate project or within current inspection regimes. The Expert Panel recommended that these be prioritised to achieve confirmation and then implemented into the corporate system and suitable processes be put in place for the management of the data on an ongoing basis.

4 REVIEW OF SPECIFIC ASSET CATEGORIES ('DEEP DIVES')

Fourteen 'deep dives' were undertaken following the selection of specific asset categories as outlined in Section 2.2. The aim of these 'deep dives' was to scrutinise the procedures adopted to confirm whether the resultant changes to asset volumes were reasonable and suitable for inclusion in regulatory network size reporting.

4.1 Basis of Selection

The asset types chosen for Priority 3 & 4 Deep-dive analyses were selected according to the largest differences between the revised (NDIP) information and the previously submitted 2012/13 RRP data – both in terms of asset volumes (asset counts or kilometres for cable assets) and asset value (MEAV). For each Deep-dive exercise, the corresponding revisions to asset volumes were assessed for the SPD and SPM network areas.

For each of the selected asset categories the following items were explored:

1. How the initial asset volumes were generated for the Priority 3 & 4 asset groups including the systems and asset attributes used in the assessment process?
2. Details of business rules applied to determine asset volumes.
3. Level of engagement with asset experts and business stakeholders outside the NDIP team to validate the proposed revisions to asset volumes.
4. Details of the processes adopted to ensure the revised asset volumes are accurately updated in SPEN asset information systems.
5. Measures to minimise the likelihood of inaccurate data records occurring in the future?

During each review, PA has worked closely with the NDIP team to understand the processes adopted for each asset type. The asset categories selected for the Deep-dive assessments are repeated for clarity in Table 3.

PA chose to concentrate on the unsynchronisable Priority 3 & 4 asset groups as part of this assurance work which required input from Expert Panel members. This decision was also influenced by the magnitude of asset volume changes which were more significant for the 'unsynchronisable' asset categories. Two 'synchronisable' Priority 3 asset categories were also included in the deep-dive reviews. The magnitude of the asset volume changes in each of the chosen categories is provided in Table 4.

Table 3 – Asset categories selected for detailed 'Deep-dive' reviews in SPD & SPM areas

Asset Group	Asset Name	Validation Methodology
LV Pillars	LV Pillar (ID)	Expert Panel Review
	LV Pillar (OD at Substation)	Expert Panel Review
LV Boards	LV Board (WM)	Expert Panel Review
	LV Board (X-type Network) (WM	Expert Panel Review
LV Services	LV Service (OHL)	Expert Panel Review
	LV Service (UG)	Expert Panel Review
	LV Service associated with RLM	Expert Panel Review
	Cut Out (Metered)	Expert Panel Review
Rising and Lateral Mains	Rising and Lateral Mains	Expert Panel Review
Protection	Pilot Wire Overhead	Expert Panel Review
	Pilot Wire Underground	Expert Panel Review
33kV Switchgear	33kV Switchgear – Other (PM)	Exception Reporting
	33kV Switchgear (PM)	Exception Reporting
Cable	HV Submarine Cable	Exception Reporting

Table 4 – Summary of the most significant Priority 3 & 4 asset volume changes selected for Deep-dive review and validation

Priority	Licence	Name	Units	'Expert' Unit Cost: (not SP) £k	RRP V1 Submission for 2012/2013		Proposed RRP V1 Submission for February 2014				Variance	
					Volume	MEAV (£k)	Current IT Volume	MEAV (£k)	Proposed Volume	MEAV (£k)	Volume	MEAV (£k)
Pilot Wires group												
4	SPD	Pilot Wire Overhead	km	10	0	0	0	0	181	1,810	181	1,810
4	SPD	Pilot Wire Underground	km	60	2,086	125,160	3,159	189,540	2,777	166,620	691	41,460
4	SPM	Pilot Wire Overhead	km	10	0	0	0	0	988	9,880	988	9,880
4	SPM	Pilot Wire Underground	km	60	140	8,400	473	28,380	11,880	712,800	11,740	704,400
LV Boards & Pillars group												
3	SPD	LV Board (WM)	Each	10	0	0	0	0	4,850	48,500	4,850	48,500
3	SPD	LV Board (X-type Network) (WM)	Each	10	0	0	0	0	0	0	0	0
3	SPD	LV Pillar (ID)	Each	7.5	16,065	120,488	0	0	2,286	17,145	-13,779	-103,343
3	SPD	LV Pillar (OD at Substation)	Each	7.97	0	0	0	0	13,324	106,192	13,324	106,192
3	SPM	LV Board (WM)	Each	10	0	0	0	0	6,011	60,110	6,011	60,110
3	SPM	LV Board (X-type Network) (WM)	Each	10	4,869	48,690	0	0	4,747	47,470	-122	-1,220
3	SPM	LV Pillar (ID)	Each	7.5	10,907	81,803	0	0	428	3,210	-10,479	-78,593
3	SPM	LV Pillar (OD at Substn)	Each	7.97	0	0	0	0	1,195	9,524	1,195	9,524

Priority	Licence	Name	Units	Unit Cost (£k)	RRP V1 Submission for 2012/2013		Proposed RRP V1 Submission for February 2014				Variance	
					Volume	MEAV (£k)	Current IT Volume	MEAV (£k)	Proposed Volume	MEAV (£k)	Volume	MEAV (£k)
LV Services group (including RLM)												
4	SPD	LV Service (OHL)	Each	0.47	29,528	13,878	122,772	57,703	122,772	57,703	93,244	43,825
4	SPD	LV Service (UG)	Each	1.18	2,043,611	2,411,461	1,383,204	1,632,181	1,383,204	1,632,181	-660,407	-779,280
4	SPD	LV Service associated with RML	Each	1.18	0	0	0	0	511,284	603,315	511,284	603,315
4	SPD	Rising & Lateral Mains	Each	1	0	0	0	0	79,605	79,605	79,605	79,605
4	SPM	LV Service (OHL)	Each	0.47	49,503	23,266	45,484	21,377	45,484	21,377	-4,019	-1,889
4	SPM	LV Service (UG)	Each	1.18	1,496,934	1,766,382	1,316,976	1,554,032	1,316,976	1,554,032	-179,958	-212,350
4	SPM	LV Service associated with RML	Each	1.18	0	0	0	0	136,282	160,813	136,282	160,813
4	SPM	Rising & Lateral Mains	Each	1	0	0	0	0	25,597	25,597	25,597	25,597
33 kV Switchgear group												
4	SPD	33 kV Switchgear – Other	Each	58.74	1,325	77,831	0	0	0	0	-1,325	-77,831
3	SPD	33 kV Switch (PM)	Each	2	0	0	248	496	248	496	248	496
4	SPM	33 kV Switchgear – Other	Each	58.74	1,493	87,699	0	0	0	0	-1,493	-87,699
3	SPM	33 kV Switch (PM)	Each	2	0	0	1	2	1	2	1	2

Priority	Licence	Name	Units	Unit Cost (£k)	RRP V1 Submission for 2012/2013		Proposed RRP V1 Submission for February 2014				Variance	
					Volume	MEAV (£k)	Current IT Volume	MEAV (£k)	Proposed Volume	MEAV (£k)	Volume	MEAV (£k)
HV Submarine Cable group												
3	SPD	HV Sub Cable	km	351.75	3	1055	0	0	11	3869	8	2814
3	SPM	HV Sub Cable	km	351.75	5	1759	0	0	5	1759	0	0

4.2 Summary of findings

This section summarises each of the Deep-dive asset reviews undertaken by asset category. The information presented shows the proposed changes in asset volumes for inclusion in 2013/2014 RRP and the RIIO-ED1 business plan in March 2014. Each Deep dive investigation is discussed in turn according to the significance of the asset volume changes being proposed.

4.2.1 Pilot Wire Group

The reporting definitions for overhead and underground pilot wires are provided in Table 5. SPEN includes optical fibre, wireless, and telecoms related cables in this asset group which has a significant impact on reported lengths in both network areas. PA regards SPEN's inclusion of these cables with pilot wire to be reasonable.

Table 5 – Reporting definitions for Pilot Wires

Asset Type	**PILOT WIRE Overhead**
Voltage	All distribution voltages including 132 kV in SPM
OFGEM Definition	A multicore cable, not part of a distributing main, that forms part of a protection scheme, which • is suspended on poles or towers; and • carries signals, currents or voltages between different substation sites.
Data Sources	Fibre, wireless & telecoms cable: Circuit Provisioning Application database (CPA managed by Vodafone) HV: High voltage Customer Interruptions reporting tool (HVCI) EHV: Legacy Network Management System information (NMS)

Asset Type	**PILOT WIRE Underground**
Voltage	All distribution voltages including 132 kV in SPM
OFGEM Definition	A multicore cable, not part of a distributing main, that forms part of a protection scheme, which: • is buried with mains cables or separately; and • carries signals, currents or voltages between different substation sites
Data Source	Fibre, wireless & telecoms cable: Circuit Provisioning Application database (CPA managed by Vodafone) HV: High voltage Customer Interruptions reporting tool (HVCI) EHV: Legacy Network Management System information (NMS)

Original Corporate System Volumes

In previous regulatory submissions, SPEN did not report overhead pilot wires length although asset experts confirmed the presence of relatively short line lengths on both networks. Underground pilot wires are used more extensively in both networks and the length recorded for SPD (2,086 km) was regarded as credible although that for SPM (140 km) appeared very low given the extensive use of unit protection.

Pilot Wires Underground have historically had a feature class within SPEN's ESRI Geographic Information System, currently still unable to Capture Pilot Wire Overhead. However, total volume extracts from indicated only 473 km of underground pilot wire in and given SPM's dependence on unit protection, this volume was regarded as too low by asset experts. It was realised that the ESRI records for Pilot Wire were incomplete and therefore alternative data sources would be required.

Incomplete pilot wire records in ESRI have arisen from the time of map vectorisation through to current records, only updated when suitable Data Returns are received. Digital raster records do not record pilot wire lengths and are difficult to distinguish from other cable. It was recognised that searching for pilot wires records within ESRI would not identify the total size of the pilot wire asset base in either network area. However, it should be noted that ESRI already contains functionality to record pilot wire length both through the 'Pilot Wire Underground' Feature Class and 'Detail' Attribution Fields associated with the ESRI 'Construction Type'. Figure 4 & Figure 5 provide examples of raster and vectorised pilot wire records in ESRI.

Figure 4 – RASTER Image of Pilot Wire

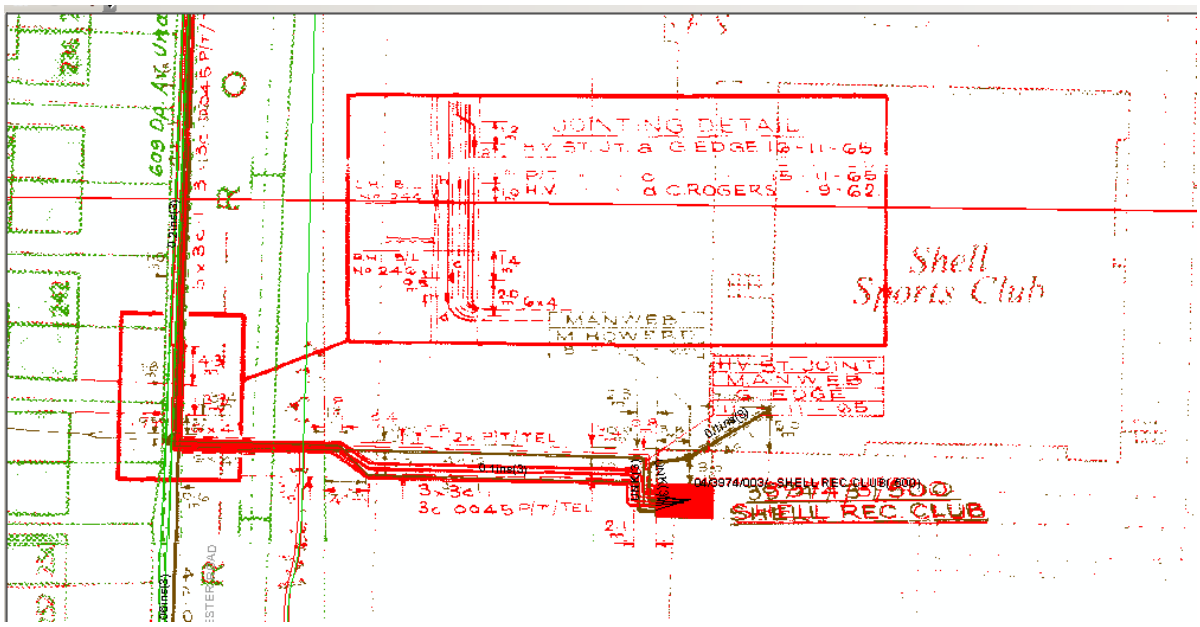
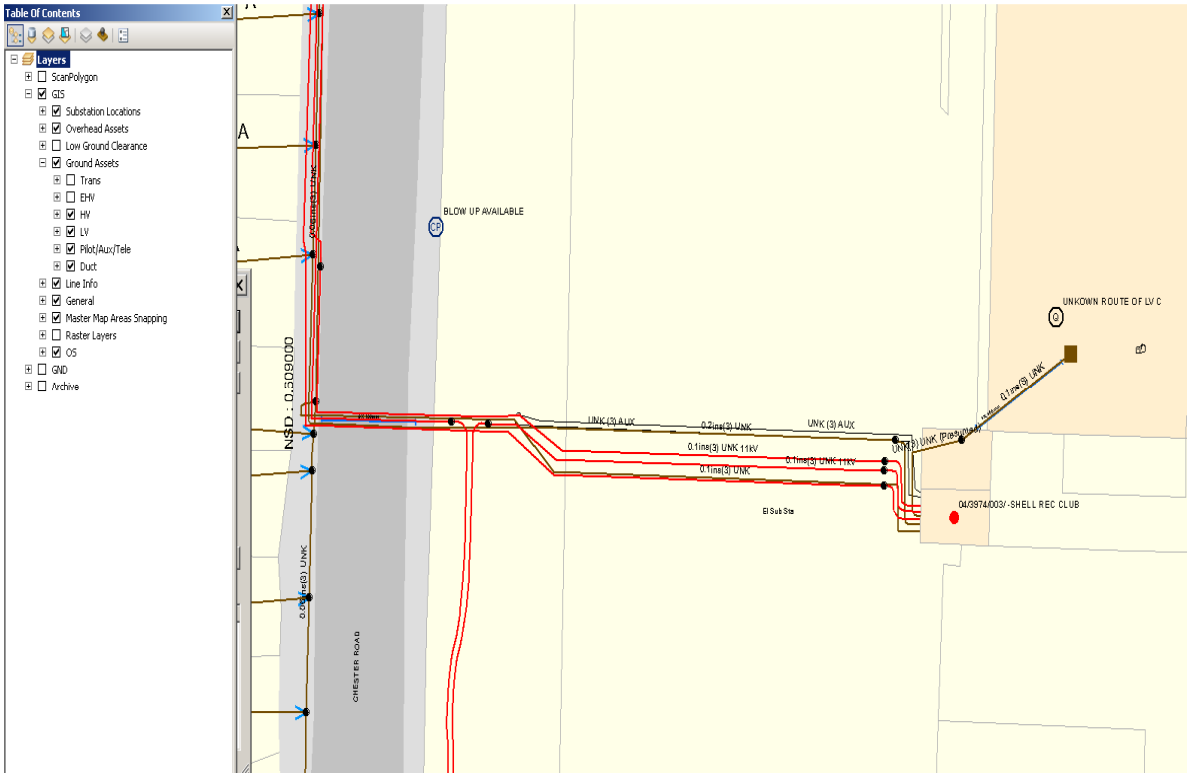


Figure 5 – ESRI Image of RMU Circuit



Expert Panel Approach

An alternative pilot wire quantification methodology was adopted based on the recommendations of the Expert Panel. Initial approaches to interrogate ESRI records were dismissed as records were incomplete and time-consuming to interpret. Similarly, averaged cable length approaches for pilot wires were deemed insufficiently accurate and therefore alternative data sources were required.

The adopted methodology used a combination of different data sources and applied business logic to calculate the lengths pilot & communications wires. The following three additional data sources were utilised:

- **CPA database**: The Circuit Provisioning Application database is a third party managed repository for communications related infrastructure initially established by Scottish Power Telecoms. This database contains length information for overhead and underground fibre-optic, telecoms and wireless cables. Management responsibility for the CPA database has changed following various mergers and acquisitions and is currently outsourced to Vodafone. SPEN staff regularly update CPA records through established monthly extracts from Vodafone. The information contained in CPA is not currently recorded in ESRI.
- **HVCI reporting**: The High Voltage (11kV) Customer Interruptions reporting tool uses SAP circuit information to record quality of supply related incidents (Customer Interruptions & Customer Minutes Lost) on 11 kV circuits in SPD & SPM. As HVCI records supply incidents on all 11 kV circuits and identifies substations linked by each circuit, it was possible to segregate circuits with unit protection, which were deemed to be served by a pilot wire. The HCVI reporting tool quantifies the length of each circuit's underground and overhead components. By assuming a 1:1 relationship between power cable length and pilot wire length, it was possible to estimate total asset volumes in each network area for underground and overhead pilot wires on 11 kV circuits. The length of such pilot wire on the SPD network was found to be minimal due to the infrequent use of unit protection on the largely radial network.

- **NMS legacy data**: The Expert Panel recognised the need to quantify pilot wire employed on 33 kV circuits and realised SPEN's legacy Network Management System contained additional pilot wire records. Previous investigations had quantified the length of such pilot wire and this was validated by running traces in ESRI against the current network length and then used to supplement the CPA & HVCI totals. The length of such pilot wire on the SPD network was found to be minimal due to the infrequent use of unit protection on the largely radial network.

Each data source enabled calculation of discrete pilot wire lengths which could be summated to determine total pilot wire volumes, both for underground and overhead circuits in each network area. The results of these analyses are summarised in Table 6 & Table 7.

Table 6 – Pilot Wire component lengths

Data Source	SPD		SPM	
Pilot Wire Position (UG/OH)	**Underground**	**Overhead**	**Underground**	**Overhead**
CPA Database	2,777 km	181 km	7,337 km	367 km
HVCI Reporting Tool	0	0	3,318 km	465 km
NMS Legacy Data	0	0	1,225 km	156 km
Total	**2,777 km**	**181 km**	**11,880 km**	**988 km**

Table 7 – Pilot Wire asset volume and MEAV changes

Licence	Name	Units	Unit Cost (£k)[11]	RRP V1 Submission for 2012/2013		Proposed RRP V1 Submission for March 2014		Variance	
				Volume	MEAV (£k)	Proposed Volume	MEAV (£k)	Volume	MEAV (£k)
SPD	Pilot Wire Overhead	km	10	0	0	181	1,810	181	1,810
SPD	Pilot Wire Underground	km	60	2,086	125,160	2,777	166,620	691	41,460
SPM	Pilot Wire Overhead	km	10	0	0	988	9,880	988	9,880
SPM	Pilot Wire Underground	km	60	140	8,400	11,880	712,800	11,740	704,400

As can be seen, a significant additional volume of underground pilot wire has been identified in SPM. This is primarily attributable to more than 7,000 km of underground communications related cable being identified for SPM this is largely due to the inclusion of the 132kV pilot network, which are regarded as transmission assets in Scotland. Clearly, the inclusion of optical fibre, wireless and telecoms related cables also has a significant impact on SPM reported lengths in this asset category.

[11] The Unit Costs used by SPEN in MEAV calculations are based on Ofgem expert costs. SPEN has indicated that a Unit Cost of £20k is more appropriate for Pilot Wire Underground as such cable would be laid at the same time as power cable, thus avoiding additional installation costs.

Potential improvements

A number of decisions will need to be made regarding the enduring solution to maintain accurate asset records for pilot wires, fibre-optic, wireless and telecoms cables. The following options require consideration:

- Evaluate opportunity for SPEN to assume in-house management responsibility for CPA database;
- Inclusion of CPA asset information in ESRI;
- Inclusion of NMS asset information in ESRI; and
- Confirm existence of pilot wires on 11 kV circuits through business as usual Inspection & Maintenance activities

Whilst ERSI currently contains the functionality to incorporate pilot wire underground information within the GIS system, this would be a substantial exercise which merits thorough cost-benefit analysis before committing expenditure.

4.2.2 LV Boards and Pillars Group

The reporting definitions for LV Pillars and Boards are provided in Table 8. Whilst all LV Pillar & Board information is held centrally in SAP, some misallocation of assets has occurred due to the inability of SAP to distinguish between freestanding and wall-mounted Fuseboards[12].

Table 8 – Reporting definitions LV Pillars & Boards

Asset Type	**LV PILLAR (ID)**
Voltage	LV
OFGEM Definition	A free standing or transformer mounted LV cable connection pillar with busbars, circuit protection and isolation facilities located indoors
Data Source	EXPERT PANEL ESTIMATION FROM SAP

Asset Type	**LV BOARD (WM)**
Voltage	LV
OFGEM Definition	Wall-mounted distribution boards within indoor substations with open type assembly usually used for live withdrawal/insertion of fuse-links. Excludes LV Board (X-Type network) (WM).
Data Source	EXPERT PANEL ESTIMATION FROM SAP

Asset Type	**LV BOARD (X-TYPE NETWORK) (WM)**
Voltage	LV
OFGEM Definition	Wall-mounted distribution boards with open type assembly usually used for live withdrawal/insertion of fuse-links. Used on interconnected networks with unit type protection**.**
Data Source	EXPERT PANEL ESTIMATION FROM SAP

[12] SAP currently lacks an attribute field to record whether a LV board is wall-mounted

Asset Type	**LV PILLAR (OD AT SUBSTATION)**
Voltage	LV
OFGEM Definition	A free standing or transformer mounted LV cable connection pillar with busbars, circuit protection and isolation facilities located outdoors within or adjacent to a substation and connected directly to the substation distribution transformer.
Data Source	SAP

Original Corporate System Volumes

Historic reporting of asset volumes in the LV Boards and Pillars group has incorrectly defaulted towards indoor LV Pillars in both network areas. In SPD, no wall-mounted boards of any type have been reported. In the SPM network area, wall-mounted LV Boards (X-Type) asset volumes have been reported as a consequence of SAP being able to identify LV Boards at unit protected substations and these were all assumed to be wall mounted. Whilst a significant number of LV Pillars were expected to need reallocating as wall-mounted LV Boards, the combined total of LV Boards and Pillars was not expected to change significantly.

Expert Panel Approach

SPEN's corporate systems do not currently distinguish whether LV Fuseboards are wall-mounted or free-standing. Therefore asset volumes had to be derived from corporate system SAP data using business rules developed with the Expert Panel. The first step of the process was to identify, using the SAP situation field, whether LV Fuseboards located at each secondary (HV/LV) substation was either Indoor or Outdoor. The latter information was used to directly determine the asset count for 'LV Pillars (OD at substation)' in both network areas.

The second step of the process developed with the Expert Panel was to identify the number of LV Pillars with an Indoor Situation Description, which also had an associated transformer mounted LV cable connection pillar[13] as per Ofgem's definition. Step 3 required a SAP query to be developed which identified the subset of Indoor Fuseboards coinciding with a Secondary transformer as part of the asset description. This identified the asset count for 'LV Pillar (ID)'.

Step 4 applied a difference technique to subtract the number of LV Pillar (ID) records from this total number of Indoor Fuseboards identified in Step 1. It was deduced that the resultant number of indoor LV Fuseboards would be wall-mounted. However, further analysis was required to determine how many of these wall-mounted LV Boards were associated with X-Type networks.

Step 5 of the Expert Panel process was required to identify the number of Wall Mounted LV Boards associated with X-Type Networks. This was achieved through a SAP query on the combined wall mounted dataset to identify Fuseboards with a Ground Mounted Secondary Transformer which also have an associated X-type RMU at the substation. This calculation identified the asset count for 'LV Boards (X-Type Network) (WM)' and it follows that the remaining wall-mounted Fuseboards would not be associated with X-Type Networks and therefore could be classified as 'LV Boards (WM)'.

[13] Referred to by SPEN as 'Take-off Chambers'

Table 9 – Indoor LV Board & Pillar Calculation Methodology

Steps of LV Boars & Pillar Calculation Methodology	SPD	SPM
Total count of LV Indoor Fuse boards associated with a HV substation from SAP	7,136	10,148
LV Pillar (ID) – (e.g. Secondary Connection Type = "Unit/ Take Off Chamber")	-2,286	-427
Derived Count for Total Wall Mounted Boards:	4,850	9,720
LV Wall mounted boards that have an associated X-Type RMU. i.e. **LV Boards (X-Type) (WM)**	0	-4,747
LV Wall Mounted boards (no X-type equipment) at Secondary substations	4,850	4,973
LV Wall Mounted Fuseboards at LV Only Substations (Predominantly SPM)	0	1,038
Total LV Wall Mounted Boards, i.e. **LV Boards (WM)**	4,850	6,011

Table 10 – Asset volume revisions for LV Fuseboards & LV Pillars

Licence	Name	Units	Unit Cost (£k)	RRP V1 Submission for 2012/2013		Proposed RRP V1 Submission for March 2014		Variance	
				Volume	MEAV (£k)	Proposed Volume	MEAV (£k)	Volume	MEAV (£k)
SPD	LV Board (WM)	Each	10	0	0	4,850	48,500	4,850	48,500
SPD	LV Board (X-type Network) (WM)	Each	10	0	0	0	0	0	0
SPD	LV Pillar (ID)	Each	7.5	16,065	120,488	2,286	17,145	-13,779	-103,343
SPD	LV Pillar (OD at Substation)	Each	7.97	0	0	13,324	106,192	13,324	106,192
SPM	LV Board (WM)	Each	10	0	0	6,011	60,110	6,011	60,110
SPM	LV Board (X-type Network) (WM)	Each	10	4,869	48,690	4,747	47,470	-122	-1,220
SPM	LV Pillar (ID)	Each	7.5	10,907	81,803	428	3,210	-10,479	-78,593
SPM	LV Pillar (OD at Substn)	Each	7.97	0	0	1,195	9,524	1,195	9,524

A final step, which was more relevant to the SPM network, was to add the number of LV Fuseboads located at LV substations to the LV Board (WM) asset count as Expert Panel members confirmed all such Fuseboards would be wall-mounted. This final step was less relevant in SPD as a consequence of there being very few LV-only substations.

The resultant changes to asset volumes in each of the LV Boards and Pillars Asset Categories can be summarised as follows:

- Previously unreported LV Boards (WM) have increased to 4,850 & 6,011 units in SPD & SPM respectively;
- The number of LV Boards (X-type Network) (WM) in SPM have been derived to be 4,747;
- There are no LV Boards (X-type Network) (WM) located in SPD;

- The number of LV Pillars (ID) in SPD & SPM have been reduced significantly to 2,286 & 428 respectively;
- Previously unreported LV Pillars (OD at Sub) have increased to 13,324, & 1,195 units in SPD & SPM respectively;
- The total number of LV Pillars and Boards in SPD has increased by 4,395 units; and
- The total number of LV Pillars and Boards in SPM has increased by 1,474 units.

PA believes the calculation methodology using existing SAP asset data as devised by the Expert Panel and implemented by the NDIP team to be reasonable and robust.

Potential improvements

From a corporate systems development perspective, the inclusion of a new 'Wall-mounted' and 'Wall-Mounted (X-type)' Attribute in the Situation Field in SAP could avoid the requirement to derive asset volumes for LV Pillars and Boards in future utilising a single count rather than a derivation method. However, direct reporting from SAP would be conditional upon all Fuseboard records being cleansed according to the described methodology to ensure this Attribute Field was correctly populated from the outset.

LV Pillar and Board asset data accuracy could be further refined through refinements to business as usual Inspection & Maintenance activities. However, such refinements could be complicated to implement in the absence of a 'Wall-mounted' Attribute Field in SAP.

It should be recognised that whilst the accuracy of regulatory asset volume reporting has been improved as a result of the Expert Panel calculation methodology, it is not yet possible for SPEN to record these asset attributes in SAP although corresponding system updates are being planned.

4.2.3 LV Services and Rising & Lateral Mains

The reporting definitions for LV Services and Rising & Laterals Mains are provided in Table 11. Although the total number of customers in each network area is well understood, accurate reporting of the numbers of the different types of LV Service has not been possible until 2014.

Table 11 – Reporting definitions for LV Services & RLM

Asset Type	**LV SERVICE (UG)**
Voltage	LV
OFGEM Definition	An underground cable which connects either a street electrical fixture, or normally no more than four consumers' installations in adjacent buildings (with the exception of looped underground services), to either an LV Underground Main or LV Overhead Main.
Data Source	ESRI

Asset Type	**LV SERVICE (OH)**
Voltage	LV
OFGEM Definition	A LV overhead line which connects either a street electrical fixture, or no more than four consumers' installations in adjacent buildings, to an overhead main.
Data Source	ESRI

Asset Type	**RISING & LATERAL MAINS (RLM)**
Voltage	LV
OFGEM Definition	Individual DNO owned 3 phase cable or busbar, not laid in the ground, which runs within or attached to the outside of a multiple occupancy building for: • More than 3m vertically, or • More than 3m horizontally, and • to which a number of individual services are connected, usually via a distribution board. This excludes undereaves or mural wiring.
Data Source	**EXPERT PANEL ESTIMATION**

Asset Type	**LV SERVICE ASSOCIATED WITH RLM**
Voltage	LV
OFGEM Definition	An LV service which connects an individual property to a Rising or Lateral Main
Data Source	**EXPERT PANEL ESTIMATION**

For the 2013/2014 financial year, SPEN has sought to improve quantification of the number of LV Services by utilising data from corporate information systems combined with Expert Panel estimation techniques for RLMs. The situation regarding the number of RLMs in the SPD & SPM networks differs substantially in terms of the percentage of customers living in flats, tenements and tower-blocks. In the SPD network area, census data confirms that the proportion of customers living in multi-occupancy dwellings is significantly higher than the UK average, particularly in the Greater Glasgow and Edinburgh conurbations. Shared internal mains systems are common in multi-occupancy property types. However, quantification is complicated by the RLM definition which explicitly excluding single-phase supplies.

Original Corporate System Volumes

SPEN's initial approach to quantify RLM served customers was not aligned with Ofgem definitions as attempts were made to estimate cable lengths associated with RLMs instead of confirming absolute numbers of RLM systems. In the previous regulatory submission, SPEN did not provide metrics for the numbers of RLM systems or the number of LV services associated with RLMs. Instead, a fully inclusive estimate of the number of LV Services (UG) was reported. Given the property mix in both network areas, SPEN has sought to develop alternative quantification methodologies for RLMs and associated LV Services.

Expert Panel Approach

SPEN's revised asset counts for RLMs and the number of associated LV Services were established through liaison with an Expert Panel. In the past two years, SPEN has mobilised a significant modernisation programme for RLMs initially targeting the highest risk tower-blocks for asset renewal. This has improved SPEN's understanding of the number and typical layouts of RLM served buildings.

The quantification of stand-alone underground and overhead LV Services was straightforward as this information was readily available from SPEN's ESRI Geographic Information System (GIS). Another feature of SPEN's GIS system was the inclusion of Ordnance Survey Topographical Identifier (TOID) information from their maintained and updated MasterMap Address Layer 2 dataset (based on the Post Office Postcode Address File (PAF)) for properties containing multiple customer addresses, thus

indicating multi-occupancy. Cross-checks were undertaken to confirm how RLM related asset volumes aligned with the other LV Services and Cut-Outs to ensure consistency.

The Expert Panel developed business rules to estimate the number of RLMs and associated LV Services by using TOID counts to determine whether a property was likely to be served by a RLM system. Table 12 summarises potential RLM volumes within properties containing different numbers of TOIDs. A key Expert Panel assumption was that multiple-occupancy properties would be served by a single RLM system, only where the number of customer TOIDs per property was above an agreed threshold. This was confirmed by the ASG Chair, based upon information collected during the modernisation programme. By grouping TOID data, options to estimate the 'Number of Services associated with RLM' could also be reviewed as shown in Table 13.The key challenge to estimating the numbers of RLMs and associated LV services was the choice of TOID threshold beyond which a RLM system was assumed to exist.

Table 12 – Estimation of RLMs located in multiple-occupancy buildings

ESRI Ordnance Survey Topographic Identifiers (TOID) per Building	SPD		SPM	
	Absolute	Cumulative	Absolute	Cumulative
1 TOID	1187750		1388724	
2 TOIDs	120553		43563	
3-4 TOIDs	***25915***	***79605***	***14460***	***25597***
5-6 TOIDs	23276	53690	4995	11137
7-12 TOIDs	24358	30414	3947	6142
13-28 TOIDs	4615	6056	1340	2195
>28 TOIDs	1441	1441	855	855

Table 13 – Estimation of LV Services associated with RLMs in multiple-occupancy buildings

ESRI Ordnance Survey Topographic Identifiers (TOID) per Building	SPD		SPM	
	Absolute	Cumulative	Absolute	Cumulative
1 TOID	1187750		1388724	
2 TOIDs	241106	845761	87126	271537
3-4 TOIDs	93371	604655	48129	184411
5-6 TOIDs	***135911***	***511284***	***27894***	***136282***
7-12 TOIDs	214505	375373	34881	108388
13-28 TOIDs	78959	160868	24114	73507
>28 TOIDs	81909	81909	49393	49393

The TOID threshold chosen by the Expert Panel to estimate the total number of RLMs acknowledges the possibility that 3-phase RLMs could exist in some properties with only 3 or 4 TOIDs. The decision to use a 3-4 TOID threshold minimises the possibility of underestimating the total number of RLMs in each area.

The resultant estimates in each area for the total number of RLMs in SPD & SPM were 79,605 & 25,597 respectively, using this cumulative 3-4 TOID threshold. These estimates were checked with members of SPEN's RLM modernisation team for reasonableness.

SPEN chose a more conservative TOID threshold of 5-6 TOIDs per building to estimate the 'Number of Services associated with RLM' having considered additional external information sources such as census data. Therefore, it was possible to determine the cumulative number of such services in the buildings with a minimum TOID count of 5. The corresponding estimates of the 'Number of Services associated with RLMs' were 511,284 for SPD and 136,262 for SPM.

Clearly whilst these Expert Panel methodologies provide logical estimations of the numbers of RLMs and associated LV Services, actual numbers will inevitably differ. Sensitivity analysis highlights a potential swing of approximately 100,000 'Services associated with RLMs' depending on TOID threshold selection. Similarly a swing of >20,000 is possible for the number of RLMs.

By adopting the Expert Panel's estimation methodology, the NDIP team has been able to provide a more accurate representation of the distribution of LV Services across building types which represents a significant improvement relative to the zeros reported in previous years for RLMs and associated services.

Current Status of Data Cleansing Activities

The numbers of underground and overhead LV Services will continue to be sourced directly from ESRI, although further refinements regarding the attributes to be used in future need to be agreed. Future changes will be managed according to business as usual processes by SPEN's Data Management function. At present, SPEN's corporate systems do not make provision for recording estimates of the number of RLMs or the associated numbers of LV Services. Instead, SPEN's ESRI system will be updated on an ongoing basis to capture the work undertaken by SPEN's RLM modernisation programme, i.e. details of modernised RLMs will be recorded in ESRI rather than estimates of the total population. As the new RLM information is recorded, the level of estimation will reduce until all RLM reporting will be sourced directly from corporate systems.

Future Improvements

It should be possible to further improve the accuracy of SPEN estimates for the number of RLMs and 'Services associated with RLMs' by incorporating feedback from the RLM modernisation programmes. As these programmes progress, improved insights should become available regarding the key features of RLM systems, so it will be important to utilise this information to refine modelling assumptions.

Table 14 – Revisions to LV Services numbers

Licence	Name	Units	Unit Cost (£k)	RRP V1 Submission for 2012/2013		Proposed RRP V1 Submission for March 2014		Variance	
				Volume	MEAV (£k)	Proposed Volume	MEAV (£k)	Volume	MEAV (£k)
SPD	LV Service (OHL)	Each	0.47	29,528	13,878	122,772	57,703	93,244	43,825
SPD	LV Service (UG)	Each	1.18	2,043,611	2,411,461	1,383,204	1,632,181	-660,407	-779,280
SPD	LV Service associated with RML	Each	1.18	0	0	511,284	603,315	511,284	603,315
SPD	Rising & Lateral Mains	Each	1	0	0	79,605	79,605	79,605	79,605
SPM	LV Service (OHL)	Each	0.47	49,503	23,266	45,484	21,377	-4,019	-1,889
SPM	LV Service (UG)	Each	1.18	1,496,934	1,766,382	1,316,976	1,554,032	-179,958	-212,350
SPM	LV Service associated with RML	Each	1.18	0	0	136,282	160,813	136,282	160,813
SPM	Rising & Lateral Mains	Each	1	0	0	25,597	25,597	25,597	25,597

4.2.4 33 kV Switch Group

As part of PA's 2013 network size assurance of the Priority 1 & 2 groups, the asset volume changes associated with 33 kV ground-mounted Switches (Priority 2) were reviewed. Before 2012/2013, no asset volumes had been recorded for this Priority 2 asset type. The 2013 investigations significantly increased the number of these ground-mounted 33 kV switches. The work undertaken by the NDIP represents a continuation of this earlier 33 kV Switchgear analysis to include pole-mounted 33 kV switches and the generic asset type '33 kV Switchgear – Other' which SPEN classifies as Priority 3 & 4 asset types respectively. The reporting definitions for pole-mounted 33 kV Switches and '33 kV Switchgear – Other' are provided in Table 15.

Original Corporate System Volumes

The asset volume reporting situation for the '33 kV Switch (PM)' type is similar to the Priority 2 grounded mounted 33 kV switchgear variants in that no volumes have historically been reported by SPEN. Instead SPEN has historically recorded significant volumes of '33 kV Switchgear – Other' assets which included the majority of pole-mounted and ground-mounted 33 kV switches. Consequently it was necessary to identify and reclassify the pole-mounted 33 kV switches to align with regulatory reporting requirements.

Table 15 – Reporting definitions for 33kV Switchgear

Asset Type	**33kV SWITCH (PM)**
Voltage	EHV
OFGEM Definition	33 kV (includes 22 & 25 kV) switch (pole mounted) includes – all pole mounted circuit breakers, switches and auto sectionalisers
Data Source	SAP & POWERON

Asset Type	**33kV SWITCHGEAR – OTHER**
Voltage	EHV
OFGEM Definition	Detailed definition not available
Data Source	SAP & POWERON

Approach

As SPEN's 33 kV switchgear is recorded in both SAP and PowerOn, it was possible to run synchronisation exception reports which negated the need for Expert Panel reviews. To reconcile the number of assets in the 33 kV Switch (PM) category, SPEN firstly took the decision to discontinue volume reporting for the '33 kV Switchgear – Other' due to a lack of clarity in the definition of this reporting requirement. Instead SPEN took the decision to classify all 33 kV switchgear as either ground or pole-mounted switches. The resultant changes to the Priority 3 & 4 33 kV switchgear asset categories are provided in Table 16.

As described above, asset volumes in the '33 kV Switchgear – Other' category have been set to zero and smaller number of 33 kV pole-mounted switches have been confirmed to exist on the SPD network. These 33 kV pole-mounted switches are far less common in the SPM area with only one such asset being identified.

In order to fully understand the asset movements in this asset group, it is necessary to consider the Priority 2 ground-mounted 33 kV switches in addition to the Priority 3 & 4 assets described above. The NDIP's exception reporting process for both the ground and pole-mounted 33 kV switches has effectively migrated the previously reported volumes in the '33 kV Switchgear – Other' asset type to SPEN's Priority 2 '33kV Switches (GM)' and the Priority 3 '33 kV Switches (PM)' category. Overal the number of assets in these combined 33 kV switchgear ground has increased by 440 units & 586 units in the SPD & SPM network areas respectively.

Current Status of Data Cleansing Activities

Asset data for pole-mounted 33 kV switches has been aligned in SAP and PowerOn as part of the NDIP team's exception report resolution processes in both network areas. In future, asset information changes will be managed by SPEN's Data Management function.

Table 16 – Revisions to 33 kV asset volumes

Licence	Name	Units	Unit Cost (£k)	RRP V1 Submission for 2012/2013		Proposed RRP V1 Submission for March 2014		Variance	
				Volume	MEAV (£k)	Proposed Volume	MEAV (£k)	Volume	MEAV (£k)
SPD	33 kV Switchgear – Other	Each	58.74	1,325	77,831	0	0	-1,325	-77,831
SPD	33 kV Switch (PM)	Each	2	0	0	248	496	248	496
SPM	33 kV Switchgear – Other	Each	58.74	1,493	87,699	0	0	-1,493	-87,699
SPM	33 kV Switch (PM)	Each	2	0	0	1	2	1	2

Future Improvements

It is recommended that SPEN seeks clarifications from Ofgem regarding future reporting requirements for the '33 kV Switchgear – Other' asset types. As mentioned above, SPEN has chosen not to report in this asset category and has instead reallocated its 33kV switchgear as either pole or ground-mounted.

4.2.5 HV Submarine Cable

The regulatory reporting definition for HV submarine cable is provided in Table 17. SPEN has historically reported HV Submarine Cable based on estimates of cable length passing beneath known watercourses. As part of the Priority 3 validation of asset volumes, SPEN sought to establish a more robust approach to the identification of measurement of HV Submarine Cable lengths.

Table 17 – Reporting definition for HV Submarine Cable

Asset Type	**HV SUB CABLE**
Voltage	HV
OFGEM Definition	HV cable which is placed below the surface of the water and laid on or under the sea bed or the bed of a river or estuary whether or not designed for this purpose.
Data Source	ESRI

Original Corporate System Volumes

Estimations of total HV Submarine Cable lengths for the SPD & SPM networks have historically been low at 3 km & 5 km respectively. It should be noted that whilst the total length of HV submarine cable is relatively low in both networks, this typically comprises many short lengths of cable on individual circuits passing beneath watercourses.

NDIP Approach

Using the above definition of HV Submarine Cable, a spatial query was run within ESRI to identify potential submarine cables, at intersections with water features within the Ordnance Survey MasterMap datset. The NDIP team then developed a standardised methodology to validate whether cables were actually submarine using the background functionality of the ESRI Geographic Information System, the GND Archive Raster Layer and Google Streetview , along with a series of business rules to determine whether cables were eligible for inclusion in regulatory reporting. Where a desktop determination could not be made SPEN used the local knowledge of field teams to confirm whether a cable was submarine. The majority of the cable length investigations were undertaken as desk-top exercises using the ESRI corporate system. Fortunately, ESRI had been updated to contain a SP Underwater attribute field within the Cable Feature Class which could be used to identify HV submarine cable and simplify the future reporting of this asset type.

The process followed by the NDIP team involved identifying circuit intersections with watercourses using the embedded Ordnance Survey data showing the locations of offshore channels, estuaries, rivers, canals and streams. Having identified all HV circuit intersections it was possible to apply the business rules listed in Table 18 to determine whether a cable was eligible ('valid') to be included in the HV Submarine Cable category. Having established the validity of such cables for inclusion, the cable was split at the appropriate intersections to separate the Submarine section from the land based sections and an exact cable length was generated by ESRi in accoridance with is geo-reference co-ordinates using built-in ESRI measurement functionality. For clarity,,in coastal areas, the measurement was taken from the high-water mark.

Valid circuits containing HV submarine cable lengths were identified as ducted and below water level, or below a river bed from records contained in ESRI, either as vectorised maps or in embedded Raster images. In addition, cables crossing watercourses which did not contain any references to cable bridges or ducts were also included for reporting purposes. A small subset of cables existed where it was not possible to determine from ESRI whether a particular cable length was underwater and therefore site visits were initiated to confirm the status of these cables. A further refinement adopted by NDIP was to only include submarine cable lengths of over 3 meters for reporting purposes. An example of an ESRI investigation showing a typical watercourse crossing is provided in Figure 6.

Table 18 – Business rules applied to determine HV Submarine Cables volumes

NDIP Rule	Rule Description	Asset count validity	Comment	System Update
1	Cable is Ducted in ESRI and shown / described below water level	Valid	Ducted, Submarine.	ESRI
2	Cable is Ducted on raster and shown / described below water level	Valid	Ducted, Submarine.	ESRI
3	Cable is Ducted and described below River Bed	Valid	Ducted, Submarine.	ESRI
4	Shown on raster as crossing on bridge, but not shown on bridge in ESRI	Invalid	Not submarine, attached to raster bridge (PAI issue)	None
5	Marked with / nearby 'Gantry'	Invalid	Not submarine, above water cable only bridge	None

6	Raster indicates Duct, Channel or Cable Hung on Bridge	Invalid	Not Submarine, Attached to bridge	None
7	Cable is not shown as ducted or attached to bridge and crosses water feature in both raster & ESRI	Valid	Submarine Cable.	ESRI
8	Shown on raster as being on land, but shown on ESRI Ordnance Survey background as underwater	Invalid	Not submarine (PAI issue)	None
9	Cannot determine from ESRI / Raster and Google Maps	Site visit required	Confirm cable position (above / below water)	ESRI
10	Cable is Out of Use	Invalid		None
11	Width of water feature is less than 3m	Invalid	<3m	None

Figure 6 – Typical ESRI Screen image showing HV Submarine Cable in Barmouth, North Wales

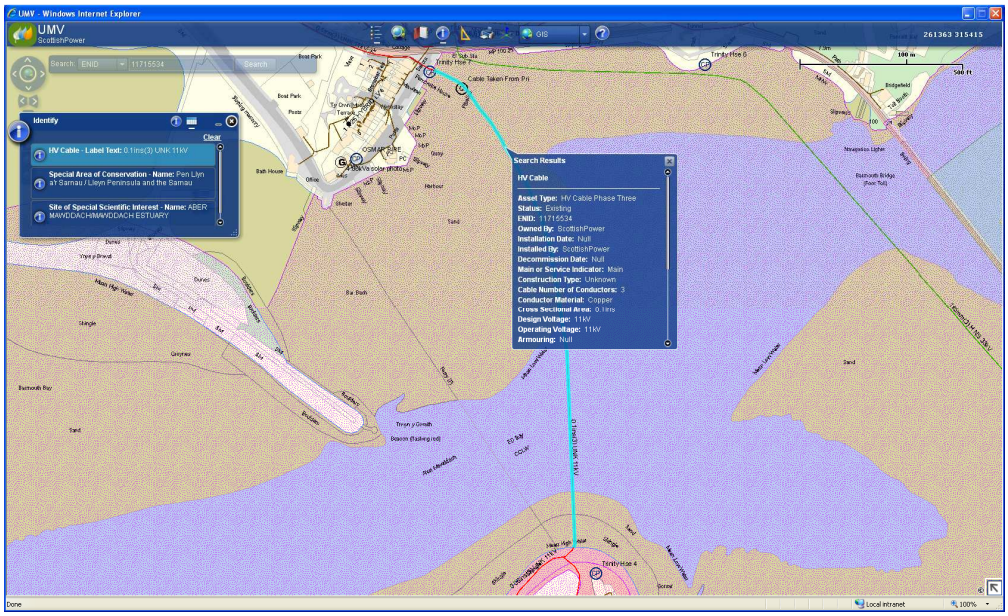


Table 19 – Revisions to HV Submarine Cable lengths

Licence	Name	Units	Unit Cost (£k)	RRP V1 Submission for 2012/2013		Proposed RRP V1 Submission for March 2014		Variance	
				Volume	MEAV (£k)	Proposed Volume	MEAV (£k)	Volume	MEAV (£k)
SPD	HV Sub Cable	km	351.75	3	1055	11	3869	8	2814
SPM	HV Sub Cable	km	351.75	5	1759	5	1759	0	0

Completion of the data validation exercise revealed an additional 8 km of HV Submarine Cable within the SPD network. The previously reported cable length in the SPM networks of 5 km was confirmed to be correct. In total, the NDIP Data Quality team investigated over 5,000 instances of circuit intersections with watercourses for all voltages, including EHV. Where the presence of submarine cable was confirmed, ESRI records were divided to separately record the submarine element of the

cable using the SP Underwater attribute field. The Data Quality team identified 376 HV Submarine Cables in SPD. The corresponding figure for SPM was 171 HV Submarine Cables.

Current Status of Data Cleansing Activities

The process implemented by the NDIP Data Quality team to confirm the size of SPEN's Priority 3 'HV Sub Cable' asset base also updated ESRI records on completion of each investigation. Therefore, the reported asset base is now accurately reflected in SPEN's corporate GIS system. In future, asset information changes will be managed by SPEN's Data Management function.

Future Improvements

The earlier addition of the 'SP Underwater' ESRI attribute field for cable circuits will maintain the accuracy of HV Submarine Cable in future and will also simplify future regulatory reporting of this asset type. Therefore, no further system enhancements are planned for this asset type.

4.3 Summary of the Deep-dive asset group analyses

The Priority 3 & 4 asset groups evaluated in this section were selected according to the magnitude of asset volume changes identified by SPEN's NDIP team and to assess the validity of each bespoke assessment methodology developed by the Expert Panels. For each of the selected asset categories PA has explored:

1. How the initial asset volumes were generated for the Priority 3 & 4 asset groups including the systems and asset attributes used in the assessment process?
2. Details of business rules applied to determine asset volumes.
3. Level of engagement with asset experts and business stakeholders outside the NDIP team to validate the proposed revisions to asset volumes.
4. Details of the processes adopted to ensure the revised asset volumes are accurately updated in SPEN asset information systems.
5. Measures to minimise the likelihood of inaccurate data records occurring in the future.

A summary of the current situation in relation to asset volume changes for the most significant Priority 3 & 4 asset groups is provided in Table 20, addressing the following key questions:

- Whether the NDIP derived asset volume revisions have been approved by SPEN senior management;
- Whether the revised asset volumes are now captured in SPEN corporate systems;
- Details of any enhancements identified for operation procedures;
- Details of any required changes to corporate system functionality for storing asset information; and
- Details of any other system changes requiring consideration.

For all asset categories, PA can confirm that the revised asset volumes to be used in future regulatory reports have all been approved by SPEN's senior management team[14] and that the revised values are significantly more robust than those reported previously.

For the asset categories where asset volumes were validated using synchronisation exception reports, PA can confirm that the resultant changes are now captured in SPEN corporate systems as part of the process of resolving exceptions.

For the asset categories where asset volumes were estimated using Expert Panel approaches, PA can confirm that the resultant changes have yet to be captured in SPEN corporate systems. Further

[14] Including Regulation and ASNP Directors

detailed analysis will be required to evaluate the costs and benefits of including all revised asset information in corporate systems. It is anticipated that most asset volumes updates will be captured in SPEN corporate systems using business as usual Data Management business processes.

The NDIP data validation exercise has identified a number of operational procedures that could be enhanced in future to maintain and improve the enduring accuracy of asset volume information. Most of these improvements relate to the development of detailed inspection instructions and guidance for field staff.

Similarly, for the Expert Panel related asset volume investigations, a number of potential system changes have been identified for both SAP and ESRI to enable direct reporting of relevant asset volumes rather than being reliant on calculation and estimation techniques. This will significantly simplify the reporting of regulatory asset volumes in future. Each potential change will require detailed cost-benefit analysis.

In relation to pilot wires, there is an opportunity for SPEN to also consider incorporating all relevant asset data within the corporate Geographic Information System, as opposed to residing in external 3rd party managed databases or within legacy asset information repositories.

Table 20 – Status of asset volumes and opportunities to refine SPEN operational processes and systems for Deep-dive asset categories

Asset Type	Revised Asset Volumes Approved	Core Asset Registers Updated	Operational Procedures Updates	Changes to Core System	Other Changes
Pilot Wires	March 2014	Cost Benefit Analysis to be undertaken during Summer 2014 to establish use of assumed routes within ESRI	Guidance to Field Teams to identify Pilots during inspections	Opportunity to add a feature class in ESRI to identify pilot wire overhead	Consider SPEN taking responsibility for CPA database. Consider vectorising all known legacy pilot wire route data within ESRI
LV Pillars & Boards	March 2014	Planned for late 2014 using established Data Management change processes	Instructions to Field Teams to establish whether Boards & Pillars are located indoor, wall mounted or outdoor during Substation inspections	Opportunity to add field in SAP to distinguish wall mounted boards (both for X & Y-Type networks)	None Required
LV Services & RLMs	March 2014	Planned for later in 2014 using established Data Management change processes	RLM Modernisation programme to feedback field data to confirm estimation assumptions and input into ESRI where possible	Opportunity to expand ESRI fields to identify Rising & Lateral Mains & number of Associated Services	Clarify RLM definitions with Ofgem
33 kV Switchgear	February 2014	SAP data corrected	Business as Usual to maintain accuracy of 33 kV switchgear group	SAP & PowerOn synchronisation already accommodates	None Required
HV Submarine Cable	February 2014	ESRI data updated	Business as Usual to maintain accuracy of HV submarine cable group	SP Underwater asset field already created in ESRI	None Required

5 CONCLUSIONS

PA Consulting can confirm that the amendments made to asset volumes in the Priority 3 & 4 asset groups have resulted in significant improvements to the accuracy of network size information. Therefore, the resultant asset volumes, to be presented to Ofgem in 2014, are significantly more robust than those reported in July 2013.

For each of the Priority 3 & 4 asset groups investigated, it was apparent that the original network size information contained anomalies due to missing or misallocated records in the relevant asset registers and thus merited detailed review by the NDIP team.

PA can confirm that SPEN's Expert Panel processes have significantly improved the accuracy of reported asset volumes according to Ofgem asset type definitions. PA can also confirm that SPEN has achieved this improvement to the overall accuracy of network size reporting for the Priority 3 & 4 asset groups, using actual asset data wherever available, and has only developed estimation techniques where information has not historically been available.

Reconciling asset volumes in some of the Priority 3 & 4 asset groups (particularly Pilot Wires), has revealed legacy information sources not previously utilised for network size reporting which have increased asset volumes significantly. Consequently, given the size of this asset group, SPEN will need to evaluate whether this information can be consolidated within SPEN's main asset registers in a cost-effective manner.

In relation to the number of Rising and Lateral Mains, PA Consulting observed that the reported 'Number of Services Associated with RLMs' and the 'Number of RLMs' represent a significant improvement and the reported volumes are aligned with SPEN's RLM modernisation programme. PA observed that the estimated asset volumes in these two asset categories can vary according to input assumptions and therefore it will be important to review these assumptions using RLM modernisation programme feedback. PA believes that the estimation assumptions adopted by the NDIP Data Quality team are pragmatic and justifiable.

For the Priority 3 & 4 asset categories evaluated using Expert Panel based methodologies, PA observed that the revised asset volumes need to be reflected in SPEN's corporate information systems. PA believes that corrected asset volume information should be updated within corporate systems promptly to maintain the accuracy of this information in future. It is anticipated that most of the required asset volume changes can be accommodated by Data Management processes although such work will need to be prioritised to occur in parallel with 'Business-as-Usual' activities.

PA Consulting agrees that accuracy of network size information could be improved through refinements to operational inspection procedures and improved guidance to field staff. However, changes to corporate systems will be necessary to capture the additional asset data required for

reporting purposes. This is particularly relevant for the LV Fuseboards and Pillar asset records in SAP and Pilot Wire information recorded in ESRI. Further detailed analysis is required to evaluate the costs and benefits of including all identified asset information in corporate systems.

PA Consulting can confirm that the approach adopted to reconcile 33 kV switchgear volumes and submarine cable lengths was based on SPEN's proven asset data exception reporting processes as employed previously for Priority 1 & 2 assets. PA Consulting regards this approach as robust and believes that the accuracy of reported submarine cable lengths and pole-mount 33 kV switchgear has improved accordingly. A significant benefit of this approach is that all inaccuracies identified are automatically reconciled in corporate systems as part of the validation process.

PA Consulting can confirm that the changes made in the Priority 3 & 4 asset categories, as approved by SPEN's senior management, provide a more accurate basis for regulatory reporting in relation to the total size of the SPD & SPM networks.

The investigations undertaken by the NDIP team and Expert Panels have also provided critical insights that will enable SPEN to prioritise options to improve accuracy of Priority 3 & 4 asset data in future, through a range of operational and system improvements.

6 RECOMMENDATIONS

PA's review of the processes employed by the Network Data Improvement Programme has identified a range of initiatives to simplify network size reporting and improve the accuracy of asset data held on SPEN corporate systems. PA therefore recommends the following 'next steps' which will enable SPEN to simultaneously improve data accuracy and reporting efficiency:

- **Ensure that Expert Panel derived asset information is promptly updated SPEN's corporate information systems**. Although the asset volume adjustments developed by the NDIP team using Expert Panel guidance are now approved for network size reporting, corresponding adjustments to asset data in corporate systems remains to be completed. Clearly, it is important that SPEN's systems are updated to reflect the revised asset data as soon as possible.
- **Develop SPEN's corporate asset information systems to hold all relevant asset information required for regulatory reporting**. Such initiatives will improve the accessibility of asset information and will enable SPEN to fulfil regulatory reporting obligations in a more efficient manner. The ability to directly access and extract relevant asset data will reduce dependence business-rule based approaches and estimation techniques accordingly. We recognise that SPEN has initiated a wider reporting project that will take these issues into consideration.
- **Ensure that SPEN retains the knowledge and expertise amassed by the Network Data Improvement Programme**. PA recognises the NDIP was established to address asset data discrepancies in a structured and prioritised manner. It will be important to embed the network size quantification techniques and associated business rules in SPEN's enduring asset management processes.
- **Ensure that all asset information identified by Expert Panels, currently residing outside SPEN corporate systems, is retained in future.** In order to avoiding losing key asset data contained in 3rd party databases and legacy information systems, SPEN should evaluate options to incorporate such information in SAP and/or ESRI by undertaking prioritised cost-benefit assessments.
- **Promptly implement system changes in corporate systems to improve the granularity of asset information**. System changes have been identified for particular asset types to simplify asset volume reporting. These include new attribute fields in SAP for wall-mounted fuseboards and feature classes in ESRI for overhead pilot wires. These relatively minor changes need to be implemented in order to capture required information for future reporting purposes. However, the most effective method of populating these new data fields will require detailed consideration.
- **Enhance operational inspection procedures to capture additional asset information as part of routine site-visits by field staff**. Through revised instructions to field staff with corresponding changes to reporting procedures and systems, it will be possible to continually improve the accuracy of asset data on SPEN corporate information system. The

implementation of revised asset inspection instructions will be contingent on SPEN system being able to capture and store such information and therefore corresponding operational and system changes will need to be developed in parallel.

APPENDICES

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A EXPERT PANEL TERMS OF REFERENCE

This document defines the terms of reference of the Data Quality Asset Review Expert Panel established in August 2013 by the EN Data Improvement Programme. It defines:

- General background and reason for creation;
- Objectives and purpose ;
- Membership (incl. Roles and Responsibilities);
- Meeting frequency, methods and draft agenda;
- IT systems deemed in scope.

The scope of this The Data Quality Asset Review Expert Panel will to be work in partnership with the Asset Stewardship Group's, however it is a NDIP Project specific initiative, with given timescales and deadlines so will not be an enduring process as agreed at the Data Governance Forum.

1. ISSUE RECORD

This is a reference document. **It is your responsibility to ensure you work to the current version.**

Issue Date	Issue No.	Author	Amendment Details
9th August 2013	Draft 1	Ross McDonald	Initial Draft for Comment by DM
20th August 2013	Draft 2	Ross McDonald	Final Draft for Issue
4thSeptember 2013	FINAL	Ross McDonald	Added in Investment Planning Representative, and changing Section 11 Assets under Review.

2. ISSUE AUTHORITY

Author	Owner	Issue Authority
Name: Ross MacDonald Title: NDIP Technical Team Lead	Name: Kam Gateru Title: NDIP Data Quality Project Manager	Name: Pearse Murray Title: Asset Strategy & Networks Programme Director ..... Date: .....

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3. INTRODUCTION AND BACKGROUND

Energy Networks has a licence requirement to accurately report to OFGEM information about the network, including size, and activities on the network. As part of the RRP submission in 2011 (for 2010-11) mis-reporting issues were identified when trying to reconcile asset movements against the size of the asset base. The Energy Networks Data Improvement Programme is responsible for validating the asset base balances of the business for the RRP Submission to OFGEM as part of the regulatory requirement for 2013-2014 RRP year for the SPM and SPD licence areas.

Historical changes to organisational structures and reporting lines have contributed to the dispersal of responsibilities and a lack of clarity in many asset areas in relation to the correct processes that are required to ensure asset data integrity and Network Asset Volume reporting across all departments and the various IT systems. So far the Project has prioritised 161 asset types into 4 groups. Priority 1 and Priority 2 asset types, of which there are 86, have already been validated and network asset volumes submitted to OFGEM under the 2012-2013 RRP Submission. The remaining 75 assets types make up the Priority 3 and Priority 4 asset types. The project has identified 13 asset types which can be readily validated through being synchronisable assets between two corporate data systems.

The need to formally record and address the 62 identified asset types where source data is held in one or no corporate system (defined under Section 9) has therefore led to the creation of the Data Quality Asset Review Expert Panel. These 62 asset types will be grouped into the same groups identified by the Asset Stewardship Groups (as listed below) for the purposes of convenience and expediency during the workshops.

- Cables
- Distribution Subs
- Light Current
- Pole Lines
- Service Position / Rising Mains
- Tower Lines
- Transmission Subs

The opportunity exists through the Networks Data Improvement Programme to improve the robustness of the reports produced for OFGEM to populate the RRP, to prevent similar mis-reporting issues in future. The objective of NDIP is to remove the variance in reporting systems in order to have a single repeatable and reliable Network Asset Volume by asset type to report to OFGEM.

4. OBJECTIVES AND PURPOSE

The objective of the Data Quality Asset Review Expert Panel is to ensure that:

- The Network Asset Volume of each Asset Type is, where possible defined and validated to an agreed approach to ensure correct volume reporting to OFGEM through RRP, and then to review the analysis and findings from that validation approach.

- Where data on the different asset types exists outside of the corporate data systems, that this data is made available to the NDIP in order to validate Network Asset Volume.

- Where asset types not recorded on a source data corporate system the Data Quality Asset Review Expert Panel will review and provide recommendations to the requisite Asset Stewardship Group to implement the embedding of these assets into the Corporate Systems.

5. MEMBERSHIP

Members of the Data Quality Asset Review Expert Panel will comprise of:

- Expert Panel Chair
- Asset Stewardship Group Representative (if not covered by Expert Panel Chair)
- NDIP Data Quality Project Manager
- NDIP Data Quality Technical Team Lead
- Asset Management Representative
- Investment Planning Representative

The quorum for meetings shall be all members detailed above or their representative, to whom responsibility has been delegated, excluding those on a required basis only.

Members on a required basis only:

- Systems UK Representative
- Data Management Network Updates Representative (North & South)
- NDIP Programme Manager
- Asset Subject Matter Experts

6. ROLES AND RESPONSIBILITIES

Role:	**Responsibilities:**
Expert Panel Review Chair - In-line with Asset Stewardship Group Chair.	• To Chair the Expert Panel Meetings / Workshops, agreeing agendas and ensuring focus is maintained • To formalise and agree the Validation Approach for the NDIP Data Quality Project. • To provide support to the NDIP Data Quality Technical Team Lead as required achieving stated objectives and outcomes. • To provide facilitation support alongside Technical Lead.
Investment Planning Representative	• To provide input on how historically the V1 table has been populated and maintained for each asset type, and • To formalise and agree the outputted RRP Volumes from the validation work undertaken by NDIP Data Quality Project.
NDIP Data Quality Project Manager	• To provide facilitation support alongside Technical Lead. • To act as Senior Project representative and ensure that Expert Panels and Workshops are appropriately represented and run effectively. • Facilitate the Expert Panel, in conjunction with both the Expert Panel Review Chair and the NDIP Data Quality Technical Team Lead to achieve stated objectives and outcomes.
NDIP Data Quality Technical Team Lead	• Expert Panel Inputs: Establish, document and coordinate any pre-requisite inputs required for the Expert Panel Workshops. • Facilitate the Expert Panel, in conjunction with the Expert Panel Review Chair to achieve stated objectives and outcomes. • Expert Panel Outputs: Document and communicate outputs from Expert Panel Workshops including resultant findings and

	recommendations.
Asset Management Representative	• To assist Expert Panel Review Chair and the NDIP Data Quality Technical Team Lead in any pre-requisite information gathering required for the workshops. • To provide technical input and support, in particular on the implementation of any validation approach during and post any Workshops.
Asset Subject Matter Experts - This may require input from a number of different business areas (incl. but not limited to Operations, Investment Planning),	• To provide Asset centric subject matter expertise as required, determined by the Expert Panel Review Chair.

7. MEETING FREQUENCY AND METHODS

The Data Quality Asset Review Expert Panels, which are to be decided, based on groupings of individuals and asset types will meet on no more than 3 x ½ day occasions. These workshops will be focused on the primary objective with an aim of being efficient and diligent, in achieving that, it will not be a forum for highlighting issues, but resolving them.

Some preliminary pre-workshop work will be required, in the form of a short fact finding questionnaire (with approx. 10 questions), to be completed by the Expert Panel Review Chair with input from other panel members where required, to inform the discussions of the first workshop.

The Data Quality Asset Review Expert Panel will meet for two initial workshop type meetings and a final workshop to agree the proposed RRP Network Asset Volume to be submitted by the Project to inform the 2013-2014 RRP OFGEM submission for each asset type. The following proposed agendas (defined under Section 8.1) aim to resolve any issues within the workshop environment, any outstanding issues and actions will be formally logged and tracked, and actions will be allocated to the appropriate owners within the panel.

7.1 PROPOSED MEETING AGENDAS

Duration:

Workshop 1: Definition of Approach — **1-4 hrs (dependent on requirement)**

1. Safety Contact
2. Assets Under Review
3. Definition of Assets
4. Review of Questionnaire Results
5. Current Data Source Knowledge
6. Agreement of Pilot Validation Approach
7. Review of Actions Raised

Workshop 2: Validation of Approach — **1-4 hrs (dependent on requirement)**

1. Safety Contact
2. Review of Action Log

3. Assets Under Review
4. Validation of Pilot Data Analysis Findings
5. Agree Final Validation Approach
6. Agree Interim Recommendations for Future Remediation
7. Review of Actions Raised

Workshop 3: Agreement of Outputs 1-2 hrs

1. Safety Contact
2. Review of Action Log
3. Assets Under Review
4. Agree RRP Volume Reporting Volumes
5. Agree Final Recommendations for Future Remediation
6. Review of Action Completion

Items requiring approval out with the group shall be submitted to the requisite Asset Stewardship Group, or if not practicable the Data Improvement Governance Forum which meets monthly and is represented by Directors from across the business (with the exception of the Health & Safety Director).

7.2 KEY DATES & TIMELINES

[Schedule to be completed early September, once suitable resources for the Panels are identified and allocated, due to be completed 30th August 2013.]

8. IT SYSTEMS IN SCOPE

This group will address issues pertaining to synchronisation across the following IT Systems:

- POWERON
- SAP
- ESRI
- ADQM

9. PANEL OUTPUTS

The Expert Panel will produce the following documentation in accordance with these terms of reference:

1. Action Log
2. Issue Log
3. Final Validation Approach
4. Approved Network Asset Volume for RRP reporting.
5. Recommendations for Future Remediation

The possible output options for Recommendations for Future Remediation are detailed below:

5. **Accept current process for reporting** – Having gone through the process the Expert Panel conclude that whilst the data exists in one corporate system, the process for recording, maintaining and reporting Network Asset Volume is under adequate control and acceptable for future reporting.

6. **Business decision required -** In the instances where no data can be found within the business the Expert Panel recommends that the business carry out a cost benefit analysis and risk assessment to determine the exposure of the business of not collecting and maintaining the asset type data.

7. **Use an estimating system for network size –** where data exists but it is not maintainable within a corporate system, an estimating system based on sound business logic that could be applied in order to provide a best estimate network size.

8. **Implement Data into a Corporate System**
   a. **Implementation feasible within current corporate system –** Where data is readily available and does fit in with the current data model adopted by the corporate system the Expert panel will recommend implementation is carried out, either as a separate work project or as an ongoing data improvement schedule with suitable processes put in place for the management of the data on an ongoing basis.

   b. **Requiring a system Data Change for implementation** – Where data is readily available for asset types within the business but which do not fit in with the current data model adopted by the corporate system, the Expert Panel will recommend that a change is requested through the Data Change Forum, to enable this data to be inputted into the system and suitable processes put in place for the management of the data on an ongoing basis.

   c. **Full Site Survey required for confirmation before implementation -** for asset types which are eligible (i.e. non-buried assets) to be Site Surveyed in an expedient manner and can be implemented into the current corporate systems, either as a separate work project or within current inspection regimes. The Expert Panel recommends that these are prioritised to achieve confirmation and then implementation into the corporate system and suitable processes put in place for the management of the data on an ongoing basis.

10. ASSETS UNDER REVIEW

Licence	Asset	Name	Asset Stewardship Group	ASG Chair
SPM	Cable	LV Main (UG Consac)	**Cables**	**Andrew Woolon**
SPD	Cable	LV Main (UG Consac)	**Cables**	**Andrew Woolon**
SPM	Cable	UG Cable (Oil & Gas) - Decommissioned	**Cables**	**Andrew Woolon**
SPD	Cable	UG Cable (Oil & Gas) - Decommissioned	**Cables**	**Andrew Woolon**
SPM	Cable	UG Cable (Oil & Gas) - Decommissioned	**Cables**	**Andrew Woolon**
SPM	Civils	Cable Tunnels (DNO owned)	**Cables**	**Andrew Woolon**
SPD	Civils	Cable Tunnels (DNO owned)	**Cables**	**Andrew Woolon**
SPM	Civils	Cable Bridges (DNO owned)	**Cables**	**Andrew Woolon**
SPD	Civils	Cable Bridges (DNO owned)	**Cables**	**Andrew Woolon**

SPM	Cable	HV Sub Cable	**Cables**	**Andrew Woolon**
SPD	Cable	HV Sub Cable	**Cables**	**Andrew Woolon**
SPD	Switchgear	LV Circuit Breaker	**Distribution Subs**	**Jonathan Hughes**
SPM	Switchgear	Fuses (GM) (TM)	**Distribution Subs**	**Jonathan Hughes**
SPD	Switchgear	Fuses (GM) (TM)	**Distribution Subs**	**Jonathan Hughes**
SPM	Switchgear	LV Circuit Breaker	**Distribution Subs**	**Jonathan Hughes**
SPM	Switchgear	LV Pillar (ID)	**Distribution Subs**	**Jonathan Hughes**
SPD	Switchgear	LV Pillar (ID)	**Distribution Subs**	**Jonathan Hughes**
SPM	Switchgear	LV Pillar (OD at Substation)	**Distribution Subs**	**Jonathan Hughes**
SPD	Switchgear	LV Pillar (OD at Substation)	**Distribution Subs**	**Jonathan Hughes**
SPM	Switchgear	LV Board (WM)	**Distribution Subs**	**Jonathan Hughes**

SPD	Switchgear	LV Board (WM)	**Distribution Subs**	**Jonathan Hughes**
SPM	Switchgear	LV Board (X-type Network) (WM)	**Distribution Subs**	**Jonathan Hughes**
SPD	Switchgear	LV Board (X-type Network) (WM)	**Distribution Subs**	**Jonathan Hughes**
SPM	Switchgear	LV Transformers/Regulators	**Distribution Subs**	**Jonathan Hughes**
SPD	Switchgear	LV Transformers/Regulators	**Distribution Subs**	**Jonathan Hughes**
SPM	Switchgear	33kV Switchgear - Other	**Distribution Subs**	**Jonathan Hughes**
SPD	Switchgear	33kV Switchgear - Other	**Distribution Subs**	**Jonathan Hughes**
SPM	Switchgear	LV Pillars (OD not at Substation)**	**Distribution Subs**	**Jonathan Hughes**
SPD	Switchgear	LV Pillars (OD not at Substation)**	**Distribution Subs**	**Jonathan Hughes**
SPM	Switchgear	6.6/11kV Switch (PM)	**Distribution Subs**	**Jonathan Hughes**
SPD	Switchgear	6.6/11kV Switch (PM)	**Distribution Subs**	**Jonathan Hughes**

SPM	Switchgear	6.6/11kV Switchgear - Other (PM)	**Distribution Subs**	**Jonathan Hughes**
SPD	Switchgear	6.6/11kV Switchgear - Other (PM)	**Distribution Subs**	**Jonathan Hughes**
SPM	Switchgear	33kV Switch (PM)	**Distribution Subs**	**Jonathan Hughes**
SPD	Switchgear	33kV Switch (PM)	**Distribution Subs**	**Jonathan Hughes**
SPM	Switchgear	LV UGB (OD not at Substation)**	**Distribution Subs**	**Jonathan Hughes**
SPD	Switchgear	LV UGB (OD not at Substation)**	**Distribution Subs**	**Jonathan Hughes**
SPM	Protection	Batteries at GM HV Substations	**Light Current**	**Willie Leggat**
SPD	Protection	Batteries at GM HV Substations	**Light Current**	**Willie Leggat**
SPM	Protection	Batteries at 33kV Substations	**Light Current**	**Willie Leggat**
SPD	Protection	Batteries at 33kV Substations	**Light Current**	**Willie Leggat**
SPM	Protection	Pilot Wire Overhead	**Light Current**	**Willie Leggat**
SPD	Protection	Pilot Wire Overhead	**Light Current**	**Willie Leggat**
SPM	Protection	Pilot Wire Underground	**Light Current**	**Willie Leggat**
SPD	Protection	Pilot Wire Underground	**Light Current**	**Willie Leggat**

SPM	Switchgear	Switching Points with Remote Control/Automation Facility	**Light Current**	**Willie Leggat**
SPD	Switchgear	Switching Points with Remote Control/Automation Facility	**Light Current**	**Willie Leggat**
SPM	Protection	Batteries at 132kV Substations	**Light Current**	**Willie Leggat**
SPM	Overhead Pole Line	LV Service (OHL)	**Pole Lines**	**Andrew Brown**
SPD	Overhead Pole Line	LV Service (OHL)	**Pole Lines**	**Andrew Brown**
SPM	Switchgear	Fuses (PM)	**Pole Lines**	**Andrew Brown**
SPD	Switchgear	Fuses (PM)	**Pole Lines**	**Andrew Brown**
SPM	Shared Poles	Shared Poles	**Pole Lines**	**Andrew Brown**
SPD	Shared Poles	Shared Poles	**Pole Lines**	**Andrew Brown**
SPM	Shared Poles	Shared Poles	**Pole Lines**	**Andrew Brown**
SPD	Shared Poles	Shared Poles	**Pole Lines**	**Andrew Brown**
SPM	Percentage of Poles Shared	Percentage of Poles Shared	**Pole Lines**	**Andrew**

				Brown
SPD	Percentage of Poles Shared	Percentage of Poles Shared	**Pole Lines**	**Andrew Brown**
SPM	Percentage of Poles Shared	Percentage of Poles Shared	**Pole Lines**	**Andrew Brown**
SPD	Percentage of Poles Shared	Percentage of Poles Shared	**Pole Lines**	**Andrew Brown**
SPM	Cable	LV Service (UG)	**Service Positions / Rising Main**	**Alastair Graham**
SPD	Cable	LV Service (UG)	**Service Positions / Rising Main**	**Alastair Graham**
SPM	Cable	Rising & Lateral Mains	**Service Positions / Rising Main**	**Alastair Graham**
SPD	Cable	Rising & Lateral Mains	**Service Positions / Rising Main**	**Alastair Graham**
SPM	Cable	LV Service associated with RLM	**Service Positions / Rising Main**	**Alastair Graham**
SPD	Cable	LV Service associated with RLM	**Service Positions / Rising Main**	**Alastair Graham**
SPM	Switchgear	Cut Out (Metered)	**Service Positions / Rising Main**	**Alastair Graham**

SPD	Switchgear	Cut Out (Metered)	**Service Positions / Rising Main**	**Alastair Graham**
SPM	Shared Poles/Towers	Shared Poles/Towers	**Tower Lines**	**David Kiddel**
SPD	Shared Poles/Towers	Shared Poles/Towers	**Tower Lines**	**David Kiddel**
SPM	Shared Poles/Towers	Shared Poles/Towers	**Tower Lines**	**David Kiddel**
SPM	Percentage of Poles/Towers Shared	Percentage of Poles/Towers Shared	**Tower Lines**	**David Kiddel**
SPD	Percentage of Poles/Towers Shared	Percentage of Poles/Towers Shared	**Tower Lines**	**David Kiddel**
SPM	Percentage of Poles/Towers Shared	Percentage of Poles/Towers Shared	**Tower Lines**	**David Kiddel**
SPM	Overhead Tower Line	33kV Fittings	**Tower Lines**	**David Kiddel**
SPD	Overhead Tower Line	33kV Fittings	**Tower Lines**	**David Kiddel**
SPM	Overhead Tower Line	132kV Fittings	**Tower Lines**	**David Kiddel**

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