SP Energy Networks 2015–2023 Business Plan

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Annex

Losses Strategy

SP Energy Networks

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SP ENERGY NETWORKS

Losses Strategy

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1. Scope

This strategy document addresses our approach to managing the main causes of energy losses from SP Energy Networks' distribution systems. Energy losses arise for a variety of technical and non-technical reasons and this section describes the different types of distribution losses.

Technical losses

Our electricity distribution networks comprise overhead lines, underground cables, switchgear and transformers which we operate at a range of voltages from the interface with the transmission system through to the low-voltage supplies used by residential customers. Each of these components consumes small quantities of energy relative to the total energy delivered. Energy is consumed by each of these network components for the following reasons:

- *Variable losses: All conductors in each of the above network components have electrical resistance which causes energy to be dissipated when an electrical current flows through the equipment. This energy is typically lost to the environment in the form of heat. The relationship between the current flow and the energy lost is non-linear and proportional to the square of the current, and therefore such lost energy is categorised as 'variable losses'. It follows that the variable losses from equivalent distribution assets carrying high currents (i.e. high asset utilisation) are significantly greater than those from lightly-loaded assets.*

- *Fixed losses: SP Energy Networks distributes electricity at a range of voltages. Large numbers of transformers are used to connect our networks operating at different voltage levels. Our transformers are electro-magnetic devices which typically operate at 132 kV, 33 kV, 11kV and 400V. The process of stepping-up (or stepping-down) between network voltages results in energy losses arising from magnetising currents which are fundamental to the voltage transformation process. These losses do not change significantly with variations in network loading and are referred to as 'fixed losses'. Again, these losses are typically dissipated in the form of heat.*

- *Energy consumed by our equipment to ensure reliable network operation: In addition to the fixed and variable losses described above, further energy is required to ensure safe and reliable operation of our networks. In our substations, energy is typically consumed for heating and lighting, dehumidification & cooling equipment, oil pumps, air compressors and battery chargers to maintain secure network operation and resilience[1].*

1 Unlike the other losses described in this document, which are invisible to the settlements process, the electricity consumed at SPD & SPM substations is recorded as separate unmetered supplies and corresponding estimates of annual energy consumption are uploaded into the settlement system.

Non-technical losses

Non-technical losses primarily relate to unidentified, misallocated and inaccurate energy flows. The three main types of non- technical losses addressed in this strategy document are described below:

- *Energy theft: Illegal abstraction of electricity by a minority of customers, achieved through tampering with supplier meters or interference with our network assets, remains an ongoing challenge for the electricity industry and concerted effort by a range of stakeholders will continue to be required to mitigate this problem. In addition to fraud there are serious safety aspects to be considered.*

- *Unmetered supplies: Not all customer supplies in our distribution areas are metered. Typical unmetered loads include street lighting, traffic lights and road signs, advertising hoardings and lighting in shared occupancy buildings. Such consumption is quantified by establishing accurate records for each unmetered supply and applying a representative profile to estimate consumption characteristics. Losses typically arise as a consequence of incorrect or incomplete unmetered supplies records and inaccurate estimated annual consumption information.*

- *Conveyance – electricity delivered but not accurately recorded in energy settlements: Situations arise where energy is consumed but is not accurately recorded in the national electricity settlement system and effectively becomes lost energy. Typical reasons for energy not being accurately recorded include missing/unregistered metering points, incorrect recording of metering point energisation and incorrect registration of metering systems which all result in inaccurate or missing consumption data.*

2. Table of linkages

This energy losses strategy forms an integral part of SP Energy Networks' RIIO-ED1 business plan and is linked to other sections and annexes within our overall submission, particularly those relating to capital expenditure, smart meters, smart grids and innovation. Further insights regarding interfaces between this losses strategy and other RIIO-ED1 initiatives are provided in the documents contained in Table 1.

Table 1 - Linkages to RIIO-ED1 business plan

Document	Chapter / Section
SP Energy Networks Business Plan 2015-2023	Chapter C6 – Expenditure d. Load Related Expenditure e. Non Load Related Expenditure
SP Energy Networks Business Plan 2015-2023 Annexes	Annex C7 – Smart Grid Strategy - Creating a Network for the Future – SPEN
SP Energy Networks Business Plan 2015-2023 Annexes	Annex C7 – Smart Meter Strategy – SPEN
SP Energy Networks Business Plan 2015-2023 Annexes	Annex C5 – Environmental Strategy – SPEN
SP Energy Networks Business Plan 2015-2023 Annexes	Annex C6 – Load Related Investment Strategy – SPEN
SP Energy Networks Business Plan 2015-2023 Annexes	Annex C6 – LCT Network Monitoring Strategy – SPEN
SP Energy Networks Business Plan 2015-2023 Annexes	Annex C7 – Innovation Strategy – SPEN

3. Introduction

This annex describes SP Energy Networks' strategy for managing energy losses that occur on electricity distribution networks. This strategy applies throughout the RIIO-ED1 regulatory period and will be subject to regular reviews and updates. There are a variety of reasons that energy losses occur on electricity distribution networks and this strategy addresses both the technical and non-technical aspects of such losses. Technical losses arise predominantly for engineering-based reasons whereas non-technical losses primarily relate to misallocated & unidentified energy flows.

SP Energy Networks' strategy is to proactively monitor all energy losses on its distribution networks and to implement a range of measures with the objective of cost-effectively reducing or mitigating increases in losses as electricity demand increases in future. The key benefits to customers of pursuing a strategy designed to reduce electricity losses include:

- *Cost savings from avoided and deferred network investment;*
- *Increased network capacity;*
- *Increased network flexibility to accommodate future load growth and new customers;*
- *Lower electricity production requirements;*
- *Reduced electricity purchasing requirements for suppliers;*
- *Societal benefits in terms of lower emissions of greenhouse gases;*
- *Deterring theft of electricity by a minority of customers; and*
- *Reducing the cross-subsidies between different customers groups, e.g. metered, unmetered and those prepared to illegally abstract their electricity supply.*

Consistent with our obligations to develop, maintain and operate an efficient, coordinated and economic system for the distribution of electricity, SP Energy Networks gives a long-term commitment to proactively manage the energy losses on our networks for the benefit of our stakeholders. We believe that this losses strategy will be consistent with any new licence obligations requiring losses to be as low as reasonably practicable.

We will take advantage of emerging opportunities to improve our management of losses by using data from smart meters, enhanced network monitoring and new smart grid applications. Details of these smart grid techniques are contained in our Smart Grid Strategy and provided as **Annex C7 – Smart Grid Strategy - Creating a Network for the Future – SPEN**.

4. Overview

SP Energy Networks divides responsibility for mitigating technical and non-technical losses between its engineering and commercial functions. Our plans for managing technical and non-technical energy losses are addressed in Sections 7 & 8 of this strategy document respectively.

Implementation of this losses strategy will continue to be the responsibility of our respective engineering and commercial functions throughout the RIIO-ED1 period and our strategic objectives will be delivered by embedding new planning standards and policies, equipment specifications and service levels agreements within our business processes. SP Energy Networks losses strategy for RIIO-ED1 has;

- *Committed to the continued deployment of existing loss mitigation measures,*
- *Formulated new initiatives for immediate implementation to pro-actively reduce losses, and*
- *Identified longer term initiatives for further evaluation.*

In addition to developing an innovative range of measures to reduce electricity distribution losses, working with a range of partners and stakeholders, SP Energy Networks will also adopt techniques developed by other GB DNOs. SP Energy Networks will share insights and learnings from its loss mitigation activities within the GB DNO community, and we also gain further insights from the regular information exchanges that take place with our parent company, Iberdrola e.g. our approach to transformer procurement and fraud detection initiatives.

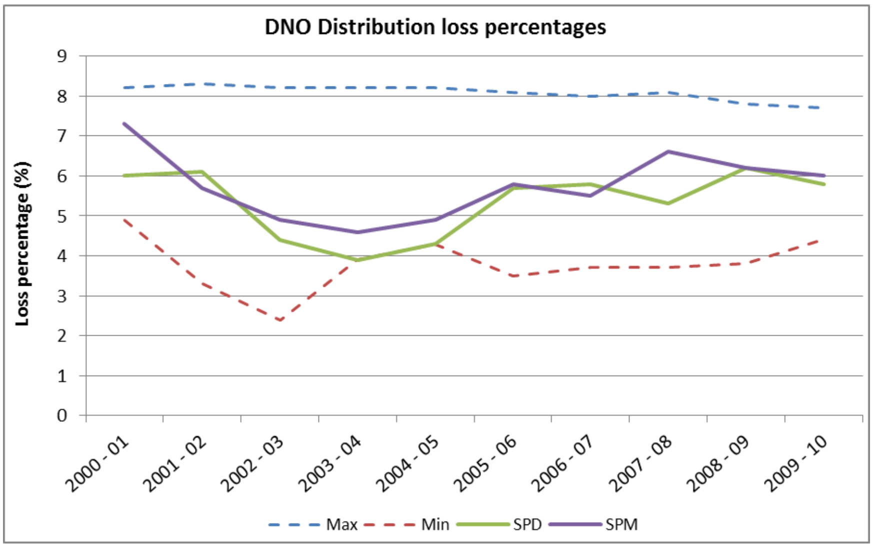
The asset lives of the equipment employed on our distribution networks require us to adopt long-term perspectives to assess the cumulative benefits to customers of energy loss reduction initiatives, typically over the entire lifecycle of the proposed investment that may be up to 45years. This ensures that our investment decisions are not unduly influenced by short-term considerations. SP Energy Networks therefore adopts a standardised cost benefit assessment methodology to determine which loss mitigation techniques are economically justified in the long-term.

5. Baseline & projections

5.1. Historical situation & current baseline

Historically, network losses were calculated using meter settlement data and reported annually to Ofgem. This practice ceased in 2010 at the introduction of DPCR5 due to inherent inaccuracies in calculating losses and the challenges of making meaningful comparisons between different DNO licence areas. These difficulties are explained further in section 6.1. The chart in Figure 1 below indicates the range of losses previously reported to Ofgem and is provided solely for illustration.

Figure 1 - Historic DNO losses



Source: Ofgem, Electricity Distribution Loss Percentages by Distribution Network Operator (DNO) Area

From 2005-06 onward, the start of DPCR4 and the introduction of the Ofgem losses incentive, total losses expressed as a percentage have remained relatively flat across all DNOs, including the SPD and SPM licence areas.

In 2009-10 SPD reported energy losses of 1,250 GWh, equating to 5.8% of the energy entering the distribution network and SPM reported losses of 1,040 GWh, or 6.0% of energy entering the network.

5.2. Impact of load growth on losses during RIIO-ED1

Our load growth forecasts are driven by a combination of economic forecasts and by Department of Energy and Climate Change (DECC) scenarios for the anticipated uptake of low carbon technologies. SP Energy Networks has adapted the DECC scenarios to its local operating environments and produced a 'best view' forecast (see **Chapter C6 – Expenditure – d. Load Related Investment** and **Annex C6 – Load Related Investment Strategy – SPEN**) based on the industry standard Transform model for the SPD and SPM licence areas.

Our 'best view' forecast predicts a rise in peak demand of approximately 552MW (11.7%) and 338MW (9.2%) in SPD and SPM licence areas respectively. The overall impact of these demand increases on network losses is likely to vary, with increased losses due to the electrification of heat and transport partially offset by a greater penetration of distributed generation and energy efficient initiatives.

The modelled outputs of our 'best view' DECC scenario LCT penetrations by 2023 indicate significant volume increases from the present levels to;

- *1,762 MW of photovoltaic (PV) distributed generation installed,*
- *242,301 heat pump installations, and*
- *90, 024 electric vehicle (EV) charger installations.*

Any assessment of the overall impact on losses from these technologies is subject to significant variability due to uncertainties regarding LCT adoption rates and locational factors (including clustering), and therefore it will be essential to monitor the network as LCT penetrations rise in order to mitigate any increase in losses appropriately. Our monitoring strategy (see **Annex C6 – LCT Network Monitoring Strategy – SPEN**), particularly for secondary substations and LCT hot spots described in section 7.2, provides more detail.

In general, from a qualitative perspective, increases in both peak and average demand can be expected to increase losses in existing network infrastructure due to higher levels of asset utilisation and corresponding increases in variable losses. However, where reinforcements and asset replacements are planned there will be opportunities to offset these increases by installation of new lower loss network infrastructure where economically justified by cost-benefit analysis.

5.3. Smart grid impact & increasing asset utilisation

As the deployment of distributed generation and low carbon technologies accelerates, placing additional demands on network capacity and utilisation, it is envisaged that smart grid technologies will be deployed as a cost-effective solution to network capacity maximisation. SP Energy Networks is actively pursuing the development and installation of smart technology where appropriate.

Active Network Management (ANM) schemes are sophisticated network management systems designed to control load flows around network constraints. They are a particularly useful technology option in facilitating the connection of distributed generation schemes to a constrained network and can reduce losses by maximising the output of such local generation[2].

ANM, or potentially less complex automation schemes, can also be deployed to dynamically manage the position of Network Open Points on 11kV circuits to optimise loading conditions and losses. We have recently completed the first phase of an innovation project[3] to evaluate this opportunity in detail.

Dynamic line rating is an operational technique employed to maximise the available capacity of an overhead line and can be a cost-effective alternative to network reinforcement. However, one disadvantage of this technique is that the variable losses associated with additional load flows are likely to increase. Other smart network investments such as Intelligent Voltage Control, and the integration of Statcoms may also provide optimisation opportunities for technical losses and these are discussed further in Section 7.

From a commercial perspective, during the course of RIIO-ED1 we plan to develop demand side response solutions to smooth load profiles and improve loss reduction by reducing peak demand. This is detailed within our innovation strategy (see **Annex C7 – Innovation Strategy – SPEN**) as a key area of focus due to the possibility of multiple benefits being realised.

Similarly, contracting for localised generator support will offset demand in specific areas reducing the distances over which energy is transported and the associated losses. This is included within our portfolio of smart solutions for general reinforcement in RIIO-ED1 and builds on the learning of DNOs through LCNF projects, such as Low Carbon London.

5.4. Projections for unmitigated losses

Based on our ‘best view’ load growth scenario, which includes economic growth and LCT adoption projections, we estimate that between the start and end of the RIIO-ED1 regulatory period, annual network losses would have increased by 145 GWh for SPD in the absence of planned loss mitigation measures. The corresponding increase in annual losses for SPM would be 94 GWh if unmitigated. These increases are summarised in Table 2 and have been calculated by applying historic average loss factors to our forecasts for load growth over the ED1 period.

2 In networks areas where maximum loading conditions are generation related, it is possible that further increases to generator outputs will also increase losses.

3 Innovation project IFI-0615 SP Active Research Centre.

Table 2
Unmitigated increases in annual losses during the RIIO-ED1 regulatory period

Unmitigated Losses	SP Distribution		SP Manweb	
	Incremental increase during ED1	Total estimated losses in 2023	Incremental increase during ED1	Total estimated losses in 2023
GWh	145	1,290	94	1,069

The measurement initiatives described in Section 6 will improve the accuracy of these estimations by addressing inherent approximations in averaged approaches. These developments will also provide a more robust baseline from which the effectiveness of our planned mitigation measures will be assessed. Details of each mitigation measure and corresponding reduction in losses are provided in Section 7.

6. Measurement

6.1. Historic approach to quantification

Energy entering the distribution network at transmission GSPs is measured with high accuracy metering and is readily quantified. However, the quantification of energy exiting the distribution network is currently dependent on aggregating all customer metered consumption. The difference between the aggregated meter consumption data, provided from the settlement system, and the GSP metered energy represents overall network losses.

The current approach to determining distribution network losses has several shortcomings;

- *It is not possible to distinguish between technical network losses and non-technical losses,*
- *The process is very sensitive to data quality and accuracy,*
- *Estimated energy consumption is used to determine energy use from unmetered supplies, and*
- *Apportionment of losses across customers is reliant on educated estimates.*

Ofgem has recognised these shortcomings and withdrew the previous losses incentive mechanism at the start of DPCR5 due to the challenges of obtaining accurate data to provide meaningful and consistent quantification of technical and non-technical losses.

During RIIO-ED1 there is an expectation that DNOs will develop a methodology to establish a consistent and reliable losses baseline within the period. SP Energy Networks is fully supportive of this requirement and commits to working closely with Ofgem, DNOs and other interested parties to develop a robust measurement framework for both technical and non-technical losses.

6.2. Losses baseline development

Establishing a reliable losses baseline within RIIO-ED1 will require an improved understanding of the load flows across our network from the GSP to the consumer meter. To achieve this will require additional monitoring and metering capabilities across the network, particularly at primary and secondary substations and the LV network.

SP Energy Networks will develop an enhanced LV network modelling capability that aggregates energy density values to LV circuit and secondary transformer levels. This approach builds on the LV Template modelling techniques previously established by WPD and integrates customer connectivity, address and MPAN data to model energy density changes on the LV network and provide improved information on secondary substation utilisation.

The availability of smart meter data, in association with enhanced network monitoring, will feature prominently in improving our understanding of the magnitude and location of losses, especially on LV networks, and will inform development of our baseline methodology. Smart Meter data will provide disaggregated within-day consumption data for individual customers, which when interfaced with our network connectivity models can be used to provide detailed insights into substation average and peak loading from which loss calculations can be performed. Further refinements linked to the selective use of substation monitoring (potentially portable) will enable individual circuit loadings to be observed from which circuit-specific losses can be calculated. Comparison of circuit loadings with aggregate half-hourly smart metering data will be used to reveal the magnitude of total losses and will highlight specific areas of concern where there are significant unexplained differences between measures, i.e. large deltas could indicate the presence of unexplained non-technical losses which could include theft, unregistered MPANs or unrecorded unmetered supplies inventories. The use of smart meter data is discussed further in **Annex C7 – Smart Meter Strategy – SPEN**.

SP Energy Networks will also consider innovation and learning from other DNO initiatives to better understand the behaviour of networks, for instance, WPD's LV network templates and ENW's LV network modelling.

6.3. Opportunities for direct measurement

SP Energy Networks is already committed to the deployment of advanced monitors on LV feeders at 1,348 secondary substations across both licence areas. The purpose of this monitoring is to collate enhanced data from the secondary transformer and LV network interface to provide improved network operational information including power flow, power factor and phase balance. As discussed in section 7.2 the combination of fixed and mobile monitors will be initially targeted at highly loaded sites where LV network losses are potentially greatest. This advanced monitoring capability will be augmented by the installation of smart MDIs (Maximum Demand Indicators) at a further 1,200 secondary substation sites across SPD and SPM to provide a monitoring capability at a total of 2,500 substation sites.

We will proactively pursue detailed analysis of smart meter data and develop models to compare and reconcile data from the advanced monitors and smart MDIs. This approach will greatly increase our knowledge of LV network losses and will provide indicators on how best to improve uncertainties around the quantification of unmetered supplies and theft. Such detailed and localised quantification of total losses will increasingly influence our capital planning processes regarding asset replacement, network expansion and reinforcement strategies. Further information can be found in our smart metering strategy provided as **Annex C7 – Smart Meter Strategy – SPEN**.

6.4. Establishing a long-term scorecard

SP Energy Networks is fully supportive of a new competitive regulatory element to incentivise reductions in losses using a discretionary reward (DR) arrangement at various points during RIIO-ED1 in lieu of the previous losses incentive mechanism.

Determination of a scorecard or dashboard to measure and visualise performance of proposed loss reduction initiatives against the baseline is an intuitive progression. SP Energy Networks recognises that such a scorecard must incorporate criteria common to all DNOs to attain comparable performance measures and we will pursue a collaborative approach with the other DNOs in their development.

We are committed to actively participating in Ofgem consultations and working groups with industry stakeholders to encourage further losses reduction initiatives.

6.5. Regular review & reporting

During the RIIO-ED1 period SP Energy Networks will continue to deploy current losses reduction techniques and augment these with initiatives, as discussed in Sections 7 and 8, to further reduce losses as the nature and location of demand changes. These new initiatives will be closely monitored and reviewed annually to ascertain progress against CBA objectives and to maximise value and learning from the data and results available.

We will review all activities relating to losses mitigation collectively, to provide a holistic view of performance across the losses strategy and to identify potential opportunities for improvement. SP Energy Networks will incorporate smart meter losses initiatives into the holistic losses strategic review as data becomes available. Communicating our losses strategy, together with a commitment for regular reviews, will be key to maintaining a collective focus and understanding of the total reductions achieved during RIIO-ED1.

SP Energy Networks is confident that the review cycle outlined above will exceed Ofgem's annual reporting requirements and we will work with all stakeholders to develop a standardised reporting framework.

7. Technical losses mitigation

7.1. RIIO-ED1 loss reduction expenditures and outputs

SP Energy Networks will implement a number of technical loss mitigation initiatives during the RIIO-ED1 regulatory period. We are also committed to evaluating a range of innovative new measures for potential implementation later in period, as outlined below. Our philosophy for technical loss reduction is to adopt a holistic approach which considers a range of factors to maximise overall benefits to customers. The principles underpinning the planned losses reduction initiatives to be implemented during RIIO-ED1 are to maintain network security, reliability, quality of supply and also to avoid compromising the asset health of existing infrastructure. All loss reduction initiatives will also be subject to rigorous cost-benefit analysis to ensure each is economically justified. Furthermore, many of the loss reduction initiatives planned will provide wider benefits to customers in terms of increased network capacity, greater flexibility to integrate LCT technologies and better resilience to adverse weather conditions.

CBA methodology & assumptions

As outlined in the core business plan our approach to cost benefit analysis (CBA) is compliant with HM Treasury Green Book guidelines. Adherence to the CBA guidance provided by Ofgem in the "Business plans and proportionate treatment" decision paper has been pursued and we have utilised the standard Ofgem CBA template in the selection of appropriate technical loss reduction options. It should be recognised that whilst a number of loss reduction initiatives provide positive net benefits overall, DNOs often incur additional incremental costs in order for the wider benefits to flow to other stakeholders (e.g. suppliers) and ultimately customers.

Ofgem provided input data guidance to all DNOs covering the value of losses to be used in the CBA at £48.42 / MWh and a useful economic lifetime for assets of 45 years. However, during RIIO-ED1 we will also undertake sensitivity analysis using alternative energy prices and asset life assumptions to assess the circumstances under which particular losses reduction initiatives become economically justified.

During RIIO-ED1 cost benefit analysis will be key to our investment decision process for major reinforcement, asset replacement and refurbishment activities to ensure that each intervention is optimised. Our planning methodologies have been adapted to ensure losses reduction considerations are embedded in the overall CBA assessment. Separately quantifying loss reduction options within our CBAs ensures that appropriate new technologies, such as those examples detailed in section 7.2, are included alongside the more traditional loss reduction techniques.

In general, SP Energy Networks has not found loss reduction asset replacement initiatives to be economically viable when assessed in isolation. The one exception identified for the RIIO-ED1 period, and detailed later in this section, is the proactive replacement of inefficient secondary transformers manufactured prior to 1962 as discussed further below.

Transformers

SP Energy Networks procures all transformers based on the lifetime cost of the transformer, incorporating capitalisation of losses, over a transformer working life expectancy of 40 years.

Manufacturers offer transformer designs to provide optimised cost/losses benefits based on the following formula;

Lifetime Cost (£) = Purchase price (£) + (No load £/kW x No load loss kW) + (Load loss £/kW x Load loss kW).

Note that the load loss £/kW figure incorporates a utilisation factor that varies between transformer types to reflect typical duties, e.g. a secondary transformer utilisation factor is higher than that of a primary transformer.

We have been using this optimised transformer procurement policy since 2005 and our experience demonstrates that manufacturers consistently provide transformers that are lower loss than required by our minimum transformer design specification. SP Energy Networks will review this policy to reinforce the challenge to manufacturers as the proposed Ecodesign transformer standards are adopted.

EU Directive 2009/125/EC will mandate the adoption of Ecodesign power transformers in two stages; Tier 1 on 1st July 2015 and Tier 2 in 2020. The proposed Ecodesign requirements specify new maximum load and no-load losses for all power transformers deployed within our networks and peak efficiency requirements for large power transformers. ;

Grid & Primary transformers

Our current policy to procure optimised, high efficiency grid and primary transformer designs already exceeds the proposed power transformer EU Directive Tier 2 efficiency standard for 2020. SP Energy Networks will replace 21 grid and 89 primary transformers in SPM and 61 primary transformers in SPD during RIIO-ED1. This plan results in a loss reduction of 63.9 GWh in SPM and 12.9 GWH in SPD for the programmed grid and primary transformer replacements over the RIIO-ED1 period. Achievement of the losses benefit is embedded in our replacement programme and SP Energy Networks will continue our proven, cost-effective transformer procurement policy into RIIO-ED1. See Table 3

Table 3
Grid & Primary transformer losses mitigation

Grid & Primary transformer replacement programme						
Licence Area	Transformer volumes		Losses reduction over ED1 period		Losses reduction over asset life	
	Grid	Primary	GWh	tCO_2e	GWh	tCO_2e
SPD	-	61	12.9	5,603	130.8	22,982
SPM	21	89	63.9	27,839	575.6	103,312
Total	21	150	76.8	33,442	706.4	126,294

The high losses reductions achieved in SPM are due to the volume, forty-four, of particularly inefficient pre-1962 era transformers programmed for replacement in ED1.

Secondary transformers

Current policy for our entire condition driven transformer replacement programme is to install new units that comply with our lifetime cost optimised design methodology. Whilst the efficiency of these new transformers exceeds our minimum specification they do not meet the efficiency standards of the proposed EU Directive Tier 1, due to come in to force from 1st July 2015.

At present, there is considerable uncertainty on the cost of secondary transformer designs to meet the Tier 1 requirements. However, SP Energy Networks has conducted analysis that indicates, although its proposed transformer replacement programme would still realise a net benefit, the NPV would be reduced by £0.32m in SPD and £0.38m in SPM allowing for the assumed 15% cost increase[4] of Tier 1units. We will revise our analysis when manufacturers provide more certainty around the scale of potential cost increases. The incremental losses reductions over our current transformer procurement policy are indicated in Table 4.

Table 4
Ecodesign transformer losses mitigation

Secondary ground mounted transformer replacement programme utilising Tier 1 Ecodesign					
Licence Area	Secondary transformer replacement volumes	Losses reduction over ED1 period		Losses reduction over asset life	
		GWh	tCO_2e	GWh	tCO_2e
SPD	144	5.7	2,497	54.0	9,611
SPM	493	20.4	8,855	188.6	33,672
Total	637	26.1	9,152	242.6	43,283

Low loss transformers are generally considerably larger than similarly rated standard oil filled transformers, exhibiting increases in both mass and volume. This issue has the potential to impact the footprint required for ground mounted substations and the design of overhead line structures, with associated increases in total costs. SP Energy Networks has sought further information from transformer manufacturers requesting further information on this matter to assess whether any modifications are required to design standards and the potential impact on related costs.

Pre-1962 secondary transformers

In addition to our transformer asset replacement programme, SP Energy Networks has identified a population of particularly high loss secondary transformers installed in both licence areas prior to 1962. Transformers manufactured prior to 1962 were produced using a core manufacturing process that resulted in efficiencies that are approximately 60% poorer than modern transformer designs. Replacement of several of these high loss transformers is incorporated into the core asset replacement programme but we will replace additional pre-1962 units in a drive to proactively reduce network losses. Replacement of these additional transformers will be prioritised by highly loaded and utilised units to realise the greatest benefits early in the RIIO-ED1 period.

SP Energy Networks has a population of 3,201 pre 1962 secondary transformers and we plan to replace a total of 1,347 during the RIIO-ED1 period; 922 from the losses driven initiative and 425 in the asset replacement programme. The losses driven programme and related losses savings is summarised in Table 5. Replacement volumes are limited in RIIO-ED1 due to deliverability constraints and it is our intention to complete the programme in ED2.

4 Report to the ENA: Proposed EU Ecodesign Regulations on Transformers – Impact on UK, May 2013.

Table 5
Pre-1962 transformer losses mitigation

High loss pre-1962 transformer replacement					
Licence Area	Losses driven transformer replacement volumes	Losses reduction over ED1 period		Losses reduction over asset life	
		GWh	tCO_2e	GWh	tCO_2e
SPD	570	26.5	11,513	245	43,742
SPM	352	16.0	6,962	148	26,370
Total	922	42.5	18,475	393	70,112

This losses driven initiative to replace 922 transformers will provide a reduction of losses during RIIO-ED1 totalling 42 GWh, realising a saving of 18,475 tonnes CO_2 equivalent.

A full cost benefit analysis for this £11.5m expenditure, £6.8m in SPM and £4.7m in SPD, is provided in CBA 1.1 and 1.2 in **Annex C6 – Cost Benefit Analysis – SPEN**, realising an NPV benefit of £1.98m in SPD and £0.67m in SPM.

Overhead line conductor

Increased conductor size of main line 11kV OHL rebuilds

SP Energy Networks has been operating an overhead line resilience policy based on a geographical demarcation of normal and severe weather areas. Asset replacement and new build, reinforcement driven overhead line investments in normal weather areas are currently constructed with lighter 50mm² conductor whereas those in severe weather areas utilise heavier 100mm² conductor.

Additional loss reduction options have been considered for normal weather areas during the RIIO-ED1 period and cost benefit analysis performed. A full CBA is provided in **Annex C6 – Cost Benefit Analysis – SPEN** that justifies the installation of larger size conductor when rebuilding OHL in normal weather areas. The CBA demonstrates that it is beneficial to construct all main line rebuilds with the heavier 100mm² conductor and this policy has been adopted for RIIO-ED1.

This revised policy provides the key benefit of a reduction in electrical losses and also delivers enhanced resilience and a degree of future proofing to accommodate potential load growth, e.g. from the adoption of low carbon technologies.

Table 6
HV conductor losses mitigation

Increase main line conductor size to $100mm^2$					
Licence Area	Overhead line replacement km/year	Losses reduction over ED1 period		Losses reduction over asset life	
		GWh	tCO_2e	GWh	tCO_2e
SPD	110	9.3	4,040	85.6	15,300
SPM	99	8.6	3,764	79.8	14,255
Total	209	17.9	7,804	165.4	29,555

The reduction in net losses over the RIIO-ED1 period is estimated to be 17.9 GWh, resulting in a saving of 7,804 tonnes CO_2 equivalent as summarised in Table 6.

A full cost benefit analysis is provided in CBAs 68.1 and 68.2 in **Annex C6 – Cost Benefit Analysis – SPEN**, realising an NPV benefit of £1.46m in SPD and £1.4m in SPM.

Underground cables

Installation of larger cross-section LV and 11kV cables

In 2009 SP Energy Networks commissioned a study by EA Technology Ltd (EATL) into the effects on losses from installing larger section LV and 11kV cables on a selection of typical circuits with varied demand profiles, e.g. domestic, commercial and mixed. The EATL report[5] analysed new installations only and included cost benefit analysis examining the benefits attributable to the DNO, customer and environment based on, respectively; a £48 / MWh incentive rate, cost reduction reflected in bills and reduced CO_2 production. Whilst the overall benefit from totalling these three factors was generally positive the benefit to the DNO alone could not be justified and SP Energy Networks, therefore, did not change policy at that time to install larger section cables.

SP Energy Networks is committed to loss mitigation and will update the 2009 EATL study to better reflect our holistic approach, considering the wider customer and societal benefits to be delivered over the RIIO-ED1 period. The revised study will be extended to consider additional factors such as future load growth, stock holding costs and procurement volume discounts on the cost benefit analysis.

The incremental cost of installing larger section cables on new circuits is low and our resulting approach, informed by the revised CBA, is likely to be applied selectively to circuits, based on forecast demand profiles, to achieve optimum benefit. Any marginal cost increases will be absorbed within our submitted expenditure. However CBA results clearly demonstrate that the significant costs of excavation during cable installations more than offset any loss reduction benefits and therefore cannot be justified in isolation.

6.6kV to 11kV voltage uprating / rationalisation

SP Energy Networks will continue its ongoing programmes, in both SPD and SPM, of uprating islands of distribution network currently operating at 6.6kV to 11kV. This work programme is demand and capacity driven but will also contribute to our loss mitigation endeavours. Considerable pre-engineering work is required to deliver our voltage uprating and rationalisation programme resulting in delivery constraints. A total of six 6.6kV islands, 2 in SPD and 4 in SPM, will be uprated during RIIO-ED1 with the final two in SPD uprated in ED2. A further 3 island groups in SPM will be uprated during the RIIO-ED2 period and the final 2 island groups completed in ED3.

Substation energy consumption

Our grid and primary substations have equipment rooms and switch rooms that house the main assets and accompanying control systems. These rooms are temperature controlled to prevent condensation within the equipment and subsequent degradation in its condition. Increasing provision of power supplies for electronic and IT equipment within the substation is also increasing demand and energy consumption.

During RIIO-ED1 SP Energy Networks will embark on a programme of work, as are all DNOs, to improve the resilience of control and protection systems at grid and primary substations. This initiative, described in **Annex C5 – Black Start Capability – SPEN**, is likely to further increase substation demand due to increased battery charging and control system requirements.

We remain committed to quantifying and managing the energy consumed by our substations which is required to ensure safe and resilient network operation. From a settlement perspective, the electricity consumed by our substations is treated as an unmetered supply where the total consumption for each network area is determined by the number and load characteristics of different types of substation. Throughout RIIO-ED1, it will become increasingly important to update the unmetered supplies inventories for our substations on a regular basis to reflect the changes to the equipment installed on each site.

5 Reduction of Losses and Carbon Dioxide Burden in Cables, G. J. Le Poidevin, February 2009.

SP Energy Networks has recently instigated an innovation project[6] in association with the University of Strathclyde, funded under the Innovation Funding Incentive (IFI), to determine consumption profiles and trends of our grid and primary substations in relation to temperature and humidity. The objective of the IFI project is to examine the use of different heating, lighting and de-humidification options to reduce substation energy consumption cost-effectively. We will use the electricity meter data collected from this project, and subsequent regular meter readings, to inform future RIIO-ED1 substation energy monitoring initiatives to;

- *Identify further opportunities to reduce substation energy consumption, and*
- *Improve the accuracy of substation demand reported as losses to ensure the anticipated reductions are captured.*

7.2. Longer-term loss reduction initiatives

SP Energy Networks is committed to the pursuit of loss reduction and will evaluate a range of other opportunities with the potential to reduce technical losses during RIIO-ED1. The key areas for further evaluation in the short-term include;

- *Voltage regulation and optimisation,*
- *Optimisation of network configuration,*
- *Secondary substation and LV network monitoring, and*
- *Transformer 'standby' opportunities in SPM.*

SP Energy Networks expects the proposed secondary substation monitoring initiative to provide data that quantifies emerging network issues to identify appropriate longer term evaluation options relating to phase imbalance, harmonics and power factor correction.

Voltage regulation & optimisation

As part of our current Tier 2 LCNF Flexible Networks project, we are examining the voltage dependency of load and the opportunities presented to optimise the voltage set point at primary substations in relation to demand and loss management. The technology has been selectively applied to quantify these uncertainties and is well underway to achieve completion by the end of 2014. We will use the learning from this investigation to inform and evaluate our future plans for optimising voltage control in relation to the nature of the load.

In addition to the expected learning from the LCNF project above, SP Energy Networks has identified an opportunity, to be pursued in RIIO-ED1, to improve voltage control philosophy and associated technologies at primary and grid substations. The anticipated additional sophistication is likely to offer benefits to the accommodation of distributed generation as well as the ability to optimise voltage for the minimisation of losses. This programme will initially be focussed on more rural sites where circuit lengths are considerably longer, voltage drops are more significant and losses potentially higher.

Optimisation of network configuration

Historically, network open points requiring manual operation, particularly overhead, have been located to provide ease of access to operational staff. As the use of remote control and automation is now more prevalent there is an opportunity to re-assess the location of open points and to optimise the balance of load on each side, thereby minimising overall losses.

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6 IFI 1219 – Substation Efficiency, SP Energy Networks Innovation Funding Incentive Annual Report, 3rd September 2013.

A prototype tool has been developed[7] in partnership with the University of Strathclyde that can be used to determine an optimised network configuration that considers the cost / benefit balance of loss reduction whilst maintaining network reliability.

We will conduct further work during RIIO-ED1 to develop this tool, transfer it from a test environment and integrate it into existing network management systems for deployment in both operational and planning environments. We are planning to interface this network configuration optimisation tool into automation and smart control initiatives during RIIO-ED1.

Secondary substation and LV network monitoring

The greatest contribution to overall distribution network losses occurs across the secondary substation transformer and connected LV network. SP Energy Networks will focus on collating enhanced data from this interface through the installation of fixed and mobile advanced monitoring devices. Installation of these devices will be targeted at sites experiencing high load growth, high utilisation and those forecast to become likely LCT hot spots. A total of 1,384monitors will be installed in RIIO-ED1, 880 in SPD and 504 in SPM, representing approximately 5% of the ground mounted substation population.

These monitors will provide data to quantify issues and inform analysis and decisions at a localised level around;

- *Demand growth pattern and types of load,*
- *Emerging trends and issues resulting from the expansion of low carbon technologies,*
- *Phase imbalance, the impact on losses and appropriate mitigation actions,*
- *Power factor correction and any solutions required that may reduce losses, and*
- *Harmonics contributions from the demands connected to the LV network.*

We will also take the opportunity to reconcile smart meter data (see **Annex C7 – Smart Meter Strategy – SPEN**) with the substation monitor data to better understand the location and quantification of losses across the LV network.

In addition to the installation of the advanced monitors, SP Energy Networks will install smart MDIs (maximum demand indicators) to monitor the demand at secondary substation LV busbars at 400 sites in SPD and 800 sites in SPM. These will be rolled out as part of the planned LV board replacement programme.

SPM secondary transformer ‘standby’ opportunities

As described in **Annex C6 – SP Manweb Company Specific Factors – SPEN**, the SPM distribution network architecture differs from most other GB electricity distribution networks in terms of the levels of interconnected meshing between urban substations at all voltage levels which potentially could provide opportunities for further reductions in losses. The losses situation in the SPM urban networks also differs from other distribution networks with regard to higher average transformer loadings and smaller cross-section cable, particularly at 11 kV. Both of these considerations can result in higher than average technical losses.

The SPM interconnected HV network operates with groups of up to 5 interconnected transformers. SP Energy Networks will evaluate loss reduction opportunities in urban SPM networks which would involve switching transformers out of service where interconnected networks retain sufficient redundancy during light loading periods, e.g. selected transformers could operate on ‘cold standby’ in summer months. Such an approach will carefully consider and quantify the trade-off between any reduction of reduced fixed losses and increased variable losses. The potential impact on network reliability and customer service would also need to be factored into the risk and cost benefit analysis.

7 A constituent part of innovation project IFI-0615 SP Active Research Centre.

8. Non-technical losses

SP Energy Networks categorises non-technical losses as energy that is delivered and consumed but is not accurately recorded within the settlement process. Such losses result in increased electricity costs for all customers. SP Energy Networks believes it is important that all stakeholders in the electricity supply chain proactively detect, remedy and deter increases in non-technical losses, thereby improving the overall accuracy of total energy consumption as recorded by the electricity settlement process.

As part of our overall strategy for electricity losses, SP Energy Networks provides an enduring commitment, throughout the RIIO-ED1 regulatory period, to reduce the main contributors of non-technical losses which include:

- *Electricity theft;*
- *Unmetered supplies; and*
- *Electricity Conveyance.*

8.1. Theft & Revenue Protection services

SP Energy Networks is committed to addressing electricity theft in order to ensure the equitable allocation of energy costs across customers, remedying safety concerns associated with the illegal abstraction of electricity and assisting enforcement agencies in the prevention of criminal activities. We believe the threat of detection combined with the prospect of legal recourse provides a deterrent to the illegal abstraction of electricity in future. Consequently SP Energy Networks will remain committed to Revenue Protection throughout the RIIO-ED1 period working closely with a range of industry stakeholders.

Revenue Protection services

For the RIIO-ED1 regulatory period we plan to retain SP Metering Services as the provider of Revenue Protection services to SP Energy Networks. This Revenue Protection service is fully compliant with all requirements of the Revenue Protection Code of Practice of Great Britain, which details the rights and obligations of DNOs and suppliers in relation to the prevention of meter interference and other forms of illegal electricity abstraction. The service provides corresponding updates to information systems and customer records arising as a consequence of the Revenue Protection activities conducted on the behalf of SP Energy Networks.

Our Revenue Protection service provider is a member of the UK Revenue Protection Association whose staff are highly trained and experienced, actively participating in relevant electricity industry forums. They work closely with electricity and gas industry stakeholders, sharing knowledge regarding meter interference and detection techniques to continually improve effectiveness. Similarly, selected Revenue Protection officers contribute to the Home Office's group addressing cannabis cultivation and work closely with Police in this field. They work with other agencies including Housing Associations, Local Authorities and emergency services to highlight the importance of Revenue Protection activities and can also deploy a mobile facility to improve customer awareness. They will also be actively engaged with other stakeholders to develop the Theft Risk Assessment Service (TRAS).

Revenue Protection forms part of a global Iberdrola 'Customer Service Network Integration' project to address fraud. The revenue protection team is participating in this information sharing and best practice initiative. The objectives of the project are as follows:

- *Protect our revenue and assets through strong prevention and detection;*
- *Employ advanced fraud/theft detection practices through new technology and skilled resources;*
- *Develop global fraud prevention methods to ensure accurate customer records; and*
- *Accurate timely billing of theft/fraud cases and debt collection (based on country specific regulations).*

During the RIIO-ED1 regulatory period, the Revenue Protection service will build upon its track record of theft detection and debt recovery to improve the accuracy cost allocation between suppliers and ultimately customers. The services we will provide with the Revenue Protection team will continue to include the following range of office and field-based activities:

- *Planning and & undertaking targeted customer site visits and meter inspections;*
- *Responding to tampering notifications and 'tip-offs' from a range of stakeholders;*
- *Replacing meters & making installations safe;*
- *Effecting repairs to electricity services and mains supplies;*
- *Assessing unrecorded energy and updating information systems accordingly;*
- *Liaison with enforcement agencies;*
- *Participation on industry and government groups regarding energy theft;*
- *Storing meters where interference has been identified for evidence purposes;*
- *Provision of stakeholder training and awareness initiatives; and*
- *Preparation of cases for enforcement action and pursuing prosecutions.*

In addition to performing the activities described above, SP Energy Networks receives monthly service reports regarding the work undertaken by the Revenue Protection team on its behalf and a cumulative summary on an annual basis in order that trends and hot-spots can be monitored.

We plan to work closely with SP Metering Services and all suppliers to enhance the scope and effectiveness of revenue protection services throughout the RIIO-ED1 period. We also believe that the roll-out of Smart Metering will present both opportunities and challenges for Revenue Protection and the service will need to evolve accordingly. During the roll-out, we anticipate higher detection rates of meter interference as a consequence of the increased number of site visits, which will create new opportunities but also impact the Revenue Protection workload.

Following completion of the roll-out programme, there will be an on-going requirement to inspect metering installations to detect tampering. The frequency of site visits by metering staff is likely to reduce due to the introduction of remote meter reading and therefore the Revenue Protection service will need to target high-risk areas and suspicious consumption trends accordingly. Otherwise there is a risk that customers may perceive the likelihood of detection to be diminished. Incentives to steal energy could be compounded by increasing energy prices, making the potential rewards of energy theft more significant to some customers.

To counter these risks, we believe that Smart Metering data will provide our Revenue Protection service with significant new opportunities to detect theft. Such opportunities will be linked to Smart Meter tampering information being automatically routed to suppliers and DNOs. The increased granularity of consumption information will also provide opportunities to detect unexpected consumption patterns. During the RIIO-ED1 regulatory period, SP Energy Networks will work closely with Revenue Protection colleagues and suppliers to develop new processes and capabilities to utilise smart metering information.

Overall, we believe the roll-out of smart meters can be used to further reduce and quantify non-technical losses. It will expose existing theft as meters are replaced and should enable earlier detection of theft and defective meters in future. We plan to selectively use smart metering data mapped to network and substation monitoring to identify potential theft during RIIO-ED1, although the full potential of such initiatives may not be fully realised until the ED2 price control period.

Resources & Cost Projections

SP Energy Networks recognises that the funds arising from the detection and recovery of electricity theft are not sufficient to offset the costs of providing Revenue Protection services. Therefore it will continue to be necessary for a proportion of the costs to provide the Revenue Protection service to be recovered through Distribution Use of System charges. Although we believe that debt recovery from offenders will remain challenging during RIIO-ED1, close cooperation with other stakeholders (particularly suppliers) will improve current recovery rates and further enhance deterrence.

SP Energy Networks is planning to maintaining net expenditure on Revenue Protection related services during RIIO-ED1 at the current levels of £0.59M pa & £0.43M pa for SPD & SPM respectively. However, we will also review and flex expenditure requirements throughout the period mindful of the uncertainties regarding potential increases in workload, the impact of smart metering and the development of new business processes to improve detection.

8.2. Unmetered supplies

Throughout the RIIO-ED1 regulatory period, SP Energy Networks will continue to proactively improve the accuracy of unmetered supplies in SPD & SPM working closely with customers and energy settlement stakeholders. This will result in improvements to our understanding of non-technical losses attributable to unmetered supplies.

As described in the introduction, not all customer demand in our distribution areas is metered. Typical unmetered demands include street lighting, traffic lights and road signs, advertising hoardings and lighting in shared occupancy (often public sector) buildings. Energy consumption from unmetered supplies is quantified by agreeing inventories with each customer regarding the types of equipment consuming energy in particular locations from which representative estimated annual consumption information is agreed to match assumed demand characteristics.

Non-technical losses associated with unmetered supplies can be attributed to incomplete database records of unmetered customer loads, inaccurate equipment inventories and errors regarding the assumed demand characteristics. Typically these considerations result in the under-recording of unmetered energy consumption. An emergent trend that we anticipate continuing throughout the RIIO-ED1 period relates to large customers (often in the public sector) retrofitting energy efficient equipment within their asset portfolios to lower energy consumption. Clearly, such customers are strongly incentivised to work closely with DNOs to agree revisions to their energy consumption and we remain committed to improving the accuracy of these inventories.

Throughout the RIIO-ED1 regulatory period, SP Energy Networks will continue to work with main unmetered supplies customer groups to ensure equipment inventories are regularly updated and we will actively pursue customers where inventories have not been received. We will adopt a proportionate approach to improving the accuracy of unmetered supply records by targeting the largest customers which typically include councils and local authorities.

SP Energy Networks will also continue to monitor settlement data, use Elexon's UMS data quarterly reports and best practice guidance to continually seek to improve the accuracy of unmetered electricity consumption in the SPD & SPM distribution areas.

Where customers are unwilling to engage with us regarding asset inventories for their unmetered supplies, we reserve the right to undertake selective and targeted equipment audits in order to establish accurate consumption information for inclusion in energy settlements.

8.3. Conveyance & settlement inaccuracies

Situations arise where energy is delivered and consumed but is not accurately recorded in the electricity settlement system and therefore becomes lost energy. There are cash-flow implications for DNOs linked to such settlement inaccuracies and SP Energy Networks remains committed to identifying and rectifying the causes of these non-technical losses throughout the RIIO-ED1 regulatory period.

The main causes of these non-technical losses include missing and unregistered metering points, incorrect recording of the energisation status for metering points and incorrect registration of metering system information leading to inaccurate customer consumption data. Such non-technical losses are often regarded as ‘Conveyance’ related.

SP Energy Networks will work closely with suppliers and metering service providers to improve settlement data and metering point registration accuracy. SP Energy Networks will continue to focus on reducing the numbers of metering points without a registered supplier and has already implemented tighter controls on the allocation of new Metering Point Administration Numbers (MPANs) to property developers.

SP Energy Networks will also continue to proactively monitor the number (and check the status) of metering points registered as disconnected and de-energised by suppliers. SP Energy Networks will cooperate fully in Elexon Audits to check settlement data and resolve any inaccuracies identified with corresponding commitments to refine internal processes to prevent any reoccurrences.

During the roll-out of Smart Metering where high volumes of meters will be changed within relatively short timeframes, SP Energy Networks will work with all relevant stakeholders to develop robust industry procedures to ensure settlement accuracy is maintained throughout the transition from the current metering arrangements.

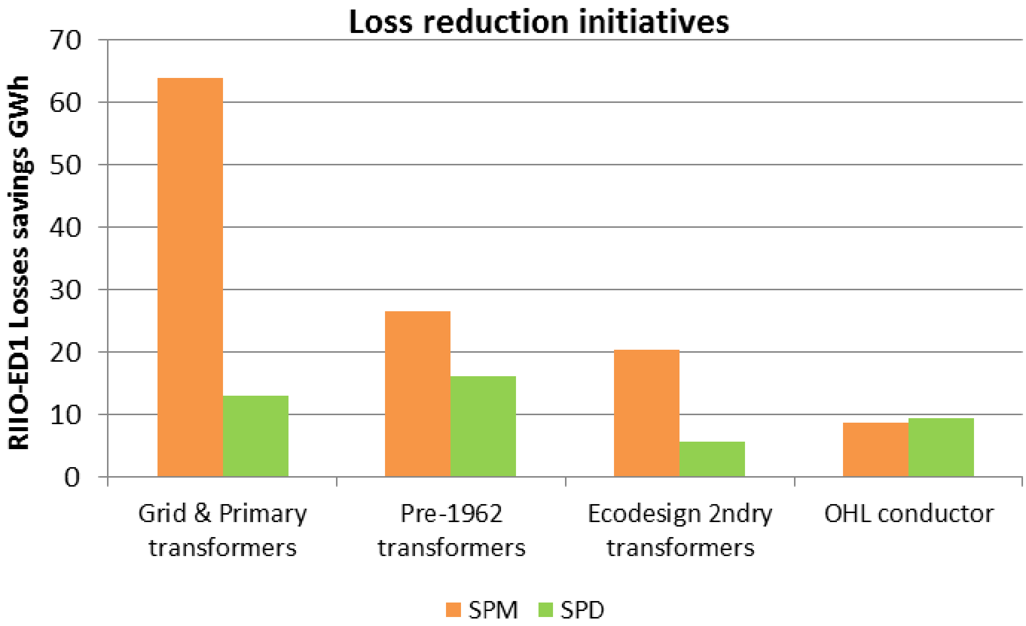
9. Losses in RIIO-ED1

The approach to managing losses described in this strategy demonstrates SP Energy Networks’ commitment to losses mitigation across all network elements during RIIO-ED1. Specific losses reduction initiatives have been identified which we anticipate will deliver a total losses reduction of 163.3 GWh; 119.4 GWH in SPM and 43.9 GWh in SPD as summarised in Table 7 and presented graphically by initiative in Figure 2

Table 7
Reductions in technical losses during RIIO-ED1

Losses reduction initiative	RIIO-ED1: SPM			RIIO-ED1: SPD		
	Expenditure	Losses Reduction		Expenditure	Losses Reduction	
	£m	GWh	$ktCO_2e$	£m	GWh	$ktCO_2e$
Grid & Primary transformers	Consistent with existing policy	63.9	27.8	Consistent with existing policy	12.9	5.6
Ecodesign secondary transformers	+15% premium	20.4	8.9	+15% premium	5.7	2.5
Pre-1962 transformers	6.8	26.5	11.5	4.7	16.0	7.0
OHL conductor	NLRE plan (no additional cost)	8.6	3.8	NLRE plan (no additional cost)	9.3	4.0
Total	£6.8	119.4	71.1	£4.7	43.9	19.1

Figure 2
Contributions of planned losses reduction initiatives



The overall impact on SP Energy Networks of the losses mitigation initiatives described in this strategy for implementation during RIIO-ED1 is to offset the increase in network losses driven by load growth to 76.3 GWh from an unmitigated value of 239.6 GWh as indicated in Table 8. This represents a 68% reduction in losses attributed to our 'best view' load growth scenario.

Table 8
Outputs from RIIO-ED1 losses mitigation initiatives

Impact of Losses Strategy in RIIO-ED1			
Licence area	Unmitigated increase (GWh)	Mitigated increase (GWh)	Reduction (GWh)
SP Distribution	145.4	101.5	43.9
SP Manweb	94.2	-25.2	119.4
Total	239.6	76.3	163.3

Deliverability of the losses strategy and outputs is embedded in the SP Energy Networks non-load related expenditure (NLRE) plan where resourcing and delivery plans have been fully evaluated. Our losses driven initiative for the replacement of pre-1962 secondary transformers is programmed for delivery over RIIO-ED1 and ED2 giving due consideration to delivery capability.

Consistent with our commitments to improve measurement and quantification of losses we will monitor the effectiveness of each of these measures and revise our implementation plans to maximise the economic benefits for our stakeholders.

10. Glossary

A

ANM – Active network management

C

CBA – Cost benefit analysis

D

DECC – Department of Energy and Climate Change

DNO – Distribution Network Operator

DPCR4 – Distribution Price Control Review 4

DR – Discretionary reward

DSM – Demand side management

DSR – Demand side response

DTR – Dynamic thermal rating

E

EATL – EA Technology Ltd.

ENA – Electricity Networks Association

EV – Electric vehicle

G

GSP – Grid supply point

GWh – Gigawatt hour

I

IFI – Innovation Funding Incentive

K

kV – kilovolt

L

LCNF – Low Carbon Network Fund

LCT – Low carbon technologies

LRE – Load-related expenditure

LV – Low voltage

M

MDI – Maximum demand indicator

MPAN – Meter point administration number

MW – Megawatt

MWh – Megawatt hour

N

NLRE – Non-load related expenditure

NOP – Network open point

NPV – net present value

O

OHL – Overhead line

P

PV – Photovoltaic

R

RIIO-ED1 – Revenue=Incentives+Innovation+Outputs – Electricity Distribution 1

RP PoC – Revenue Protection Code of Practice

S

SPD – Scottish Power Distribution

SPM – Scottish Power Manweb

Statcom – Static compensation