Distribution Network Operator Innovation Roll-Out Mechanism (IRM) Submission Pro Forma

Section 1: Application Summary

1.1 Application Title

Enhanced Secondary Substation Monitoring (ESSM) for SP Distribution and SP Manweb.

This IRM bid is made in line with Distribution Licence Condition CRC 3D.

1.2 Estimated Total Cost

SP Distribution = £26.83m

SP Manweb = £20.49m

1.3 Total Funding Request

SP Distribution = £9.71m

SP Manweb = £6.74m

This covers proposed expenditure in RIIO ED1 only and specifically excludes:

- Funding already secured for monitoring through SPEN's RIIO ED1 settlement
- Benefits derived in RIIO ED1 from postponed reinforcement as a result of the ESSM roll-out.
- Expenditure incurred during ED2

Proposed IRM Adjustment

Table 1 below shows the proposed IRM adjustment for the RIIO-ED1 regulatory period.

Table 1 – Proposed IRM Adjustment for SPD and SPM

Proposed adjustment	Licence Area	2018/19	2019/20	2020/21	2021/22	2022/23
IRM Value (£ m) *	**SPD**	£0.49m	£2.23m	£2.25m	£2.35m	£2.40m
	SPM	£0.40m	£1.73m	£1.68m	£1.67m	£1.26m

**Note: All the values are in 2012/13 prices.*

The costs to be recovered through the relevant adjustment exceed the materiality thresholds for both SPD (£6.47m) and SPM (£5.82m), and therefore meet the initial criteria for this incentive.

The derivation of the total funding request for SPD and SPM including the adjustments from planned monitoring costs and avoided reinforcement is detailed in Section 3.

1.4 Start date

April 2018

1.5 End Date

March 2023 (end regulatory year 2022/23)

Distribution Network Operator Innovation Roll-Out Mechanism (IRM) Submission Pro Forma

Section 1: Application Summary continued

1.6 Application Summary

This application seeks funding under the Innovation Roll-out Mechanism (IRM) to deploy “Enhanced Secondary Substation Monitoring (ESSM)” devices across the secondary substations in the SP Distribution (SPD) and SP Manweb (SPM) licence areas. This bid outlines the benefit to customers from accelerating this activity from ED2 into ED1.

In summary, Enhanced Secondary Substation Monitoring provides a number of key benefits to the network, including:

- Providing greater certainty about secondary network loadings and operation, allowing the efficient connection of low carbon technologies over the coming 14 years;
- Effectively adding capacity to the network by removing the conservative thresholds used to plan conventional reinforcement activities
- Enabling a smart secondary network to allow SPEN to deliver cost effective network operation

The key elements of the proposal can be broken down into 4 pillars:

Scale	Timing	Flexibility in the future	Enabling Future Smart Grid ambitions
• Appropriate scale is key to unlocking maximum cost benefit. • Larger roll out results in greater cost benefit but more up-front investment and implementation challenges. • CBA sensitivities determined roll out across 80% of the secondary network offers significant benefit whilst being practical.	• The timing is critical to maximising the reinforcement deferral • Monitoring needs to be installed prior to significant load growth in ED2 to fully capture the benefits.	• Proposed monitoring technology is open platform, multi-vendor technology • Great opportunity to implement black-box monitoring platform without commiting to limited functionality • Allows flexibility in future use of monitors	• Monitoring technology is critical enabler for network automation in future. • ESSM data will complement Smart Meter data by providing the aggregated substation picture • Ties in with SPEN's strategic objectives to move towards smart grid operation.

In summary, the proposal can be seen to clearly meet the eligibility criteria outlined by Ofgem.

The proposal will deliver significant carbon benefits through the efficient connection of low carbon technologies. The effective carbon benefit of enabling this LCT based load growth has been calculated in section 4.1.

The proposal will certainly deliver long term value for money for the customer. The CBA results show that the payback period for the proposed ESSM programme is within RIIO

Section 1: Application Summary continued

ED2 for both network areas. After the monitoring has paid for itself, the flexibility of the "open platform" design is a key strength as this will enable SPEN to determine the best use of the monitoring system for future regulatory periods once there is less uncertainty about load growth and network conditions.

This bid includes due consideration of the commercial benefits to SPEN from implementing the proposed ESSM rollout, and the avoided reinforcement costs within the RIIO-ED1 period have been offset against the amount requested from Ofgem as well as all funds related to secondary substation monitoring in the final RIIO ED1 settlement. The details of these adjustment calculations are provided in sections 1.4 and 4.3.

SPEN understands the importance of financial transparency and has outlined the detailed steps that will be taken to ensure that the IRM funding would not be used to fund any ordinary business activities in section 4.4.

Secondary substation monitoring has evolved significantly over recent years since our ED1 business plan was submitted to Ofgem and has been actively progressed by all DNOs such that it can now be considered as a Proven Innovation and TRL 9. This assumption is backed up by the ongoing work of SSE within their "Low Cost Secondary Substation Monitoring" project.

Finally, the technology is ready to be rolled out and significant thought has been put into the achievable volumes and roll-out plan. This is discussed further in section 4.6, but it can be seen that a compromise between full network coverage and the practical challenges of accessing every substation is proposed, resulting in the rollout of the ESSM across 80% of the secondary substations in the respective SPD and SPM networks. A slow build up period is also envisaged, with design, processes and preparation work in the first year, followed by a slow build up to roll out 60% within RIIO-ED1 with the remaining 20% being rolled out in ED2.

Distribution Network Operator Innovation Roll-Out Mechanism (IRM) Submission Pro Forma

Section 2: Application Description

2.1 Background to LV monitoring

Traditional LV networks are designed as "fit and forget". This approach has worked well in the past because customers' electricity consumption patterns have remained stable and predictable for many years. For example, increased use of electrical products and appliances in the home has generally been offset by each appliance being generally more energy efficient, resulting in the same overall electrical consumption in the home. This has enabled LV networks to be designed using simple, industry-accepted rules. As existing customers do not generally change their consumption levels, LV networks, once built, can perform for much of their expected lifetime without the need for subsequent LV network reinforcement.

Network monitoring for LV networks has traditionally consisted of relatively simple data associated with the monitoring of peak demands by the use of maximum demand indicators (MDI). An MDI is a current measuring device with a "tell-tale" which is moved by the indicator needle, to keep a record of the maximum current observed to date. The maximum demand reading is taken manually as part of the substation inspection process and the information is uploaded to the central system via the field staff "tough-book" (a ruggedized PC). An example MDI display is shown in *Figure 1*.

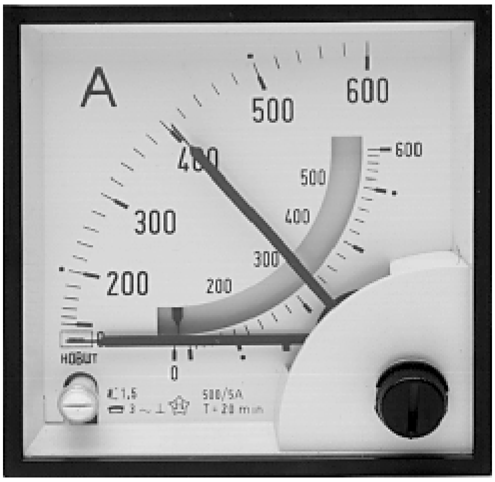


Figure 1. Conventional Maximum Demand Indicators (Source: HOBUT)

2.2 The Requirement for Change

Unfortunately, the existing approaches and systems for LV monitoring are inadequate for effective network management as we move towards a smart grid.

Increasing uptake of low carbon technologies (LCT) such as heat pumps (HP), electric vehicles (EV), photovoltaics (PV) and storage, along with changing customer consumption patterns are influencing load profiles. In addition, high density clustering of these technologies due to rollout of electric vehicle charging points for example will lead to rapid, localised load increases. Increased network monitoring will be required to enable the identification and appropriate response to networks approaching design limits. In parallel, the development of "smart" solutions that provide more rapid, incremental network capacity in comparison to traditional network asset replacement will require additional monitoring to observe and in some cases, manage performance.

Section 2: Application Description continued

Figure 2 shows the anticipated load growth in SPD and SPM network. This is based on the TRANSFORM model considering increased uptake of LCT's.

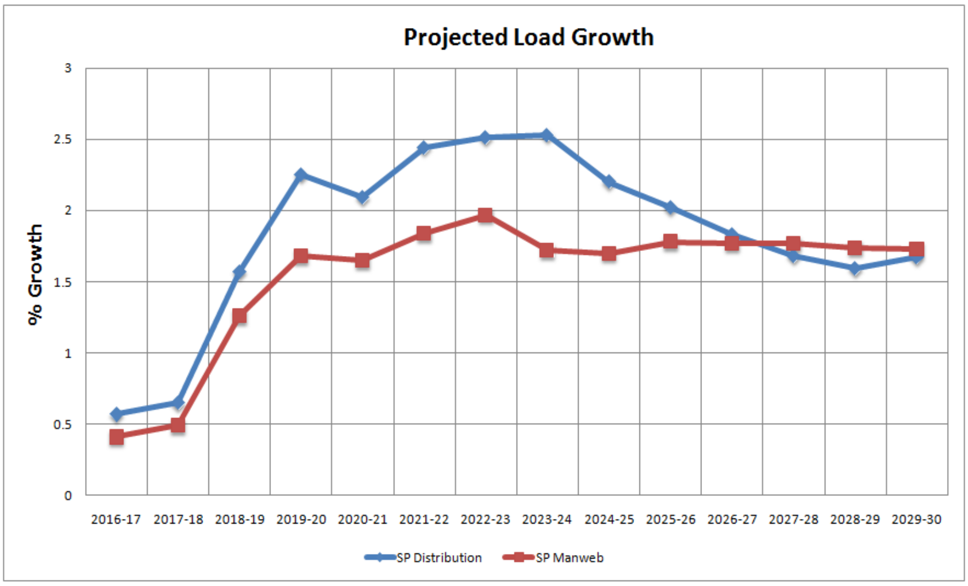


Figure 2. Forecasted demand growth

Enhanced network monitoring will provide critical data about the performance of the LV and Secondary networks that can assist in better decision making and more efficient use of existing assets. Thus one of the key enablers for the future flexible network will be enhanced visibility of secondary networks.

Figure 3 illustrates the use of monitoring data in network operations and planning.

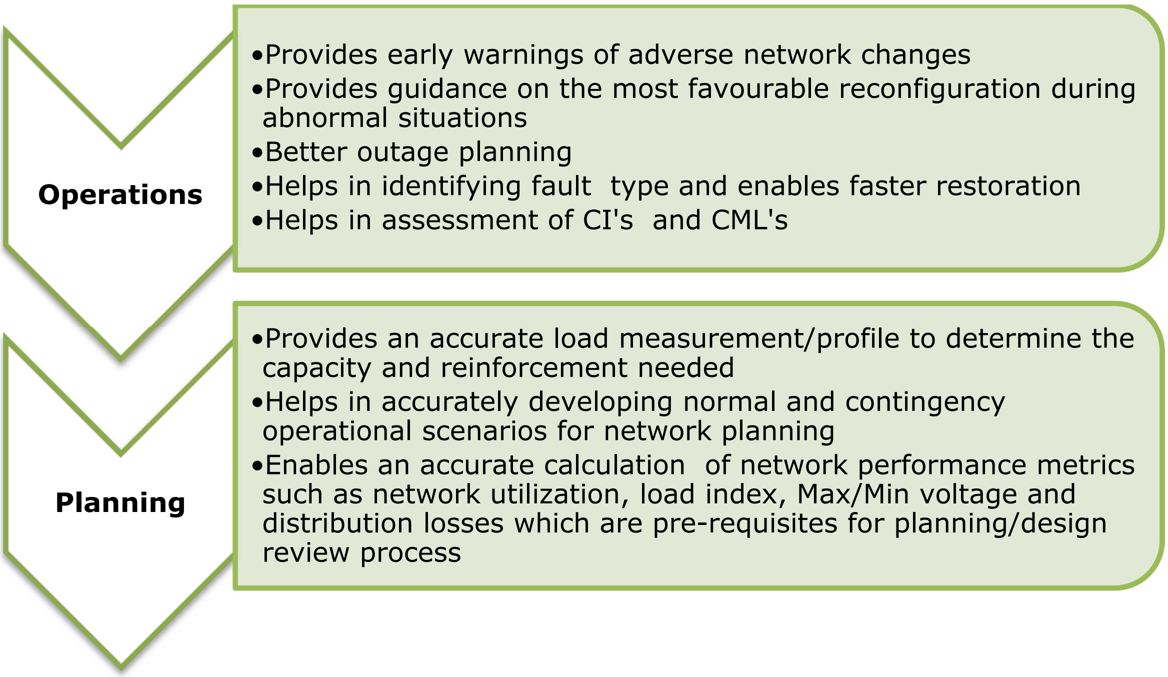


Figure 3. Applications of network monitoring data in network operations and planning

2.3 Enhanced Secondary Substation Network Monitoring in SPM & SPD

There are more than 30,000 secondary substations within the SPD and SPM licence areas to cater for the demand of 3.5 million customers. The overall number of secondary substations (≥200kVA) is detailed in *Table 2*.

Table 2. Secondary substations in SPD and SPM licence area

Secondary Substation (≥200kVA)	SPD	SPM
Ground-mounted	15378	10953
Pole-mounted	1764	1998

All the ground mounted transformer substations in the SPD and SPM licence areas are equipped with very basic maximum demand indicators (MDI's) that do not provide any information on the voltage or the timing, duration, or frequency of the peak demand. These require manual reading, the data is gathered infrequently. Further, if MDIs are not reset after temporary network alteration they can give a false reading of the substation loading. For these reasons, it has limited use for network planning and is of no use for network operations.

Enhanced Secondary Substation Monitoring (ESSM) provides a much improved visibility of the network with average voltage and current measurements recorded every 10 minutes and transmitted to the central database. Figure 4 shows the proposed arrangement of an ESSM unit installed at a secondary substation to monitor both transformer loading and the five outgoing LV feeders.

This IRM bid proposes rolling out ESSM across the secondary network to include 80% of all secondary substations, replacing the existing MDI indicators.

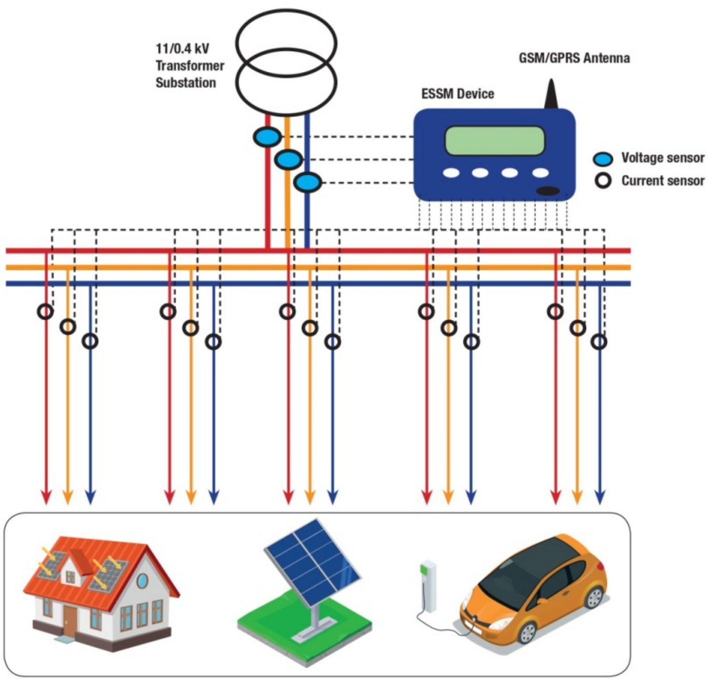


Figure 4. Arrangement of enhanced secondary substation monitoring system

Section 2: Application Description continued

The roll out of ESSM will allow SPEN to better understand the power flows and voltage profiles on the LV networks, leading to improved asset utilisation, thereby releasing additional network capacity for the connection of more low carbon technologies.

2.4 How does it relate to Smart Meter data?

Data from smart meters will start to become available in larger volumes from around 2018 and together with the secondary substation monitoring programme this will enable the development of a smart grid.

ESSM will provide additional valuable data such as aggregate feeder loadings which will complement smart meter data on voltage rise and drop along LV feeders and further verify LV network modelling tools and provide guidance on network capacity and behaviour.

Smart meter data by comparison may be difficult to aggregate for the same purpose, but can provide more detail on individual customer connections, so the two solutions are clearly **complementary.**

Substation monitoring will support the development of a smart grid by working with smart meters in future to manage network constraints and enable intelligent, automated LV networks.

2.5 Enhanced Secondary Substation Monitoring (ESSM) Technology

The ESSM technology is formed of three main components which are described in this section:

- Monitoring hardware
- Current and voltage sensors
- Data communications and data management system

Figure 5 depicts the ESSM device installed in SPEN as part of the Flexible Networks for a Low Carbon Future LCNF project, which is described further in Appendix H.

Figure 5. Enhanced secondary substation monitoring device installed in SPEN

Distribution Network Operator Innovation Roll-Out Mechanism (IRM) Submission Pro Forma

Section 2: Application Description continued

2.6 Monitoring hardware

The monitoring device will be a single unit for the measurement of voltage and current. It will be based on open platform hardware and operating system (such as [redacted] or equivalent) to allow third-party applications (such as [redacted] or equivalent) to run on the operating system.

The device will have an inbuilt GSM/GPRS modem which will enable a two-way communications functionality of sending data to a remote server in one direction and configuration settings and software upgrades in the other. The detailed technical specifications and requirement of ESSM device is presented in Appendix F and a separate description of the common application platform for the LV substations is presented in Appendix G.

2.7 Current and voltage sensors

Current Sensors

Low cost current sensors will be used to measure the LV distributor phase currents in secondary substations. The selected current sensors can be installed around existing cable cores or sections of the busbar which generally enables on-line installation without breaking the circuit. This is a key consideration for minimising the need for any circuit reconfiguration and associated CIs and CMLs.

Voltage Clamps

On secondary transformers, the output phase voltages will be measured on the 415/240V busbar connections using a proven 'G' clamp. With a clearly developed installation procedure and considering SPEN's health and safety guidelines, the voltage clamp can be installed directly on the live busbar which enables on-line installation without breaking the circuit. This is a key consideration for minimising the need for any circuit reconfiguration and associated CIs and CMLs.

2.8 Data Communication and data management system

The ESSM units will be enabled with inbuilt simcard based GSM/GPRS modem by which the monitored data will be transferred through the telecom operator's 2G/3G/4G communication gateway. The data will be received by the wireless logic at the SPEN central data network and will be transferred to a new enterprise-level data management system [redacted] which is being introduced for use with Smart Meter data. SPEN is investing some [redacted] in this new enterprise data management system (separately to this IRM proposal) and we will be leveraging this expenditure by integrating the secondary substation monitoring data into this system. This enterprise service bus arrangement will enable different applications to utilize the monitored data for further processing and analysis.

An overview of the monitoring data management system architecture is illustrated in *Figure 6* .

Section 2: Application Description continued

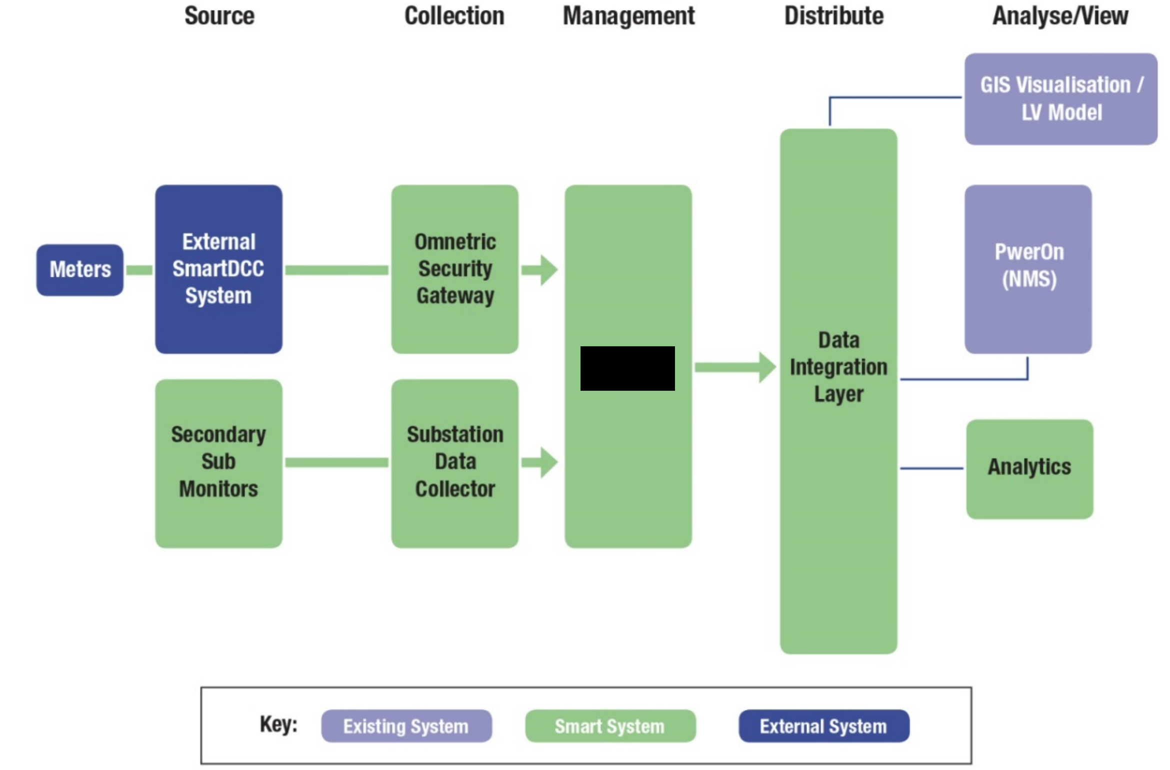


Figure 6. High level monitoring data management system architecture

The analysis tools currently in use within SPEN for connections, planning and operations functions are fragmented to a degree although many use the same data sources and underlying analysis techniques. Consideration will be made as to how these tools could be efficiently consolidated, including a provision for any new analysis tools. A preliminary functional specification for a “common library” will be developed.

2.9 Measurement parameters

The values to be measured by the ESSM units for each LV feeder from a particular secondary substation include:

- Maximum and minimum phase and neutral current
- Maximum and minimum phase voltages
- Maximum and minimum active, reactive and apparent power
- % Total harmonic distortion level
- % Voltage unbalance

All the measurements will be at a sampling rate of at least 1 second and the measured data will be reported/ transmitted typically every 10 mins through the GSM/GPRS communication channel to the central database. Further, the ESSM equipment is enabled with local storage of measured data which will be stored for a period of up to 6 months.

2.10 Technology Readiness

The Technology Readiness Level (TRL) of each of the components of substation monitoring based on SPEN requirements for retrofitting of existing substations is already well advanced at the project outset.

Section 2: Application Description continued

The TRL of enhanced secondary substation monitoring systems is at level 9 as already there are several manufacturers having proven products which are been implemented in the UK DNO's for use on the live LV network.

2.11 Training & Installation Conditions

Prior to installation of the ESSM at the secondary substation, comprehensive training will be arranged by the equipment supplier for safe installation, commissioning and use of the equipment with the technical documentation provided.

The equipment to be installed must be capable of being safely installed whilst maintaining supplies to customers connected to the network to be monitored. Given the many different types of LV distribution equipment that is deployed by SPEN on its networks and the many different location types it is essential that any retrofit monitoring equipment deployed is flexible and scalable.

Further, the monitoring equipment must be capable of being deployed in both indoor and outdoor locations and suit the LV feeder connection arrangements and physical size constraints for the circumstances detailed above.

Safety Considerations

- In all instances of installing monitoring equipment an appropriate risk assessment shall be carried out. Any unsafe situation shall be reported immediately to the associated supervisor or the SPD/SPM control engineer.
- A survey shall be carried out, as required, prior to attending the site to determine methodology and materials required. A final on-site check of the intended installation methodology shall be made before the work is started
- The installation work shall be carried out in a safe logical manner taking into account all the tasks to be undertaken. The work shall be planned with particular emphasis being taken on the safe positioning and connecting of the current sensors, voltage sensors and voltage leads.
- When an ESSM device is to be fixed, e.g. screwed to a wall or pole, all exposed live low voltage conductors shall be screened or shrouded from the work area to prevent inadvertent contact.
- Leads between any sensors or voltage connections and ESSM device shall be held in place by cable ties or protected in plastic tubing or trunking.
- Holes shall not be made (either by drill or screw) into any part of switchgear or transformer.
- All trailing wires shall be tied (plastic cable ties or similar) in place to ensure tidiness and safety.
- Staff shall have received on job training on the installation of the monitoring equipment and this process.
- The current sensors of different makes (if any) shall not be mixed.
- The voltage leads have an internal fuse which will be different depending upon the manufacturer guidelines. The voltage leads for the different makes shall not be mixed.
- All the installations shall be carried out with strict adherence to SPEN safety guidelines.

Distribution Network Operator Innovation Roll-Out Mechanism (IRM) Submission Pro Forma

Section 3: Application Business Case

3.1 Requirement for IRM Funding

IRM funding is required to facilitate the comprehensive roll out of secondary substation monitoring across the SPD and SPM networks before the next price control review, as the ED1 settlement only provided for a very limited monitoring deployment – across approximately 12% of secondary substations. The funding for secondary substation monitoring in the existing ED1 settlement is shown in *Table 3*.

Table 3 Secondary Substation Monitoring Cost Allocation – Original ED1 Settlement

	Secondary Sub Monitoring Costs (£m)								
	2016	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**RIIO-ED1**
SPM	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
SPD	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

The proposed Innovation Rollout constitutes the installation of enhanced secondary substation monitoring equipment across the network, starting in 2019 to enable significant reinforcement deferral in RIIO ED2. To achieve a rollout of enhanced monitoring across 80% of secondary substations (compared to 12% in the original business plan) will require a capital investment of **£23.5m** and **£16.5m**[1] in SPD and SPM licence areas respectively, plus operational costs. This volume of additional expenditure cannot be funded from the existing ED1 settlement, and if delayed until the ED2 settlement, the benefit of implementing the monitoring is diminished, as is shown in the CBA results in section 3.4

Meeting the definition 'Proven Innovation': The enhanced substation monitoring proposed in this bid is the result of research and operational demonstrations in LV & HV network monitoring undertaken by numerous DNOs over the last 5 years. The final step which has taken place since the beginning of RIIO ED1 is the significant cost reduction of the monitoring hardware. The resulting lower cost enhanced monitoring technology proposed in this bid can safely be considered as "proven" and meet TRL 9 as evidenced in section 4e). Many of these previous projects focusing on secondary network monitoring were enabled by Ofgem's innovation funding mechanisms. This IRM bid therefore represents a culmination of the innovation timeline with the widespread roll out of proven technology that cost-reduction engineering has now rendered good value for customers. Based on these two factors, we consider that this IRM submission meets the licence definition of 'Proven Innovation'.

Meeting the definition "roll-out": The proposal in this bid is to install enhanced substation monitoring across 80% of the secondary substations in SPM and SPD licence areas and integrate it as a "business as usual" activity. This amounts to a comprehensive coverage of the network and cannot be treated as a one off or trial innovation scheme. It represents a fundamental shift in the monitoring strategy for the whole secondary network and will be adopted as the key decision making tool for secondary and LV network reinforcement planning across the business. We therefore consider that this IRM submission meets the licence definition of 'roll-out'.

Based on our assessment of the IRM funding bid against these two definitions, we consider that this IRM submission meets the definition, and thus core intent, of the IRM licence requirement of the funding request being for the *roll-out of proven innovation.*

[1] Total capital cost include spend in ED1 and ED2. Only *additional spend* in ED1 will be recovered through IRM mechanism minus any direct commercial benefits. This calculation is detailed in section 3.8.

3.2 Why the innovation roll-out was not considered in SPEN's ED1 plan

A limited level of secondary substation monitoring was included in SPEN's original ED1 plan. This was based on manufacturer conversations at the time of the submission preparation that suggested detailed substation monitoring costs were in the region of £3000 to £3600 per substation, with cheaper monitoring options requiring significant compromises, such as not being able to monitor individual feeders as well as overall transformer loading. As a result, the ED1 plan proposed only monitoring very heavily loaded substations, or putting cheaper, limited functionality monitoring in as assets were replaced. This would result in <12% of the secondary network being monitored.

Since 2015 and the preparation of our original ED1 plan, significant advances have been made in the cost reduction of the monitoring equipment. Fully functional substation monitoring with up to 5 feeder inputs is now understood to be achievable for under [redacted] based on conversations with multiple equipment vendors. Further cost reduction beyond this is unlikely to be achievable as a significant proportion of the unit costs is now in the current and voltage sensors which are very established products.

3.3 How the roll-out links to SPEN business changes

The energy sector is experiencing an unprecedented level of change with increasingly decentralised energy generation and significant changes to the way our customers interact with the network. In addition, the electricity network will also need to be flexible enough to facilitate the electrification of heat and transport in order to meet challenging CO^2 emission targets.

To address these challenges we have released Our DSO Vision[2], outlining our aspiration to transition from a Distribution Network Operator to a Distribution System Operator. This transition has also been consulted upon by BEIS/Ofgem in their Call for Evidence on Flexibility and is now the objective of a major industry workstream under the Energy Networks Association.

Within Our DSO Vision document we outline the key enabling technologies to facilitate the transition to a DSO, among them we cite enhanced network monitoring and expanded network control as key enablers. The roll out of enhanced secondary substation monitoring will therefore be a key enabler for us to realise our vision of transitioning to a DSO.

3.4 The Business Case

We have undertaken cost benefit analysis to demonstrate that the deployment of enhanced secondary substation monitoring will deliver savings within the ED2 period, due to the capacity created by improved knowledge of the secondary network loading.

The Ofgem CBA model has been used to illustrate the costs and benefits of deploying enhanced secondary substation monitoring to facilitate the best use of existing assets and deferral of conventional reinforcement.

[2] https://www.spenergynetworks.co.uk/userfiles/file/SPEN%20DSO%20Vision%20210116.pdf

To determine the optimal volume of monitoring and timing of the roll out, we have considered three different rollout scenarios:

1. **Limited Monitoring:** Scaled down roll out (as per current ED1 plan) achieving 12% network penetration by end of ED1.
2. **Delayed Monitoring:** Full roll out achieving 80% penetration, deferred until the start of RIIO-ED2.
3. **Accelerated Monitoring (Proposed IRM Bid):** Full roll out accelerated to start in 2018 with 60% of monitoring rolled out in ED1.

CBA Results

The cost benefit analysis for the above scenarios demonstrates that Accelerated Monitoring will deliver the greatest benefit within the ED2 period. It is clear from the results shown in Table 4 and

Table 5 that the accelerated monitoring scenario delivers the highest NPV within the ED2 period.

This demonstrates the importance of timing and scale to maximise the value of deployment of ESSM in the SPD and SPM network.

NOTE: Total Cost (£$_{12/13}$m) shown below includes both Capex and Opex costs throughout ED1 + ED2. Only additional costs incurred in RIIO ED1 are requested under the IRM. This calculation is detailed in section 3.8.

Table 4 CBA Results - SPD

Scenario	**Total Cost (£$_{12/13}$m)**	**NPV (£m)**	**Comments**
Limited Monitoring	**£3.52**	£0.74	Very limited benefit due to low penetration of monitoring and therefore low capacity uplift
Delayed Monitoring	**£23.97**	£6.28	Delaying the roll out of monitoring until ED2 reduces the NPV as the capacity uplift arrives too late to defer some of the reinforcement
Accelerated Monitoring	£26.83	£7.47	Accelerating the deployment of the monitoring to start before the end of ED1 maximises the benefit in terms of deferred reinforcement

Table 5 CBA Results (SPM)

Scenario	Total Cost ($£_{12/13}$m)	NPV (£m)	Comments
Limited Monitoring	**£4.00**	£1.23	Very limited benefit due to low penetration of monitoring and therefore low capacity uplift
Delayed Monitoring	**£18.64**	£7.07	Delaying the roll out of monitoring until ED2 reduces the NPV as the capacity uplift arrives too late to defer some of the reinforcement
Accelerated Monitoring	**£20.49**	**£10.32**	Accelerating the deployment of the monitoring to start before the end of ED1 maximises the benefit in terms of deferred reinforcement

Assumptions and considerations

The assumptions and considerations within the CBA are summarised below:

- The conventional reinforcement cost per kVA is assumed to be [redacted].
- The results of the assessment carried out in the LCNF project "Flexible Networks for a Low Carbon Future" determined that there was an average additional capacity of **39.2kVA (8%)** per substation, **as detailed in Appendix H**. This network capacity headroom was accurately determined by the analysis of the enhanced data made available by the monitoring units installed, thereby allowing network reinforcement to be deferred.
- The CBA excludes the cost for the 200 No's (100 each in SPD and SPM) of existing secondary substation monitoring units in the secondary distribution network which were deployed as part of the LCNF project "Flexible Networks for a Low Carbon Future "project.
- Deployment of 3400 ESSM units (1700 each in SPD and SPM) in secondary distribution network is considered under the limited monitoring scenario excluding the existing 200 secondary substation monitoring units which were deployed as part of the LCNF project "Flexible Networks for a Low Carbon Future "project.
- Additional CI and CML impact due to installation assumed to be minimal considering current and voltage sensors to be installed on the live network in accordance with the project specific installation procedure and considering SPEN's existing health and safety guidelines.
- The charges for GSM/GPRS based data communication is assumed to be [redacted] per secondary substation and the communication costs in the CBA is considered till the end of RIIO-ED2.
- Most conservative demand forecast (i.e. low uptake of EVs and HPs) based on the TRANSFORM model output is considered to determine the deferred reinforcement time frame.

Due to the lower volume of ESSM units in the limited monitoring scenario the cost for central data storage systems and analytics will be lower and the same is considered to be [redacted] each for SPD and SPM.

3.5 Cost estimations and potential inaccuracies

Monitoring Hardware Costs

The following cost data has been determined through conversations with a number of key suppliers, including multiple potential vendors for the enhanced monitoring unit itself. The remaining items are established electrical equipment items and as such major variation to these prices are not expected. It is of course envisaged that exact pricing will vary depending on volumes, especially for the ESSM device itself, however the expected variance in this respect could be 10-20% which would have less than 5-10% impact on the total installation costs.

The cost breakdown of the enhanced monitoring is given for a single substation in *Table 6*.

Table 6. Cost breakdown for installation of ESSM device

Item description	Cost (£)
[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]

For safety reasons, the installation will be carried out by a two-man team working according to live-line working practices.

The installation cost is based on [redacted]

Central Data System Costs

The cost for central data storage systems and analytics are drawn from best practices adopted in the previous similar projects. The cost breakdown for development of central data storage systems, integration with existing data base and data analytics is detailed in *Table 7*.

Table 7. Cost breakdown for central data storage systems and data analytics

Activity	SPD (£k)	SPM (£k)
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]

Communications Costs (OPEX)

It is proposed that the ESSM units will be enabled with inbuilt GSM/GPRS modems to allow communication via public 2G/3G/4G communication networks at a relatively low cost. Data costs for the sim card have been estimated based on available tariffs today, however the certainty around these costs is lower than for the hardware above and going forward cost variation is possible especially further into the future.

In this proposal we are not committed to any fixed communications costs and the value of the IRM adjustment is not dependent on communications costs beyond 2022/23.

3.6 Assessment of Benefits

Deferred reinforcement benefit

In 2014, SPEN deployed the secondary substation monitoring devices in around 180 secondary substations covering both SPD and SPM licence areas under the SPEN LCNF Tier 2 Flexible Networks for a Low Carbon Future (Flexible Networks) project. The project was evaluated to draw out learning outcomes and good practice and to develop a robust future network monitoring strategy. This included technical and practical details of monitoring deployment, data acquisition and the application of the monitoring data to improve various business policies and practices.

From the flexible networks project, it was observed that the enhanced secondary substation monitoring released an average **8%** (**39.2kVA** average capacity per substation) better utilisation of network capacity than using conventional maximum demand indicator (MDI) data. This is simply by virtue of the fact that the detailed monitoring is a much finer time resolution and is time stamped. This enables us to understand the shape of the daily profile and the timing of the peaks. It also makes it possible to identify data anomalies (i.e. false peak MDI readings), improving the quality of our decision-making.

Considering a mass roll-out of enhanced secondary substation monitoring in around 80% of the secondary substations in the SPD and SPM licence area, the total additional capacity envisaged by virtue of enhanced monitoring will be:

Total additional capacity [redacted]

[redacted]

The cost for BaU conventional reinforcements considering [redacted] for the above additional capacity would be:

Equivalent cost for conventional reinforcements = [redacted]

[redacted]

Additional Benefits

The business case for the ESSM roll out is based on the primary benefit of increased network capacity utilisation and network; however we recognise that secondary substation monitoring has the potential to release other benefits, such as:

- Increased understanding of network losses (including fraud), working towards our key losses initiatives
- Improving our network connectivity model (e.g. phase identification of customer connections)
- Reduction in repeat LV network faults leading to a decrease in CI/CMLs

The value of these benefits has been estimated in section 4.1 and offset from the IRM funding request to ensure that SPEN will not receive any additional commercial benefits from the rollout. It is noted however that these benefits are less certain than the primary benefit of reinforcement deferral and therefore they have not been relied upon in the CBA and business case.

3.7 Sensitivity Assessment

A sensitivity assessment has been undertaken in order to establish how robust the business case is to variables beyond our control. The impact of factors such as load growth and "efficiency" of the monitoring – i.e. what proportion of monitors behave as expected, do not experience communications issues etc, were considered for the various ESSM deployment scenarios in the SPD and SPM networks.

The sensitivity of the business case to the following key factors has been investigated:

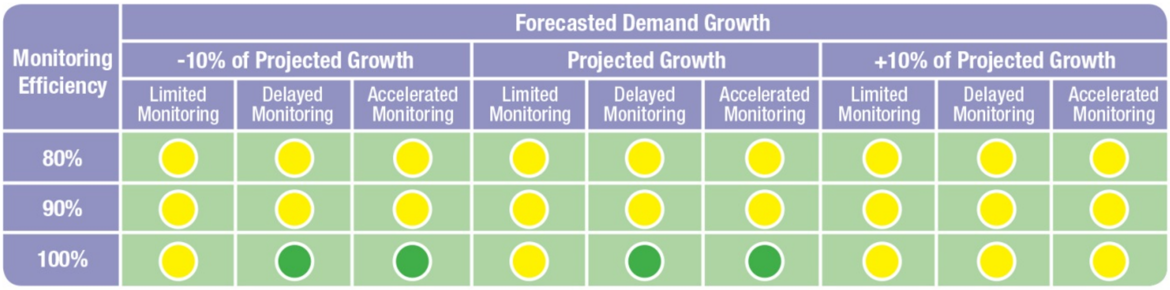
- slower load growth (-10% of the projected demand)
- faster load growth (+10% of the projected demand)
- 80% monitoring efficiency
- 90% monitoring efficiency

Section 3: Application Business Case continued

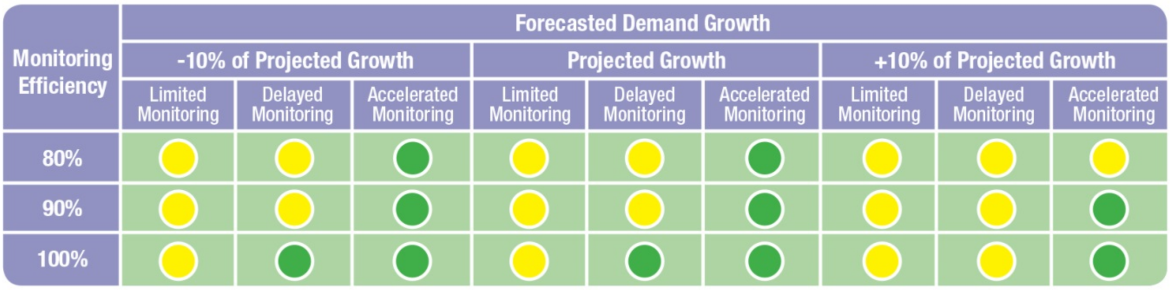
Table *8* demonstrate the sensitivity of all the three scenarios for the SPD and SPM network respectively considering the above factors.

Table 8. Sensitivity assessment of ESSM deployment

Sensitivity assessment of ESSM deployment in SPD network



Sensitivity assessment of ESSM deployment in SPM network



Key: (green) +NPV > £6m (yellow) +NPV < £6m (red) +Ve NPV

It is evident that the proposed option of accelerated monitoring is relatively robust to changes in load growth, particularly if load growth is slower than forecast, as has been observed in the first years of ED1 so far. The results also suggest the solution is robust to a small level of communication issues that might impact the monitoring efficiency, as is characteristic of GSM communications in this type of application. This could arise from intermittent communication failures or lack of network available at all in a minority of cases.

The scale and timing of the Accelerated Monitoring rollout proposed clearly shows a better NPV compared to that of limited monitoring and delayed monitoring scenarios.

3.8 Recovery of IRM Funding through UoS Charges

The requested IRM funding takes the form of an adjustment to the SPEN regulatory settlement for RIIO-ED1. Following the terms of our Electricity Distribution Licence, SPEN will then recover these costs through Use of System (UoS) charges applied to all its customers.

3.9 Recovery of costs during the relevant price control

This bid only seeks to request funding for costs during RIIO-ED1. Capital Costs and ongoing operational costs beyond ED1 are excluded from the funding request.

Distribution Network Operator Innovation Roll-Out Mechanism (IRM) Submission Pro Forma Section 3: Application Business Case continued

SPEN will ensure our IRM expenditure presented in Table 9 and

Table 10 below will be appropriately reflected in network charges by including the IRM expenditure in the Price Control Financial Model (PCFM). The PCFM is a Financial Instrument governed by the ED1 Licence.

Our IRM forecast expenditure will increase our allowed costs in the PCFM model. The model compares our allowed costs with actual expenditure and determines the appropriate revenues we should seek to collect each year. Therefore this model adjusts our network charges for any variance in our IRM expenditure between forecast and actual expenditure.

Year on Year Costs in ED1

A calculation of the year on year costs, based on the proposed ESSM roll out plan in ED1 are shown in *Table 9* and

Table 10 below.

Table 9. Calculation of ED1 Costs and Proposed IRM Adjustment – SPD

[redacted]

Distribution Network Operator Innovation Roll-Out Mechanism (IRM) Submission Pro Forma
Section 3: Application Business Case continued

Table 10. IRM Calculation of ED1 Costs and Proposed IRM Adjustment – SPM

[redacted]

The full roll-out costs in ED2 (which are not recovered through the IRM mechanism) are included in Appendix C.

Distribution Network Operator Innovation Roll-Out Mechanism (IRM) Submission Pro Forma

Section 4: Evaluation Criteria

The intention of the IRM is to overcome commercial barriers that may exist to the DNO within the present Price Control (i.e. the lack of financial incentives and level of risk) and encourage DNOs to implement new proven technologies that will deliver long-term value for customers but do not, currently, form part of Ordinary Business Arrangements.

The Distribution Licence Special Condition CRC 3D sets the following criteria to which the Authority will assess IRM application;

a) *will deliver Carbon Benefits or any wider environmental benefits;*
b) *will provide long-term value for money for energy consumers;*
c) *will not enable the licensee to receive additional commercial benefits which are greater or equal to the cost of implementing the Proven Innovation; and*
d) *will not be used to fund any of the ordinary business arrangements of the licensee*
e) *involves proven innovation and warrants limited funding support*
f) *is ready to be rolled-out with any funding provided being used in the price control period.*

The section will provide supporting information to demonstrate how the proposed scope of works will fulfil each of the above criteria.

4.1 Criteria A - Delivering Carbon Benefits and wider environmental benefits

The roll out of enhanced substation monitoring across the secondary network will play a key role in enabling the efficient connection of LCTs, the evaluation of losses and the detection of fraudulent consumption, therefore delivering societal carbon and environmental benefits.

Carbon Benefits

The load growth in SPM and SPD over the RIIO ED1 and ED2 periods is expected to comprise largely of the uptake of Low Carbon Technologies, including:

- Electric vehicles (demand)
- Heat Pumps (demand)
- PV Panels (generation)

In quantifying the Carbon Benefit of this proposal, we have compared approaches taken across a number of network operators to inform our assumptions about the equivalent grams of carbon offset by a particular volume of LCT growth. An academic study by Imperial College[3] as part of the Low Carbon London project has been used to calculate the carbon benefit per unit demand of LCTs.

An average benefit of **97g CO_2 per kWh** of LCT load growth accommodated by the monitoring has been used.

[3] Carbon impact of smart distribution networks - Low Carbon London Learning Lab https://innovation.ukpowernetworks.co.uk/innovation/en/Projects/tier-2-projects/Low-Carbon-London-(LCL)/Project-Documents/LCL%20Learning%20Report%20-%20D6%20-%20Carbon%20impact%20of%20smart%20distribution%20networks.pdf

Section 4: Evaluation Criteria continued

The details behind these calculations are given in Appendix D and the resulting carbon savings for both the SPM and SPD licence areas are given in Table 11 below:

Table 11 – Estimated Carbon Benefit resulting from Enhanced Substation Monitoring

Licence Area	**Annual Demand**	**Load Growth Enabled by Enhanced Monitoring**		**Avoided CO2**
SPM	4950000 MWh	8.0%	396000 MWh	38660 Tonnes
SPD	6600000 MWh	8.0%	528000 MWh	51546 Tonnes

Benefits in Assessing Losses

At SP Energy Networks we are committed to deliver cost effective loss reduction activities that reduce customer energy bills, reduce carbon pollution and help reduce the pace of climate change.

We include consideration of losses in all that we do, and ESSM is a key enabler to allow the accurate quantification of losses on the secondary network.

To reduce network losses, it must first be possible to identify where in the network electrical losses occur. Losses on electricity distribution networks are currently complex and difficult to quantify. Currently to estimate the level of electrical losses in the LV and HV networks specifically, it is necessary to perform detailed network modelling and rely on monitoring data from the EHV networks.

The ESSM roll out on the secondary network, in collaboration with Smart Meter data would provide reliable data regarding the flows on the secondary network, allowing losses to be calculated with much higher certainty. This will support our current and planned losses initiatives under the Losses Discretionary Reward (LDR), including:

- Initiatives 1&2 – Use of smart meter data to reduce losses
- Initiative 3 – Voltage optimisation
- Initiative 4 – Network modelling of complex networks
- Initiative 5 – Rural Networks and phase imbalance
- Initiative 6 – power factor

Preventing Fraudulent Consumption

Another benefit to rolling out ESSM more widely across the network is the increased ability to detect fraud. By monitoring each LV feeder at the point that it leaves the substation and combining this with smart meter data from customers connected to that feeder, any "lost" electricity can be calculated. Whilst this will help SPEN to assess electrical losses more accurately, it will also enable the identification of abnormally high losses or a-typical loss profiles (e.g. if losses increase when demand is low) which can signal that fraudulent activity may be taking place.

Section 4: Evaluation Criteria continued

The granularity of the ESSM monitoring means that the location of the detected fraud can be pinpointed to a precise feeder and geographic location.

Deployment of enhanced monitoring in Spain by our parent company Iberdrola has already allowed the increased detection of fraud. See Appendix I for further details.

4.2 Criteria B - Providing long-term value for money for energy consumers

The cost benefit analysis that we have undertaken demonstrates that the deployment of enhanced substation monitoring will deliver savings within the ED2 period, due to the capacity created by improved knowledge of the secondary network loading.

A CBA model for each licence area (SPD and SPM) is attached to this IRM bid submission. We have used the latest version of the Ofgem CBA tool and where relevant, figures for costs and benefits have been derived from the latest version of our completed RIIO-ED1 CBA.

The cost benefit results are presented in section 3.4 and discussed further below.

Payback Period

The payback periods for the proposal are shown in *Table 12* below for both network areas. By nature the payback periods are relatively short because the implementation of monitoring provides an immediate capacity uplift across the secondary network. The benefits however continue accruing across the lifetime of the monitoring, assumed to be 15 years. Once installed, the monitoring is a key enabler for our ambitions in working towards an actively controlled HV & LV network and as such the proposed Enhanced Substation Monitoring will carry on delivering financial benefit for customers as part of future smart solutions.

Table 12 Payback Periods for Substation Monitoring

Scenario	SPM	SPD
Delayed Substation Monitoring	9 years	9 years
Accelerated Substation Monitoring	8 years	8 years

It can be seen that by the end of ED2, the enhanced substation monitoring proposal would pay for itself within 8 years and all benefit beyond this will contribute directly to reduced costs for electricity customers by enabling lower network charges.

Costs & Benefits

The CBA was used to model three different rollout scenarios. Scenario 3, Accelerated Monitoring was shown to have the greatest benefit and forms the basis of this IRM proposal. The costs and benefits of this proposed option are outlined in this section.

A detailed breakdown of the costs and benefits of rejected options 1 and 2 can be found in Appendix E.

Section 4: Evaluation Criteria continued

Proposed Option: Accelerated Monitoring

The cost benefit analysis for this scenario is performed considering following:

- 13,634 existing MDIs in SPD and 10,281 existing MDI's in SPM respectively will be replaced with ESSM units starting from 2019/20.
- The roll out of the ESSM units is expected to be completed by 2025/26.
- Considering the projected load growth the deferred additional capacity reinforcement costs are expected to be reinvested starting from 2026/27 in SPD and 2028/29 in SPM.

Table 13 below summarizes the cost benefit analysis for the accelerated monitoring scenario.

Table 13 Breakdown of costs and benefits resulting from Accelerated Monitoring

Costs	Cost ($£_{12/13}$m) SPD		Cost ($£_{12/13}$m) SPM	
	ED1	ED2	ED1	ED2
Equipment and installation (CAPEX)	[redacted]	[redacted]	[redacted]	[redacted]
Data communication (OPEX)	[redacted]	[redacted]	[redacted]	[redacted]
Total (CAPEX + OPEX)	[redacted]	[redacted]	[redacted]	[redacted]
Benefits	SPD		SPM	
Additional capacity headroom in kVA	[redacted]		[redacted]	
Avoided reinforcement cost (£m) in ED1	[redacted]		[redacted]	
Avoided reinforcement cost (£m) in ED2	[redacted]		[redacted]	
NPV (£m) 16 years				

The accelerated monitoring scenario enables additional capacity headroom of [redacted] and [redacted] in SPD and SPM respectively which is worth [redacted] as per BaU conventional reinforcements. Considering the projected demand growth, the additional capacity headroom realised by virtue of replacing the existing MDI's with ESSM units enables in deferring the conventional reinforcements till 2026/27 and 2028/29 in SPD and SPM respectively. The accelerated monitoring scenario demonstrates a positive NPV [redacted] in SPD and [redacted] in SPM for 16 years payback period.

Timescales of deferred reinforcement benefits

The key quantifiable benefit of the proposed secondary substation monitoring roll out is the capacity uplift it provides by providing greater certainty about the loading of the secondary network. This capacity uplift will allow SPEN to defer conventional reinforcement and thus provide a financial benefit to customers.

There is a greater benefit in deferring reinforcement now rather than reinforcing and then implementing monitoring as future reinforcement deferral is very dependent on how the load grows, which is inherently uncertain.

In order to assess the likely deferral timeframe – i.e. the number of years that the conventional reinforcement activities are deferred until, the projected demand growth profile is considered and compared to the average 8% capacity uplift expected from the monitoring roll-out.

The forecast demand growth over RIIO-ED1 and RIIO-ED2 for SPD and SPM is shown in *Table 14*. These profiles are based on the TRANSFORM model calculations used to underpin SPEN's RIIO ED1 submission.

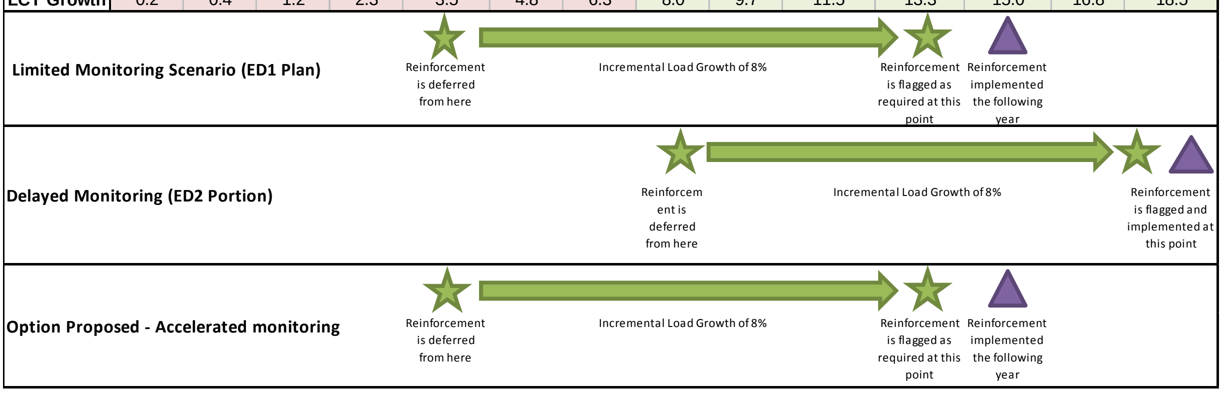
Table 14. Forecasted cumulative demand growth used in the CBA

SPD	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
%	0.4	0.9	2.3	4.3	6.2	8.5	10.8	13.3	15.5	17.5	19.4	21.0	22.6	24.3
SPM	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**
%	0.2	0.4	1.2	2.3	3.5	4.8	6.3	8.0	9.7	11.5	13.3	15.0	16.8	18.5

From the network trials undertaken as part of the Flexible Networks project, it was derived that Enhanced Secondary Substation Monitoring can enable a capacity uplift of 8% additional capacity headroom per substation on average. Therefore based on the demand growth and the year in which the monitoring is rolled out, the number of years of reinforcement deferral achieved can be calculated based on the time it takes for the cumulative demand growth to increase by 8%. This is shown in *Figure 7*and *Figure 8* below for each of the roll-out options considered in the CBA.

Figure 9 - Reinforcement Deferral for the 3 options considered in the SPM CBA

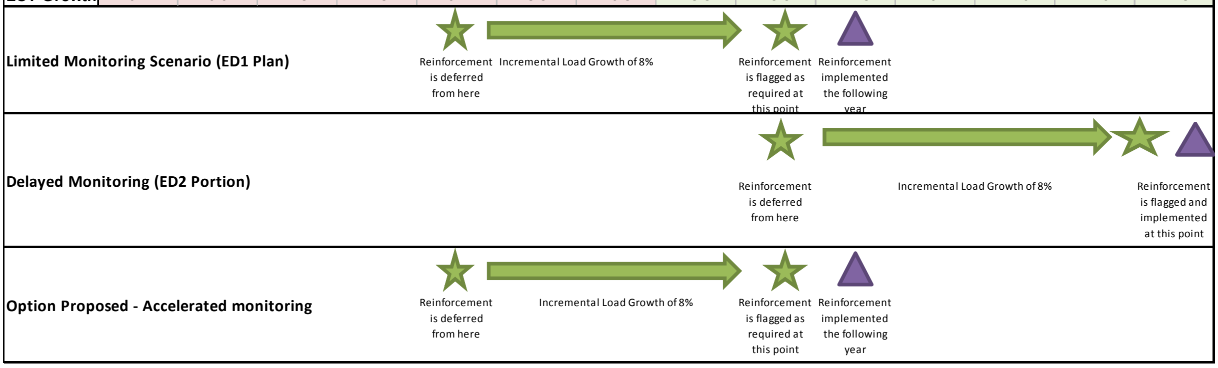
SPM	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
LCT Growth	0.2	0.4	1.2	2.3	3.5	4.8	6.3	8.0	9.7	11.5	13.3	15.0	16.8	18.5



Section 4: Evaluation Criteria continued

Figure 10 - Reinforcement Deferral for the 3 options considered in the SPD CBA

SPD	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
LCT Growth	0.4	0.9	2.3	4.3	6.2	8.5	10.8	13.3	15.5	17.5	19.4	21.0	22.6	24.3



It can be seen that for the limited monitoring scenario and the accelerated monitoring scenario, reinforcement is deferred for 7 years from 2021 to 2028 in SPM and 5 years from 2021 to 2026 in SPD. The difference between the network areas is due to a flatter load growth in the RIIO-ED2 period in SPM.

The delayed monitoring scenario, by contrast only provides a 5 year delay in SPD and a 6 year delay in SPM. This is because by delaying the start of the monitoring process to after the start of ED2, the load growth has already begun to ramp up and so the 8% capacity release equates to a smaller number of years of reinforcement deferral.

Although the deferral period is the same between the Limited Monitoring Scenario and the Accelerated Monitoring Scenario, the benefit case for the Accelerated Scenario is much greater due to the high levels of monitoring rolled out, which in turn creates a larger capacity release.

Improvement of CIs/CMLs

ESSM has the potential to improve the quality of supply for consumers by making it easy to track feeder loading and identify repeat faults on the network.

We already actively track fuse replacements on the LV network, but where a fuse has to be replaced more than twice in three months, full network checks must be undertaken manually with network engineers going to site to install fault finding equipment. ESSM offers a natural improvement in this process as the enhanced monitoring will enable remote fault finding as soon as a repeat fault is observed.

To estimate the commercial benefit this reduction in Customer Interruptions (CIs) and Customer Minutes Lost (CMLs) may have, we have analysed the number of repeat faults observed on the SPM network over the last two years. A repeat fault here refers to multiple fuse replacements (MFRs) where an MFR involves at least two fuse replacements logged within 3 months.

It is proposed that ESSM may decrease the CIs and CMLs resulting from repeat faults by up to 50% by facilitating the timely identification of the fault and repair or replacement. The value of 50% is an estimate only, as this is not an area which has yet been demonstrated by any UK DNOs. It is for this reason that this benefit has not been included in the CBA.

Appendix D shows in detail how the value of these avoided CIs and CMLs has been estimated. Table 15 and Table 16 show the resulting potential benefit from avoided CIs and CMLs in SPM and SPD over RIIO ED1 following the gradual ramp up in ESSM installation.

Table 15: Benefit from Avoided CI/CMLs due to ESSM Roll Out - SPM

SPM	ED1				
Year:	2019	2020	2021	2022	2023
ESSM Roll Out	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Avoided CIs	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Avoided CMLs	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
TOTAL	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

Table 16: Benefit from Avoided CI/CMLs due to ESSM Roll Out - SPD

SPD	ED1				
Year:	2019	2020	2021	2022	2023
ESSM Roll Out	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Avoided CIs	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Avoided CMLs	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
TOTAL	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

Roll out Optimisation

Under the limited monitoring scenario put forward in the original ED1 plan, 1700 existing MDI units will be replaced by the ESSM units. The selection of the 1700 secondary substations was proposed to be based on a detailed assessment wherein the existing highly constrained substations (>90% loading) will be identified for deployment of the ESSM units as an immediate monitoring requirement. However it is important to consider the anticipated load growth which is due to the expected uptake of LCT's which will likely be clustered both geographically and temporally and is essential in terms of identifying loading hot-spots and deploying a suitable techno-economic solution.

Under the accelerated monitoring scenario proposed in this bid therefore a more comprehensive roll-out is considered. In this bid, ESSM unit deployment has been assumed across 80% of the whole secondary substation network. The 80% roll out volume is optimised considering two factors:

- **The cost benefit case:** Sensitivities undertaken with the CBA for 60%, 80% and 100% roll out volumes indicated that the higher the roll-out volume the greater the benefit case.
- **Installation practicalities:** undertaking the comprehensive installation of anything across 100% of network assets is often extremely challenging, with a range in access conditions and substation types, and as a result it is often the most challenging last few locations that can increase project costs.

SPEN recognise the value of taking an 80/20 approach to ensure that effective network coverage is not compromised by increasing the costs of installation as the result of a small number of challenging locations.

The 80% roll out volume proposed for this project reflects the above factors and we believe presents an optimum approach.

Maintaining Flexibility

Monitoring is an inherently flexible investment. After the initial payback period, the ongoing costs of the monitoring are limited to the cost of data communication with each substation monitor. These costs are flexible depending on the best use of the monitoring and so we are not committed to any fixed costs beyond the ED2 period. It is recognised that there is reasonable uncertainty regarding network challenges and load growth beyond ED2 and so investment in flexible assets like monitoring platforms which can be used to enable a number of different network solution represent excellent value for consumers now and in the future.

Ex-post Evaluation of the Project

SPEN commit to carrying out an objective ex-post evaluation of the ESSM project to determine how well the project met its aims and delivered the cost benefits and environmental benefits that have been estimated in this bid.

The ex-post evaluation will include:

- A review of the total cost spent rolling out ESSM

A competitive procurement process for the supply of the ESSM units will be run to ensure best value is achieved. This is a healthy market and the number of potential vendors is increasing, so high levels of competition are anticipated from the project beginning. The theory is proposed in this bid that ESSM is reaching cost maturity and further cost reduction is unlikely. The ex-post review will look at how unit prices changed over the duration of the project to determine the accuracy of this view and also at the ongoing operational costs incurred, such as the cost of the communications to each ESSM unit.

- An assessment of the deferred reinforcement benefits enabled by monitoring

SPEN continuously track reinforcement spend and this will be analysed year on year after the roll out is completed and compared to load growth estimates to determine how effective the monitoring has been at deferring reinforcement activities.

- An assessment of the other benefits observed

Fraud detection and CI/CMLs will also be tracked as part of business as usual activities, but both provide important markers to track additional benefits of the ESSM roll out.

A view as to the overall success of the project in meeting the key objectives outlined in this IRM bid will be formed from the assessments above and disseminated to the wider industry

Section 4: Evaluation Criteria continued

4.3 Criteria C: will not enable the licencee to receive additional commercial benefits which are greater or equal to the cost of implementing the Proven Innovation

The IRM project will enable greater visibility of power flows and voltages on the LV distribution network and as a result the utilisation of the network can be improved as local reinforcement, driven by LCT-related load growth, becomes more targeted.

The adoption of the Proven Innovation will not result in any fundamental changes to revenue streams. Any relevant allowances made in the current Price Control Period have been subtracted from the proposed IRM adjustment value. This includes:

- All existing allowances for secondary substation monitoring in ED1 (totalling £2.6m in SPM and £3.5m in SPD).
- Any avoided reinforcement costs in ED1 due to the deployment of ESSM (totalling £0.94m in SPM and £0.18m in SPD).
- Any commercial benefits from avoided CI/CMLs due to the deployment of ESSM (totalling £0.20m in SPM and £0.22m in SPD).

The above benefits are subtracted in full from the amount requested as is shown in section 3.9 (Table 10 & 11).

SPEN will therefore not receive any commercial benefits greater or equal to the funding sought.

4.4 Criteria D: will not be used to fund any of the ordinary business arrangements of the licensee

Any funding received through the IRM will not be used to fund any Ordinary Business Arrangement. The full-scale rollout of Enhanced Network monitoring does not fit directly into any of our existing business activities. The scale of the installation programme and the data volumes that will be produced as a BaU activity go far beyond the requirements of the systems used in our existing business activities or trial projects. For example, SPEN will not have the internal resources necessary to carry out all of the installations ourselves – we expect to go out to tender for much of this activity, once we have gained sufficient knowledge and experience on installation best-practice with our own trained staff.

A key element of the proposed project is the move away from the typical "stand-alone" trial system towards the proper integration of data into our planned future enterprise data systems.

In order to support the GB smart meter rollout, SPEN has procured the [redacted] platform to manage interaction with smart meters. We believe with the support of the IRM mechanism we can show how this platform can be extended to support large scale deployment of substation monitors. We have already engaged with [redacted] on the use of their system in this way.

Open and flexible substation monitors will require sophisticated management of their hardware, firmware and applications. This will ensure effective operation and security. By re-using [redacted] for this purpose we will have a proven, enterprise grade solution to achieve this in addition to maximising our existing investment in smart meters.

Section 4: Evaluation Criteria continued

We are therefore able to leverage the value of our expenditure on the smart meter data management system ([redacted]) and only fund the incremental costs associated with extending the scope of the already-planned IT system.

4.5 Criteria E: involves proven innovation and warrants limited funding support

Secondary substation monitoring is an activity that has been developed by all the UK DNOs since the very beginning of the Low Carbon Network Fund. Starting with WPD's *"LV Templates"*, NPG's *"Customer Led Network Revolution"* and UKPN's *"Low Carbon London" projects*, secondary substation monitoring has been at the heart of the learning developed by all these first wave of projects. Monitoring-related developments continued with our own *"Flexible Networks for a Low Carbon Future"* project (see Appendix H), as well as SSE's *"New Thames Valley Vision"* and *"Demonstrating the Benefits of Monitoring Low Voltage Network with Embedded PV Panels and EV Charging Point"* projects.

The secondary substation is being recognised as a key strategic node within the Smart Grid of the future, resulting in projects that are looking at Use Cases centred around the secondary substation. This puts even more emphasis on secondary substation monitoring. The function of secondary substation monitoring is now a Proven Innovation, with many business cases created to justify its deployment. The benefits presented in this proposal are based on those observed in our own "*Flexible Network for a Low Carbon Future*" project, where it was shown that an average 8% additional capacity could be utilised based on using enhanced secondary substation data rather than existing MDI data. The business case shows that the mass rollout of secondary substation monitoring becomes feasible once the cost of monitoring drops below around [redacted] per substation. Based on discussions with several prominent equipment manufacturers, we believe that this critical price point can be passed as long as the quantities of equipment are sufficient to trigger cost reductions due to volume production.

This assumption is backed up by the ongoing work of SSE within their "Low Cost Secondary Substation Monitoring" project.

4.6 Criteria F: is ready to be rolled-out with any funding provided being used in the price control period.

This proposal marks the significant transition of the Proven Innovation of secondary substation monitoring from "trial" to "business as usual" status, as the focus shifts from "innovation" in the use of technology to "engineering" in the application of the technology, to drive down costs and thereby widen its applicability. The traditional network operator procurement expertise will play a major role in the transition to business as usual as the functional specification of the secondary substation monitoring is traded off against the costs. The important role of the procurement process is emphasised in our project plan, which allows significant time for discussions to take place between ourselves and prospective vendors.

The project plan is shown in full in Appendix A

Section 4: Evaluation Criteria continued

Managing Risk

The key risks to the successful implementation of the roll-out have been considered and practical mitigation strategies have been built into the proposal, for example by the robust design of the monitoring units themselves to be able to handle communication failures. The open vendor platform nature of the ESSM units will allow SPEN procurement flexibility and ultimately allow new and flexible uses for the monitoring devices.

Key risks that have been considered include:

- Integration with SPEN's central data systems
- Quality issues with ESSM units not meeting performance requirements
- Cyber Security risks and data protection
- Procurement process risk
- Resource constraints affect ability to meet proposed installation plan.
- Communications failures
- Price risk
- Supply chain risk
- Future network behaviour uncertain.

A risk register with mitigation strategies is shown in full in Appendix B

The business case presented earlier clearly illustrates how important the scale and timing is to the proposal; any delay to the implementation of the proposal will result in a loss in benefits; similarly, any reduction in the scale of the proposal will reduce the benefits and increase unit costs, thereby degrading the cost-benefits. In terms of scale and timing, we believe that this proposal is as optimised as possible, within the parameters that are within our control.

Distribution Network Operator Innovation Roll-Out Mechanism (IRM) Submission Pro Forma

Section 5: Regulatory Issues

This proposal does not raise any issues requiring any change in Regulatory rules and does not require any form of derogation.

This proposal does require an adjustment to the regulatory settlement, as is outlined in section 1.4 as per the calculation tables shown in section 3.9.

The proposed rollout of the ESSM units does not raise any potential negative impacts on customers, and any financial or logistical implications on generators and suppliers.

Distribution Network Operator Innovation Roll-Out Mechanism (IRM) Submission Pro Forma
Section 6: Appendices

Appendix A: Project Plan

Appendix B: Project Risk Register

Appendix C: Year on Year project costs ED1 & ED2

Appendix D: Calculation of Carbon Benefits & CI/CML Benefits

Appendix E: Calculation of Costs and Benefits for Rejected Roll-Out Scenarios

Appendix F: Enhanced Secondary Substation Monitoring Specifications

Appendix G: Data sheet of LV substation common application platform

Appendix H: SPEN "Flexible Networks for a Low Carbon Future" project summary

Appendix I: Evidence from ESSM roll out in Spain

Appendix J: Grid Key example product documentation