E6 – Innovative Solutions

Allocation and estimation methodologies: detail any estimations, allocations or apportionments to calculate the numbers submitted.

General E6 Assumptions for All Technologies

1) Costs represent the cost of the technology only i.e. it doesn't include associated costs in the CBA such as reinforcement costs
2) MVA released represents the MVA released by the technology only i.e. it doesn't include associated MVA released by reinforcement as shown in the CBA
3) Estimated gross avoided costs are the gross costs avoided by the technology plus the actual cost of implementing the technology. It doesn't include NPV costs e.g. for ANM

Pole Pinning

This is where poles reaching end of life are pinned to extend their lives

Cost of replacing one pole: This is taken from the RIIO-ED1 2016 unit cost sheet. The values vary slightly for the north and south networks and so have been separated in the CBA.

PP Tractor/Beaver Cost per month: This is the cost involved in hiring the pole pinning beaver tail machine. The annual hire cost of the machine has been split up into 12 separate months to come up with a monthly figure

Pole pinning cost per pole: This is the cost involved for pinning a single pole i.e. labour costs, pole pinning material costs.

# of poles pinned: The number of poles that were pinned in any given month
Total pole pinning cost: Total costs of pinning poles for any given month. This is also the method investment used in the asset deferment table (shown in the CBA).

Replacement cost avoided: This is the cost that would have been spent had the poles been replaced rather than pinned. This is also the base investment figure that is used in the asset deferment table.
Method NPV: The NPV costs involved in pole pinning based on the assumption that one pole, once pinned, does not need to be replaced for 14 years. This is calculated using the asset deferment benefits table.

NPV Saving: The actual saving of replacing a pole based on a poles life being extended 14 years before it needs to be replaced. It is the base investment minus the method NPV.

All calculations are demonstrated in the CBA

2016/17 Update
Pole pinning has been stopped. However, costs were incurred as it took time to take the machine off hire.

Bidoyng

This technology locates LV underground cable faults

BD3 calculated data: BD3 CI's and CML's occur where Bidoyng fuses are available and a fault has been located using Kelvatec's location services.

It is assumed that rogue circuits (circuits prone to faulting), where Bidoyng equipment is located, will have an average of 4 faults on them per year. Some will have more, some will have less, but overall an average of 4 faults will occur on them per year.

If a cable problem is located before it faults and causes a fuse operation then the maximum number of CI's and CML's are saved i.e. CI CML's multiplied by 4 (the average number of times the circuit would have faulted because of the fault). The more fuse operations that occur, the less CI CML savings occur. Once 4 fuse operations have occurred no more CI CML savings can be gained (as it is assumed 4 is the number of times a circuit will fault).

Calculation details below:

0 fuse operations =Number of CI's and CML's multiplied by 4
1 fuse operation = Number of CI's and CML's multiplied by 3
2 fuse operations = Number of CI's and CML's multiplied by 2
3 fuse operations = Number of CI's and CML's multiplied by 1
4 or more fuse operations = Number of CI's and CML's multiplied by 0

CML's: It is assumed that one fault will cause an outage of 130 mins (Previous estimate was181.3 mins). This is based on average fault restoration times for permanent cable faults.

CI's: It is assumed that one fault will cause an interruption for all customers on that particular circuit.

CBA Data
# of CI's: This is the total number of customers multiplied by the CI fine of £10.75 (changes depending on the year) and then multiplied again by the number of fuse operations.

# of CML's: This is the number of customers multiplied by £47.13. This is the average cost of a 3 hour outage i.e. 130*0.26. The resulting figure is multiplied again by the number of fuse operations to obtain a final figure.

Additional costs: These include PSI costs, backfeed costs and excavation costs.

PSI costs: These are planned supply interruption costs. It is estimated that an average cost of £995.96 will be incurred as a result of planned interruptions being necessary due to specific faults on specific circuits. This is an average figure taken from the Bidoyng business case, which takes into account average PSI costs.

Backfeed costs: These are average costs incurred as a result of backfeeding being necessary. It is estimated that an average cost of £1991.93 will be incurred if backfeeding is required. This figure has been derived from the Bidoyng business case, which takes into account average costs of backfeeding. Backfeeding savings only occur on BD3 faults i.e. faults that are transient in nature and are cleared by the automatic replacement of fuses due to Bidoyng technology. This is because it prevents the need for backfeeding being necessary.

Excavation costs: Bidoyng creates an average estimated saving of £1250 in terms of reduced excavation costs. This is because it can pinpoint underground faults more effectively, reducing the need for multiple excavations

Total costs: This is a summation of all costs stated above.

BD1 calculated data: BD1 costs vary from BD3 costs as there are no fuse units available to prevent multiple faults from occurring. However, the Bidoyng technology can prevent faults from occurring by locating pre fault 'signatures' or warning signs before an actual fault occurs. This is why we have CI and CML savings

BD2 calculated data: CML savings are allocated here as field staff are alerted to faults before customers are aware their power has been interrupted. CML savings are calculated by subtracting the average time taken to repair a permanent fault (130 mins: Taken from average fuse replacement data on LV cable faults) by the time taken to restore power.

BD3 calculated data: CI and CML savings where a Bidoyng fuse has operated and replaced. CML savings are based on average time to repair a permanent cable fault (130 mins). CI savings are calculated by multiplying the number of affected customers by the CI fine e.g. £10.75 (this varies annually).

CBA Data
# of CI's: This is the total number of customers that could be affected by an LV fault. It is calculated by taking the total number of customers on each feeder and dividing it by 3 to find the average number of customers per phase. As the fault is likely to occur on one of the phases not all customers lose supply. If faults occur on more than one phase these additional affected customers are added to obtain a final figure of how many customers could have been interrupted.
The number of customers is multiplied by £10.75 (depending on the month) to obtain a customer interruption figure.

# of CML's: This is the number of customer's that have been interrupted as calculated by BD1, BD2 and BD3 methodology.

Total out of hours cost: This is the cost associated for attending faults out of working hours. It has been derived from the Bidoyng business case which calculates an average out of hours cost per fault.

BD1 & BD3 costs are then added to get total costs used in the CBA.

Total Bidoyng contract spend: This is the amount of money spent on the Bidoyng contract specifically for fault location and fuse replacement services (refer to workings template tab in CBA).
Bidoyng incentive spend: This is the total amount of money that Kelvatec, the Bidoyng contractors, are awarded on top of the normal contract due to accurately locating faults (refer to workings template tab in CBA).

Total Bidoyng spend is the addition of these two spends.

16/17 Update: Bidoyng has performed better this year vs 2015/16, as reflected in more CIs & CMLs being avoided.

17/18 Update: Average time taken to repair a fault reduced from 181 mins to 130 mins. BD2 CML savings now included.

18/19 Update: No changes in methodology

Isle Of Wight (IoW) Active Network Management (ANM)
ANM frees up additional capacity on the network by constraining generation under specific conditions

CBA Narration

Option Baseline: Traditional reinforcement of the subsea cable is triggered in 2017/18 with capacity released 3 years later in 2021/22.

Option 2 ANM: ANM is implemented, which releases a total of 45MVA of capacity. This has allowed an 8.46MVA generator to connect early while a reinforcement scheme awaits completion. Completion is due to finish in 17/18. Once completed the generator will switch to an inter trip scheme, leaving 45MVA of capacity that can be filled by new generators wanting to connect.

In this scenario ANM is in place, which allows increased capacity on the network of 45MVA.

E6 Template: IoW ANM
Costs: Only costs for the ANM solution have been inserted here
Only the MVA released by ANM has been included. Total MVA released is 45MVA. The CBA will be updated each time capacity is filled by generators.
Estimated Gross Avoided costs: As no traditional reinforcement has been avoided yet, there are no avoided costs. It is expected that significant savings will be made when more generators connect as ANM will be able to avoid the cost of traditional reinforcement on the IoW.

2017/18 update: New generator connected to the ANM scheme which would have triggered £38m reinforcement scheme. Previous 8.46MVA has come off ANM scheme now reinforcement works have been completed.

2018/19 update: No changes is methodology

Thermal Cameras
Thermal cameras are used to assist in LV underground cable fault location where they reduce CMLs and occasionally CIs if defects are located prior to a fault occurring.

CML savings are calculated depending on the type of circuit the fault occurs on.
Rogue circuit: Where 5 or more faults have previously occurred. It is assumed this type of circuit will fault at least 4 more times prior to becoming a permanent fault i.e. replacing fuses no longer restores supply. A multiplier of 4 is used when calculating faults located and repaired on these types of circuits. Faults located and repaired are assumed to save 90 mins, based on NIA: TOUCAN field trial experiments.
Non Rogue circuit: No multiplier occurs to the 90 min CML saving.

CI savings occur if a defect is discovered before a fault becomes permanent. Savings are based on the number of customers present on the circuit multiplied by the CI fine e.g. £10.75 (varies each year).

Excavation savings are estimated at £1250 per excavation avoided (max 1 per fault attended).

General
For each of the solutions please explain:

- In detail what the solution is, linking to external documents where necessary.
- How this is being used, and how it is delivering benefits.
- What the volume unit is and what you have counted as a single unit.
- How each of the impacts have been calculated, including what assumptions have been relied upon.

Pole Pinning

1) Poles reaching their end of life or those that are significantly deteriorating to the point where they need to be replaced, can instead be pinned. Pole pinning involves using a specialised pole pinning machine that drives a pin through the base of a deteriorating pole. The pin provides the pole with additional strength. It is estimated that pinned poles will have their lifetime extended by 14 years, providing significant financial benefits.

2) Unfortunately pole pinning failed to deliver positive financial benefits and the technology has been stopped by SSEPD. This is because not enough poles were being pinned to cover the cost of the equipment hire. Field staff reported problems such as poles being too rotten to pin. It has also been discovered that pole pinning has a negative effect on asset health indices, so it was decided to stop pursuing use of this technology.

3) The volume unit is the number of pole pinning machines owned by SSEN.

4) Assumptions and how they have been calculated are mentioned in the first box

Bidoyng

1) Bidoyng provides us with accurate demand data, pre-fault detection and location, post fault location,

cable condition assessment and fault remote reclosing.

SSEPD have a team of approximately 20 field and office staff who are dedicated entirely to the Bidoyng project as well as 20 other depot personnel who provide ad hoc assistance and support to the team.

Kelvatek are the vendor who supplies the Bidoyng fault detection equipment. They also provide a fault analysis service which rapidly interprets data from the devices and sends details of fault location to the SSEPD Supply Restoration Teams.

Bidoyng fault detection equipment is designed to be mobile. It is placed on rogue circuits (i.e. circuits with high numbers of faults) until any faults are identified and resolved. The Bidoyng equipment is then moved to the next location in order to detect and prevent as many faults as possible.

When the SSEPD Bidoyng team are notified of a fault by Kelvatek, a team of field staff are sent out to locate the fault using initial location data provided by Kelvatec. In order to establish a detailed location based on the information from Kelvatek a device from EATL called a 'Sniffer' is used. Sniffers are able to detect underground faults by identifying gases that are emitted from arcing and heated cables. Once a fault is located the area must be excavated in order to fix the fault. If the fault is not located the devices continue to gather intelligence gradually building up a more accurate indication of the location of the fault.

2) Before Bidoyng technology was available, cable faults resulted in large financial penalties and operational costs. Using traditional techniques finding faults in the underground network was notoriously difficult. This often resulted in multiple excavation attempts in order to identify the fault location and each excavation is likely to cost thousands of pounds. In addition, the length of time taken to locate the fault was very long, resulting in high CML penalties.

The main purpose of the Bidoyng project is to locate faults before they cause a customer interruption along with associated customer minutes lost. It does this by identifying pre fault signals, once enough signals have been recorded and analysed it is possible to identify potential fault locations with an associated level of confidence. A team is dispatched to the pre-fault location when the analysis predicts a fault location with an estimated accuracy of +-10 metres. The team can then locate and repair the faulty cable before it becomes a full blown fault, in most cases avoiding any unplanned interruptions to customers. In addition to this ability to identify and locate faults before an outage occurs, the devices also provide detailed locational information for "hard" faults which allows the DNO to respond more quickly to minimise customer disruption. Uniquely, the device also gives the DNO the ability to reclose the circuit remotely in the case of an intermittent fault.

3) The volume unit is the number of Bidoyng contracts, which is one.

4) Assumptions and how they have been calculated are mentioned in the first box.

ANM

1) The solution deployed is Active Network Management (ANM), where generators that may otherwise have been unable to connect to the distribution network due to excessive reinforcement costs or timescales, can connect through a flexible connection. The system constitutes Information Communication Technology (ICT) architecture that monitors, in real time, the pre-identified network constraint points and ensures that no generators connected through it can breach the networks operational limits. If those limits are threatened then the system sends control signals to the most appropriate generator to reduce their export until the

network limits are no longer threatened, then the generators are released back to a safe operating state. The key governing principles are described in the ENA produced ANM Good Practice Guide, which can be found at the following link.
http://www.energynetworks.org/assets/files/news/publications/1500205_ENA_ANM_report_AW_online.pdf
The report was created by the ENA ANM Working Group where the relevant subject matter experts meet to share learning and to tackle industry wide issues affecting the wider roll out of ANM.

SSEPD have been working on ANM for a number of years, as can be seen through the work completed and charted for the Orkney ANM at the following link https://www.ssepd.co.uk/OrkneySmartGrid/ . Through this work SSEPD has built up an in-depth understanding of ANM that has allowed us to roll out ANM into Business as Usual so that more of our customers can experience the benefits that ANM can bring.

SSEPD have also recognised the need to support the rollout of this kind of innovation and have implemented business structural change to setup a team, the Active Solutions Team, whose sole responsibility is the rollout out of the more involved proven innovations, like ANM. Through setting up this team SSEPD aim to better rollout innovations quicker so that our customers can start realising the benefits sooner.

The main document detailing the reinforcement costs for IoW over the RIIO-ED1 period is located here:
ED_SSE - RRP - 2016-16 RRP\RIIO-ED1_SSEPD_BP2_Mar14_sp16_LI_sepd_Fawley-IOW_132kV_Circuit_Reinforcement_MPGP633

2) Customer's benefit from ANM as they are able to connect much sooner and at a far cheaper cost compared to traditional reinforcement. ANM defers this reinforcement cost creating NPV benefits, while allowing more generators to connect.

3) The volume unit is the number of ANM deployments, which is one.

4) Reinforcement costs has been calculated by system planners based on the size of the subsea cable that is necessary for the Isle of Wight network to ensure additional capacity is available for new connections as soon as possible.

The amount of time reinforcement is deferred for is calculated by system planners and is based upon how much additional capacity ANM can free up and predicted generator connection demand.

Currently, ANM has connected 9MVA to WI & 8.46MVA to IoW has been connected by ANM. It is unknown how much will be released each year, as it depends on demand for generator connections. We do know ANM has the ability to release 45MVA. We have assumed that over RIIO-ED1 this 45MVA capacity will be fully utilised. This is in line with predictions that reinforcement will be needed in RIIO-ED1 as well. We do not know when generators will connect. We have assumed 9MVA per year for the first 5 years will be released by ANM.

Thermal Cameras
1) Thermal cameras are used for assisting in the location of LV underground faults. They locate thermal hot spots caused by cables that have faulted or from cables that are likely to fault, as they leave a heat residue behind that the thermal camera is able to locate. This allows SSEN field staff to locate and repair faults quicker, thereby restoring power quicker to customers or even preventing faults from occurring in some cases.

The TOUCAN NIA close down report details the technology in more detail.

2) Thermal cameras have been rolled out across our southern network and are currently assisting with LV cable fault location, enabling field engineers to restore power quicker to customers, thereby reducing CMLs and occasionally CIs.

3) The volume of units is expressed as the number of thermal imaging cameras that have been purchased.

4) CI and CML saving calculations are described in the first section of this report.

Use of the RIIO-ED1 CBA Tool
DNOs should use the latest version of the RIIO-ED1 CBA Tool for each solution reported in the Regulatory Year under report. Where the RIIO-ED1 CBA Tool cannot be used to justify a solution, DNOs should explain why and provide evidence for how they have derived the equivalent figures for the worksheet. The most up-to-date CBA for each solution reported in the Regulatory Year under report which are used to complete the worksheet must be submitted.

RIIO-ED1 CBA tool used for all technologies

Changes to CBAs
If, following an update to the CBA used to originally justify the activity in column C, the updated CBA shows a negative net benefit for an activity, but the DNO decides it is in the best interests of consumers to continue the activity, the DNO should include an explanation of what has changed and why the DNO is continuing the activity.

Thermal Cameras & Bidoyngs: CI and CML monetary savings now taken from Ofgem fixed costs tab instead of those costs charged directly to SSEN for incurring IIS fines.
Reason: IIS costs vary each year for DNOs and between DNOs. Using Ofgem's fixed cost figures allows for more accurate cost saving comparisons between DNOs.

Calculation of benefits
Explain how the benefits have been calculated, including all assumptions used and details of the counterfactual scenario against which the benefits are calculated.

Pole Pinning

Refer to first box

Bidoyng

Refer to first box

ANM

Refer to first box

Thermal Cameras

Refer to first box

Cost benefit analysis additional information
Please include a reference to the file name and location of any additional relevant evidence submitted to support the costs and benefits inputted into this worksheet. This should include the most recent CBA for each solution reported in the Regulatory Year under report.

Pole Pinning

Data no longer supplied as this technology is no longer in use.

Bidoyng

Link to original BD1 and BD3 data:

CBA Location:

ANM

RIIO-ED1 Isle of Wight Development Plan with reinforcement costs location:

CBA Location:

Thermal Cameras

Thermal camera master data sheet location:

TOUCAN close down report location:

CBA Location: