ANNEX 3: COST BENEFIT ANALYSIS

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Contents

1. Overview

In developing our business plan we have been particularly focused on ensuring that our plans represent good value for money for our customers and all our stakeholders. Our engagement process clearly identified affordability as a key stakeholder priority.

In considering the range of options available to us as we respond to future challenges, we need to carefully consider the benefits and costs of the different options and ensure that we appropriately take into account the fact that some will be more enduring (longer-lived) than others.

In some areas, we have a level of discretion over whether to undertake any action at all in response to a particular issue. In other areas, the need to do something may be a given, but the exact solution may not be prescribed.

In order to help us make these decisions, we use Cost Benefit Analysis (CBA) assessments to thoroughly test alternative options for our plans. CBA is a well-respected process that most companies use in some form to evaluate different investment options.

We use the CBA methodology in the following two ways:

- For discretionary areas CBA is particularly valuable. Where we have significant discretion over both the timing and scope of interventions it ensures we select the most appropriate option. Discretionary choices that could provide value for our customers and achieve our stakeholders' preferences are evaluated by CBA.
- For non-discretionary areas, CBA may still provide valuable insights. Even when we are required to fulfil an obligation, we have evaluated a range of options utilising the CBA methodology alongside stakeholder engagement where appropriate, to select the most suitable option.

This approach ensures a systematic process by consistently calculating and comparing the benefits and costs of alternative investment options. As part of the CBA, all benefits and costs are expressed in monetary terms to allow a like for like comparison and all future benefits and costs are adjusted for the time value of money to allow the calculation of the Net Present Value (NPV) of the alternative options.

In terms of selecting the preferred option, in the case of entirely discretionary investment, this is generally based on the best positive NPV whereas in the context of mandatory but uncertain interventions, this is often on the basis of the 'least worst' option (ie where all options are negative on a strict NPV basis but where there is mandatory requirement to do something).

For a small number of models we have chosen not to adopt the most advantageous NPV where this is marginal to our proposed solution. This is always associated where the option showing the best NPV has significant delivery, compliance or other risk.

To ensure consistency across all companies, Ofgem have prescribed a particular approach to completing CBA assessments. As part of this process, we have defined a common set of benefits to take into account. This requires the quantification of intangible benefits so that they can be compared against the cost to deliver them.

2. Principles for application

In order to apply CBA effectively, we have developed a set of principles to determine where a CBA is applicable. Generally, any investment subject to a CBA should;

- Be material in terms of the investment it supports;
- Be subject to DNO discretion in terms of potential intervention options; and
- Be capable of having its costs and benefits measured.

In addition to areas not passing the general application principles above, the following have been automatically excluded;

- Any compliance-related expenditure;
- Any investment mandated by government policy or the requirements of the distribution licence; and
- Any investment subject to an uncertainty mechanism.

3. Benefits to be modelled

In order to produce a consistent set of CBAs, a common set of benefits needs to be employed in the benefit modelling. This requires the quantification (where possible) of intangible benefits to be compared with NPV cost functions.

The following are the key benefits modelled in the CBA, together with the prime source of calibration;

Benefit dimension	Measurement
Direct cost incurred	£ NPV
Safety	£ Published Cost of Life data x probabilities of incident
Environment	£ Cost of Carbon (Green Book value), also cost of oil loss
Customer impacts	£ Value of Lost Load or £ IIS incentive rates

These factors are identical to those used in our Risk model (see Annex 2) to ensure consistency between our decision support and risk evaluation tools.

4. Modelling assumptions

The following modelling assumptions have been adopted throughout all the CBA models we have used which are specific to our business.

Parameter	Value used
Pre-tax WACC	4.52%
Losses (£/MWh)	£48.42
CI (£/interruption)	£15.44
CML (£/minute lost)	£0.38
Cost per fatality	£1.79m
Cost per major injury	£30,000

Oil cost	£36/litre

Additionally we have used the following rates which were specified in the model as received from Ofgem.

Discount Rate <= 30 years	3.5%
Discount Rate > 30 years	3.0%
Discount rate for safety	1.5%
Assumed Asset Life (Years)	45

RPI INDICES

Using yearly averages (April to March)

Index		convert to 2012/13
Convert from	2003/04	1.3409
	2004/05	1.3004
	2005/06	1.2670
	2006/07	1.2214
	2007/08	1.1730
	2008/09	1.1392
	2009/10	1.1340
	2010/11	1.0804
	2011/12	1.0309
	2012/13	1.0000

The model also uses rates for carbon trading and assumptions for the decarbonisation of electricity generation, which can be found in Appendix 1 below.

There are also CBA-specific assumptions made which are included in the individual model narratives as appropriate. These include for example forecasts of future period asset replacement volumes.

The CI and CML impact of work for the various options under consideration are outlined in appendix 3.

Our assessments of the risk of injuries or fatalities have been derived based on asset fault rates only. This means for any option based on higher intervention volumes there will be a further increase of risk of injury or fatality over and above the current assumptions as a result of undertaking these higher volumes.

5. CBA application

Our application of CBAs can be broken down into a number of areas, each satisfying the criteria above and representing ‘real world’ trade-off decisions. The following section goes through the areas where we have applied the CBA approach and gives examples of each.

Asset management regimes

The majority of our network assets are subject to a lifecycle asset management regime which comprises a mix of interventions through an asset's life. These may include inspections, maintenance, painting, component replacement, refurbishment, life extension and replacement. The majority of our proposed network investment costs for RIIO-ED1 are a function of the lifecycle regimes employed.

It is incumbent on us to demonstrate that these patterns of intervention are optimum compared with other alternatives. As a result, we have completed CBAs for each major asset type and compared our proposed investment pattern with at least two alternatives, including a significant scaling back of near-term investment and a significant increase.

For the reduced option, the short-term reduction in investment is traded off against the consequential impact of increased failures and the increased replacement costs over the longer term. For the enhanced option, the additional near-term costs are considered alongside their incidental benefits and reductions in medium-term replacement requirements.

Specific examples include woodpoles, steel tower lines, distribution plant and EHV & 132kV plant.

In this category, we also consider whether there are any additional standalone drivers that may instigate intervention outside of the normal stewardship regime. Examples include the concurrent replacement of co-located assets and the replacement of high loss but otherwise serviceable transformers on the basis of the costed impact of the loss performance.

All options considered are generally do more / do less options. There are no options proposed to do nothing or to run to failure, and all options considered in the CBAs ensure we always remain legally compliant.

When assets do require end-of-life intervention (ie there is a given need to do 'something'), there can be options to refurbish rather than replace at lower cost but these may have a limited future asset life and/or degradation in performance compared to a new asset. Whilst refurbishment can be an option to keep near-term costs down, we need to show that it is the optimum solution in those areas where we have selected it as the preferred intervention option.

Specific examples in this category include the painting and selective member replacement of steel tower lines, replacement and refurbishment of pressurised cable systems and the re-generation of transformer oil.

These CBAs are to be found as AM1-22. These cover the 19 categories for which we present HI profiles, with the 132kV switchgear category covered by three individual scheme CBAs rather than a generic one.

Opportunistic betterment

Where a CBA or other analysis suggests work is required, there are opportunities to add additional functionality or capability at the same time. This could be at lower cost than would be incurred with a standalone installation; however may be sub-optimally targeted. In these instances, we use CBA to ensure that the cost of any additional functionality is justified by its benefits.

Specific examples include the opportunistic upsizing of cable and plant for capacity purposes, incurring an additional cost for lower loss transformers and the installation of remote control functionality on replacement switchgear to improve fault performance.

For the re-submission, we have added CBAs to cover Black Start strategy options following our change in approach in this area, and one for the potential undergrounding of elements of our most extreme rural HV circuits as a potential storm resilience upgrade.

Co-located activities

Where a CBA or other analysis suggests work is required, there are also opportunities to take advantage of the resources (contractors, materials, outages etc.) employed to undertake additional work on adjacent or associated assets on which work may be planned in the future. This would typically result in lower unit costs but risks the replacement of assets which might otherwise still have had a period of useful life remaining.

This issue is most pertinent when replacing plant on distribution substation sites, where the switchgear and transformers may be in different states and have different remaining life left.

These co-located assets are presented in the risk matrices in appendix 2 within HI categories lower than HI 5 as shown by the pink cells.

Unit costs

Unit costs used within the options presented in the CBAs are generally as per the unit costs forecast in the Business Plan Data Template. This is always the case for the costs of replacing assets and also for other associated costs and savings resulting from options. For refurbishment there are some options that are based on a deeper level of refurbishment scope than that presented in the baseline in table CV5, so increased unit costs have been assumed where appropriate.

Smart Grid / Smart Meter solutions

In determining the optimum solutions to load related activities we have incorporated CBA into our planning work in two ways.

For secondary network activities driven by thermal and voltage compliance issues, we have used the Transform model developed under the auspices of the Smart Grid Forum (SGF). This model contains a specific CBA model within the suite of tools and outputs the optimum set of solutions based on the best current view of the cost and benefits from smart solutions. These solutions included the use of Smart Meter data and we have separately detailed in our submission the non-load related benefits of Smart Meter data.

For investment requirements not within the scope of the Transform model; in the main 132kV and 33kV load related investments we have undertaken a general CBA analysis of smart solutions such as Demand Side Response (DSR) against traditional solutions. This analysis clearly shows the value of smart solutions and we have therefore incorporated these into our investment submissions. In order to fully represent the value of smart solutions for these networks in our plan we have deducted a flat 20% from the price of traditional solutions. This represents the average saving attainable across the broad range of investments required, it is of note that many of the technologies required to attain these savings are not yet mature and hence pricing based on a specific technology such as storage is inappropriate.

Smart technologies require a degree of enabling investment in IT systems such as control room network management systems (NMS). This investment is required to co-ordinate and implement smart solutions such as C_2C, CLASS and meshing technologies. This investment

is detailed in our Operational IT submission but has not been included in the CBA analysis as it forms part of our strategic investment for both RIIO-ED1 and RIIO-ED2.

6. Options development

Our business processes for developing investment programmes involves the consideration of multiple options when we decide that asset intervention is required. Such consideration is normally applied at programme level, but for our larger projects we undertake this on a site by site basis.

In considering the available options we take a whole life view of all related costs ranging from the initial investment through to the inspections and maintenance costs that will be incurred and effects on safety, environment and network performance. For the purposes of this work, this analysis has been transferred into the CBA template for those assets for which we felt a CBA was appropriate.

For the re-submission, we have re-crafted the options evaluated and added a number of additional CBAs to ensure that every HI category is covered by a bespoke CBA. In these models, the options are based on different portfolios of interventions mapped to the RIIO-ED1 risk matrix – see Appendix 2. This shows the scope of each option within the CBAs using a colour scheme applied to a matrix that shows the combinations of HI and CI ratings that are being included within each option. Different mixes of replacement and refurbishment are considered under these options (and including painting for towers).

Intervention strategies target the replacement of poor condition assets that are reaching end of life, but sometimes we elect to also replace assets at that site that may not be in such a poor state of health. We refer to these as consequential assets. Their replacement is either due to engineering reasons or because it makes economic sense to replace these while we have suitable resources on site even though these assets have remaining life. These consequential assets are separately identified in the CBA scope document in Appendix 2.

For each option under each asset group we have made corresponding adjustments to the medium to long term assumptions of forecast volumes for future RIIO regulatory periods using as a baseline plan our Best View projections used as the basis for Annex 22 – Long-term Strategy. These are outlined in Annex 3a.

We have tabulated the results of the CBAs for all options, as shown in the table below. This shows that while our chosen baseline option represents the lowest NPV in most cases, there are some cases when this is not the case. These are generally where there are engineering or site constraints associated with these options.

NPV Years		Option		
45 years	Study Area	1	2	3
AM1	LV Woodpoles	-20	-25	
AM2	Distribution Switchgear LV	-1	-21	
AM3	LV UGB	0	-5	
AM4	HV Woodpoles	-57	-3	
AM5	Primary Switchgear	-13	-21	-6
AM6	AM HV Switchgear	-2	-5	
AM7	Transformers Distribution	-1	-1	
AM8	Steel Towers Conductors 33kv	-5		
AM9	EHV Woodpoles	-18	-18	
AM10	Steel Towers 33kv	-1	-4	-7
AM11	Oil Cables 33kv	-49	-13	-4
AM12	Gas Cables 33kv	-26	-28	
AM13	EHV Switchgear	-12	-9	-8
AM14	EHV Transformers	-5	-168	-71
AM15	Steel Towers Conductors 132kv	-8		
AM16	Steel Towers 132kv	-0	-42	-45
AM17	Oil Cables 132kv	-88	-98	-124
AM18	Switchgear 132kv Peel	-1		
AM19	Switchgear 132kv Harker	3	-1	
AM20	Switchgear 132kv Padiham	-1	-1	-3
AM21	132kv Transformers	-8	-47	-31
AM22	Black Start	-10	-0	-12
AM23	Undergrounding	-3	-12	18

NO OPTION MODELLED

Further details on the selection of the chosen option are available on the individual CBAs.

Note that the individual 132kV switchgear projects are also covered by individual scheme summaries which give further detail on the options evaluated.

7. CBA schedule

	Area	Model
AM1	AM strategy - woodpoles	LV poles - CBRM (Risk) v Age/Residual strength Mix
AM2	AM strategy - switchgear (distribution)	LV Switchgear - CBRM (Risk) v replacement options
AM3	AM Strategy - LV UGB	LV UGB - Replacement Scenarios
AM4	AM strategy - woodpoles	11kV poles - CBRM (Risk) v Age/Residual strength Mix
AM5	AM strategy - switchgear (primary)	HV primary CBs - CBRM (Risk) v replacement options
AM6	AM strategy - switchgear (distribution)	Secondary HV CBs - CBRM (Risk) v replacement options
AM7	AM Strategy Transformers (Distribution)	Distribution (GM) - CBRM (Risk) v alternative replacement options
AM8	AM strategy - steel towers	33kV Fittings and Conductor - CBRM (Risk) v alternative Replace / Refurbishment mix
AM9	AM strategy - woodpoles	33kV poles - CBRM (Risk) v Age/Residual strength Mix
AM10	AM strategy - steel towers	33kV Towers - CBRM (Risk) v alternative Replace / Refurbishment mix
AM11	AM Strategy - Oil Cables	33kV Oil-filled cable replacement programme
AM12	AM Strategy - Gas Cables	33kV Gas-filled cable replacement programme
AM13	AM strategy - switchgear (EHV)	EHV Switchgear - CBRM (Risk) v replacement options
AM14	AM strategy - transformers (EHV)	EHV - CBRM (Risk) v alternative replacement options
AM15	AM strategy - steel towers	132kV Fittings and Conductor - CBRM (Risk) v alternative Replace / Refurbishment mix
AM16	AM strategy - steel towers	132kV Towers - CBRM (Risk) v alternative Replace / Refurbishment mix
AM17	AM Strategy - Oil Cables	132kV Oil-filled cable replacement programme
AM18	AM strategy - switchgear (132kV)	Peel 132 kV Swgr Replacement
AM19	AM strategy - switchgear (132kV)	Harker 132 kV Swgr Replacement
AM20	AM strategy - switchgear (132kV)	Padiham 132 kV Swgr Replacement
AM21	AM strategy - transformers (132kV)	132kV - CBRM (Risk) v alternative replacement options
AM22	AM Strategy - Black Start Batteries	Black Start
AM23	AM Strategy 11kV OHL to UG Cable	CBA to compare leaving circuits overhead to undergrounding in areas with high tree density to mitigate the effect of storms
L1	Losses Strategy	Losses Strategy 1 33kV 0.2 copper cables replace with 400 triplex
L2	Losses Strategy	Losses Strategy 2 33kV 0.3 copper cables replace with 400 triplex
L3	Losses Strategy	Losses Strategy 3 33kV 185 copper cables replace with 400 triplex
L4	Losses Strategy	Losses Strategy 4 HV 0.1 cables replace with 300 triplex
L5	Losses Strategy	Losses Strategy 5 HV 95PICAS replace with 300 triplex
L6	Losses Strategy	Losses Strategy 6 HV 95 Triplex replace with 300 triplex
L7	Losses Strategy	Losses Strategy 7 LV 0.1 replace with 300 waveform
L8	Losses Strategy	Losses Strategy 8 LV 95 consac replace with 300 waveform
L9	Losses Strategy	Losses Strategy 9 LV 95 waveform replace with 300

		waveform
L10	Losses Strategy	Losses Strategy 10 Transformer 50 PM like for like replacement
L11	Losses Strategy	Losses Strategy 11Transfromer 100 PM like for like replacement
L12	Losses Strategy	Losses Strategy 12 Transformer 200 PM like for like replacement
L13	Losses Strategy	Losses Strategy 13 Transformer 315 GM like for like replacement
L14	Losses Strategy	Losses Strategy 14 Transformer 500 GM like for like replacement
L15	Losses Strategy	Losses Strategy 15 Transformer 800 GM like for like replacement
L16	Losses Strategy	Losses Strategy 16 Transformer 1000 GM like for like replacement
L17	Losses Strategy	Losses Strategy 17 Transformer Grid 45 like for like replacement
L18	Losses Strategy	Losses Strategy 18 Transformer Grid 60 like for like replacement
L19	Losses Strategy	Losses Strategy 19 Transformer Grid 90 like for like replacement
L20	Losses Strategy	Losses Strategy 20 Transformer Primary 10 MVA like for like replacement
L21	Losses Strategy	Losses Strategy 21 Transformer Primary 14 MVA like for like replacement
L22	Losses Strategy	Losses Strategy 22 Transformer Primary 23 MVA like for like replacement
P14R	AM strategy - switchgear (indoor/outdoor)	Switchgear Primary 11kV indoor vs outdoor location
P15R	AM strategy - co-located asset replacement	Co-located asset replacement at distribution substations
P17R	AM strategy - Fault Current Limiter	Primary substation HV CB - defer replacement
S1	Smart Grid Solutions	Smart Grid Solutions - Grid Transformer
S2	Smart Grid Solutions	Smart Grid Solutions - Primary Transformer
S3	Smart Grid Solutions	Smart Grid Solutions - HV Cable

Appendix 1 – Decarbonisation assumptions

Power sector emissions are anticipated to reduce to 10g/kWh by 2050
assume a linear decarbonisation pathway from 2009/10 until 2050

Power sector emissions reduce by 14.5 g/kWh p.a. between now and 2030.
Beyond 2050 keep emissions at 10g/kWh

		g CO2e per kWh	
1,000 kg = 1 tonne	2009/10	589.82	(Defra)
1,000 kWh = 1 MWh	2010/11	575.32	
1 kg = 1,000g	2011/12	560.83	
	2012/13	546.33	
	2013/14	531.84	
	2014/15	517.34	
	2015/16	502.85	
	2016/17	488.35	
	2017/18	473.86	
	2018/19	459.36	
	2019/20	444.87	
	2012/21	430.37	
	2021/22	415.87	
	2022/23	401.38	
	2023/24	386.88	
	2024/25	372.39	
	2025/26	357.89	
	2026/27	343.40	
	2027/28	328.90	
	2028/29	314.41	
	2029/30	299.91	
	2030/31	285.41	
	2031/32	270.92	
	2032/33	256.42	
	2033/34	241.93	
	2034/35	227.43	
	2035/36	212.94	
	2036/37	198.44	
	2037/38	183.95	
	2038/39	169.45	
	2039/40	154.96	
	2040/41	140.46	
	2041/42	125.96	
	2042/43	111.47	
	2043/44	96.97	
	2044/45	82.48	
	2045/46	67.98	
	2046/47	53.49	
	2047/48	38.99	
	2048/49	24.50	
	2049/50	10.00	
	check	10.00	assumption; power sector should

reduce to 10 g CO2e/kWh

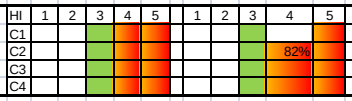
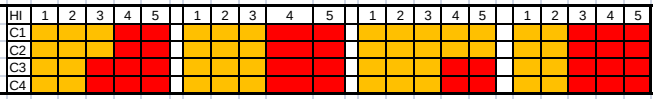
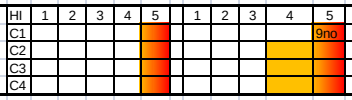
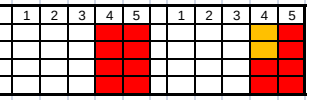
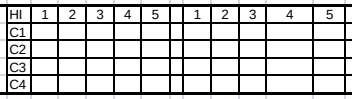
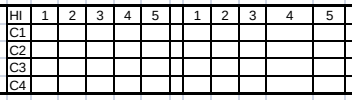
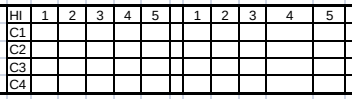
14.50 p.a. reduction in carbon intensity

	2012/13 prices	Traded carbon price (£/t 2010/11)[1]	traded carbon price (£/t 2012/13 prices)	Electricity GHG conversion factor (tonnes per MWh)[3]
1	2016	6.76	7.30	0.503
2	2017	7.10	7.67	0.488
3	2018	7.55	8.16	0.474
4	2019	8.03	8.68	0.459
5	2020	8.55	9.24	0.445
6	2021	15.26	16.49	0.430
7	2022	21.97	23.74	0.416
8	2023	28.68	30.98	0.401
9	2024	35.39	38.23	0.387
10	2025	42.10	45.48	0.372
11	2026	48.81	52.73	0.358
12	2027	55.52	59.98	0.343
13	2028	62.23	67.23	0.329
14	2029	68.94	74.48	0.314
15	2030	75.65	81.73	0.300
16	2031	81.00	87.51	0.285
17	2032	88.00	95.07	0.271
18	2033	95.00	102.63	0.256
19	2034	102.00	110.20	0.242
20	2035	109.00	117.76	0.227
21	2036	116.00	125.32	0.213
22	2037	122.00	131.80	0.198
23	2038	129.00	139.37	0.184
24	2039	136.00	146.93	0.169
25	2040	143.00	154.49	0.155
26	2041	150.00	162.05	0.140
27	2042	157.00	169.62	0.126
28	2043	164.00	177.18	0.111
29	2044	171.00	184.74	0.097
30	2045	178.00	192.30	0.082
31	2046	184.00	198.79	0.068
32	2047	191.00	206.35	0.053
33	2048	198.00	213.91	0.039
34	2049	205.00	221.47	0.024
35	2050	212.00	229.04	0.010
36	2051	220.00	237.68	0.010
37	2052	227.00	245.24	0.010
38	2053	234.00	252.80	0.010
39	2054	241.00	260.37	0.010
40	2055	248.00	267.93	0.010

41	2056	256.00	276.57	0.010
42	2057	262.00	283.05	0.010
43	2058	269.00	290.62	0.010
44	2059	276.00	298.18	0.010
45	2060	282.00	304.66	0.010
46	2061	287.00	310.06	0.010
47	2062	292.00	315.47	0.010
48	2063	297.00	320.87	0.010
49	2064	301.00	325.19	0.010
50	2065	305.00	329.51	0.010
51	2066	309.00	333.83	0.010
52	2067	312.00	337.07	0.010

Appendix 2 - CBA scope document for AM-series models

WJPB Ref	Rework Ref	Area	Model	Baseline	Option 1	Option 2	Option 3
P6R	AM1	AM strategy - woodpoles	LV poles - Policy				N/A
				80% HI5 &C1-C4	100% HI5 &C1-C4	Replace all baseline no	Refurb
P13R	AM2	AM strategy - switchgear (distribution)	LV Switchgear (ID, OD at S/S, WM) - CBRM (Risk)				N/A
				33% of HI5 & C1-4	Excludes HI5C1 in baseline	Replace all HI5 (from HI2 Table Total)	
P20N	AM3	AM Strategy - LV UGB	LV UGB & FP - CBRM				N/A
P5R	AM4	AM strategy - woodpoles	11kV poles - Policy				N/A
P11R	AM5	AM strategy - switchgear (primary)	HV primary CBs - CBRM (Risk)				
			Percentage Take Pink only	6 4 11	6 4	6 4 11	6 4
					20% Increase of baseline	100% HI5 & C1-4	
P12R	AM6	AM strategy - switchgear (distribution)	Secondary HV Swgr (CB, RMU, SW) - CBRM (Risk)				N/A
			Percentage take	0% 6% 21% 25% 100%	0% 6% 21% 25% 100%	0% 6% 21% 25% 100%	
				77% of HI5 & C2-4	10% Increase of baseline	Replace all HI5	
P21N	AM7	AM Strategy Transformers (Distribution)	Distribution (GM) – CBRM (Risk)				N/A
P22N	AM8	AM strategy - steel towers	33kV Fittings and Conductor - CBRM (Risk)			N/A	N/A
P4R	AM9	AM strategy - woodpoles	33kV poles - Policy				N/A
P3R	AM10	AM strategy - steel towers	33kV Towers - CBRM		C1: 100%; C2: 0%		
P1R	AM11	AM Strategy - Oil Cables	33 kV Oil-filled cable replacement programme				
P19N	AM12	AM Strategy - Gas Cables	33kV Gas-filled cable replacement programme				N/A
P10R	AM13	AM strategy - switchgear (EHV)	EHV Switchgear - CBRM (Risk)				
			Percentage Take Pink only		12		
P8R	AM14	AM strategy - transformers (EHV)	EHV - CBRM (Risk)				
			Percentage take				
P24N	AM15	AM strategy - steel towers	132kV Fittings and Conductor - CBRM (Risk)			N/A	N/A

WJPB Ref	Rework Ref	Area	Model	Baseline	Option 1	Option 2	Option 3
P2R	AM16	AM strategy - steel towers	132kV Towers - CBRM				
P18N	AM17	AM Strategy - Oil Cables	132kV Oil-filled cable replacement programme				
P25N	AM18	AM strategy - switchgear (132kV)	Peel 132 kV Swgr Replacement	Like for like (GIS CB and AIS BB) 3x CB and 21 disconnectors and E/Sw	GIS indoor, off line build	7x CB off line build (Discounted no cost option)	N/A
P26N	AM19	AM strategy - switchgear (132kV)	Harker 132 kV Swgr Replacement	GIS off line build indoor	GIS CB's and AIS BB - Bay by Bay	GIS AIS Off line	N/A
P27N	AM20	AM strategy - switchgear (132kV)	Padiham 132 kV Swgr Replacement	GIS to include flood defence integral to building in existing switch yard/compound	Bay by bay Asset Replacement with AIS + Perimeter flood protection, shared funding	Refurbish with Perimeter flood protection	GIS in building but with perimeter flood protection, shared costs in existing yard/compound
P7R	AM21	AM strategy - transformers (132kV)	132kV – CBRM (Risk)				
			Percentage take	100	100	100 100	100 100
P28N	AM22	AM Strategy - Black Start Batteries	Black Start	As New Submission, 78 x Battery Remainder BS's all at end of period	Batteries all sites at EOL Condition from 2020 onwards	Batteries at 78, BS at remainder. Commence All work in FY16	Batteries at all sites regardless of Condition. Commence in FY16
P29N	AM23	AM Strategy 11kV OHL to UG Cable	CBA to compare leaving circuits overhead to undergrounding in areas with high tree density	The baseline option assumes we continue to respond to damage and loss of supply at the time of storms as faults repairs. Retain OHL's and existing tree management. Major storm 1 in 4 years	Undergrounding of 2% of lines at high risk of damage during storms due to proximity to trees.	Undergrounding of 5% of lines at high risk of damage during storms due to proximity to trees for the same CI and CML benefit as option 1	Undergrounding of 2% of an increased population of lines at high risk of damage during storms due to proximity to trees with an increased CI and CML benefit over option1 and 2
P14R	NOT RENUMBERED	AM strategy - switchgear indoor/outdoor	Switchgear Primary 11kV indoor vs outdoor location				
P15R	NOT RENUMBERED	AM strategy - co-located asset replacement	Co-located asset replacement at Distribution substations				
P17R	NOT RENUMBERED	AM Strategy Fault Current Limiter	Primary substation HV CB - defer replacement				

Key

	Asset Replacement
	Asset Refurbishment
	Asset Refurbishment (Tower Painting)
	Refurb or replace depending on ability to take DC outage.
	Consequential replacement volumes
	Refurbishment of components on poles not resulting in improvement in pole health
	Refurbishment of components on poles not resulting in improvement in pole health together with some pole replacement

Appendix 3 - CI and CML assumptions

												Absolute Baseline position		Option 1		Option 2		Option 3	
Asset type	**Ref**	**Base - Op1**	**Base - Op2**	**Base - Op3**	**Change in CI's per annum Option 1**	**Change in CI's per annum Option 2**	**Change in CI's per annum Option 3**	Customer Interupted	Duration Mins	Applied to Fault Volume	Fault numbers	Total CI	Total CML	Change in CI per annum	Change in CML per annum	Change in CI per annum	Change in CML per annum	Change in CI per annum	Change in CML per annum
LV Poles	AM1	12883	0	0	-2.716%			200	20	100%	0	0	0	0	0				
LV Pillar (ID)	AM2																		
LV Pillar (OD at Substation)	AM2	-1202	3422	3737	0.904%	-2.574%	-2.811%	200	120	100%	83	16600	9960	150.11	90.069	-427.4	-256.4	-466.7	-46.67
LV Board (WM)	AM2																		
LV UGB & LV Pillars (OD not at Substation)	AM3	140	-3510	1215	-0.087%	2.187%	-0.757%	200	120	100%	6	1200	720	-1.047	-0.628	26.244	15.746	-9.082	-0.908
6.6/11kV Poles	AM4	28592	0	0	-17.815%			500	70	100%	0	0	0	0	0	0	0		
6.6/11kV CB (GM) Primary	AM5	-1426	-1413	-1431	0.888%	0.880%		6000	70	100%	0	0	0	0	0	0	0	0	0
6.6/11kV CB (GM) Secondary																			
6.6/11kV Switch (GM)	AM6	-1239	-2599	0	0.509%	1.067%		1000	55	100%	135	135000	7425	686.5	37.758	1440	79.203		
6.6/11kV RMU																			
6.6/11kV Transformer (GM)	AM7	-145	-328	0	0.109%	2.912%		200	55	100%	153	30600	8415	33.253	9.1445	891.05	245.04		
33kV Pole	AM9	2371	0		-2.358%			6000	70	1%	0	0	0	0	0				
33kV OHL (Tower line) Conductor	AM8	-140	0	0	0.980%			6000	70	1%	0	0	0	0	0				
33kV Fittings																			
33kV UG Cable (Oil)	AM11							6000	70	1%	0	0	0	0	0	0	0	0	0
33kV UG Cable (Gas)	AM12	-59	-35		3.148%	1.563%		6000	70	1%	0.53	31.8	0.37	0.01	0.0001	0.005	6E-05	0	0
33kV CB (Gas Insulated Busbars)(ID) (GM)	AM13	-80	-146	-68	5.051%	11.624%	3.586%	6000	70	1%	0	0	0	0	0	0	0	0	0
33kV Transformer (GM)	AM14	-143	-292	-5	2.490%	18.622%	0.184%	6000	70	1%	0	0	0	0	0	0	0	0	0
132kV Tower	AM16	1291	725	725	-5.167%	-4.330%	-11.300%	10000	70	1%	0	0	0	0	0	0	0	0	0
132kV Transformer	AM21	16	1	21	-1.250%	-0.391%	-16.406%	50000	70	1%	0	0	0	0	0	0	0	0	0
132kV OHL (Tower Line) Conductor	AM15	-224			0.389%			50000	70	1%	0	0	0	0	0				
132kV Fittings	AM15																		
33kV Tower	AM10	196	54	54	-2.634%	-1.197%	-1.834%	12000	70	1%	0	0	0	0	0	0	0	0	0