

Title: Beddington - Hurst

LPN Regional Development Plan

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Beddington – Hurst

All of the cost numbers displayed in this document are before the application of on-going efficiencies and real price effects.

Document History

Version	Date	Revision Class	Originator	Section Update	Details
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2.1	11/03/2014	Minor	Sharon Green	1 Executive Summary	Revised and edited the text/content/wording
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Beddington – Hurst

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Beddington – Hurst

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Contents

1	EX	ECU	TIVE SUMMARY	5
2	NE	тwс	RK CONFIGURATION	11
	2.1	Exi	STING NETWORK	11
	2.2	Ем	BEDDED GENERATION	12
:	2.3	Pro	DJECTS IN PROGRESS	12
3	NE	тwс	RK DEVELOPMENT CONSIDERATIONS	14
	3.1	De۱	/ELOPMENT AREAS	14
	3.2	Ass	SET HEALTH	15
	3.3	SEC	CURITY OF SUPPLY AND LOAD INDEX ANALYSIS	18
;	3.4	Ope	ERATIONAL AND TECHNICAL RESTRICTIONS	19
;	3.5	ΝΑΤ	FIONAL GRID	19
4	RE	CON	IMENDED STRATEGY	20
	4.1	Ass	SET REPLACEMENT	20
	4.1	.1	Transformers	20
	4.1	.2	Switchgear	20
	4.1	.3	Gas Cable	21
	4.1	.4	Fluid Filled Cable	21
	4.2	Rei	NFORCEMENT	21
	4.3 Co	OSTS	AND PHASING	22
	4.4	HI/	LI IMPROVEMENT	23
5	AL	TERI	NATIVES STRATEGIES	26
4	5.1	Use	EAIS AT ELTHAM 132 FOR SUPPLYING NEW EGLINTON SUBSTATION	26
4	5.2	Est	ABLISH A NEW 2 X 66MVA BELVEDERE SUBSTATION	26
6	RE	FER	ENCES	27
	6.1	Apf	PENDICES	27
	6.2	Do	CUMENT HISTORY	27
7	DO	CUN	IENT SIGN OFF	

Beddington – Hurst



All of the cost numbers displayed in this document are before the application of on-going efficiencies and real price effects.

1 Executive Summary

This development plan covers the Beddington Hurst network which supplies eight Grid Substations and nine Primary Substations. The aggregated group demand of the network is 443MW and 280MW in the winter and summer respectively.

The Beddington Hurst network is not expected to experience high load growth during the ED1 period, with the only significant area of development being Kidbrooke Village. However, a number of the substations on this network have existing load issues which must be resolved in order to maintain compliance with the licence conditions.

It is planned to establish a new 132/11kV substation at the disused Eglinton site and to install a fourth transformer at Eltham Grid 33kV.

A large number of sections of fluid filled and gas filled cables are planned to be replaced with solid type cables due to their asset health condition. In addition, there are projects planned to replace / retrofit 132kV and 33kV switchgear. Three grid transformers are also planned for replacement.

Proposed projects

Reinforcement Schemes

• Eglinton New 132/11kV Substation - (2x66MVA) £12.5m (£10.6m in ED1)

Asset Replacement Schemes

 Eltham Grid 132kV – Replace Switchgear 	£2.0m
 Bromley Grid 33kV – Replace Switchgear 	£1.6m
 Sydenham Park 33kV – Replace GT2B 	£1.4m
 Sydenham Park 11kV – Replace GT1A and GT3A 	£3.2m
 Eltham to Sydenham Park 132kV Gas Cable Replacement 	£26.4m
 Bromley to Hurst 132kV FFC Replacement 	£11.2m
 Beddington to Sydenham 132kV FFC Replacement 	£12.6m

Costs profile

NAMP Table J less Indirect 19th February 2014

Cat.	Reference	Description	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23
A & H		Total Asset Replacement	0	0	0	0	76,965	4,736,335	12,688,915	14,550,645	11,471,832	14,813,298
R		Total Reinforcement	418,777	3,119,762	6,666,854	6,610,413	1,120,652	0	0	0	0	0
		Grand Total	418,777	3,119,762	6,666,854	6,610,413	1,197,618	4,736,335	12,688,915	14,550,645	11,471,832	14,813,298

 Table 1.
 Total Project Expenditure





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Output Measures

Load Index of Substations on Beddington Hurst Network



Graph 1. Load Index With and Without Investment



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Health of Assets on Beddington Hurst Network

Grid Transformers



Graph 2. Grid Transformers With and Without Investment



Primary Transformers

Graph 3. Primary Transformers With and Without Investment



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132kV Switchgear



Graph 4. 132kV Switchgear With and Without Investment



EHV Switchgear

Graph 5. EHV Switchgear With and Without Investment



Beddington – Hurst

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HV Switchgear



Graph 6. HV Switchgear With and Without Investment



FFC Sections

Graph 7. Fluid Filled Cables With and Without Investment



Beddington – Hurst

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Gas Cables (km)

Graph 8. Gas Cables With and Without Investment

Scenarios Considered

The Scenario considered is based on the LPN Planning Load Estimates of August 2013 using Element Energy Load Growth assessment and the Asset Risk Prioritisation model of July 2013.

RDP Dependencies and Assumptions

The schemes covered in this RDP have been planned based on the planning load estimates 2013 with the 2012/13 maximum demand. The load forecasts are based on the element energy model. If the economic situation improves there is a risk that there will be shortfall of reinforcement schemes in the plan.

The load forecasts also include an assumed level of embedded generation being connected to the network. Should this generation not materialise, then a larger than forecast load growth could be realised.

Where Demand Site Response has been included at a substation, this is based on an assumption that customers will be willing to accept the scheme. In most cases these customers have not as yet been identified.

Beddington – Hurst



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2 Network configuration

2.1 Existing Network

This development plan reviews the LPN EHV network supplied by the Beddington to Hurst 132kV network, which is fed by five 275/132kV Super Grid Transformers (SGT's) rated at 240MVA (3 x SGT's @ Hurst) and 120MVA (2 x SGT's @ Beddington).

There are three 132kV substations on this network, Eltham Grid 132kV, Bromley Grid 132kV and Sydenham Park 132kV.

Eltham Grid 132kV

Eltham Grid 132kV is an outdoor switchboard, the majority of the breakers are Air Insulated Switchgear (AIS). There are five incoming circuits, 2 from Bromley Grid 132kV, 2 from Sydenham Park 132kV and 1 from Hurst SGT3. The circuit from Hurst SGT 3 is an overhead line under National Grid ownership. There is a termination tower on the site. National Grid have plans to underground this circuit.

The Eltham Grid site has a dual entry system as there is a model railway run at the east end of the site, access to the railway is via the UK Power Networks gates and along the side road. There is a car park at the bottom of the site, which is used jointly by UK Power Networks staff and those working at and visiting the railway.

There are 132kV connections to:

<u>Eltham Grid 11kV 4 x 15MVA</u>: This is a standard LPN 4 x 15MVA 132/11kV substation. The transformers are supplied from double banked switches on the 132kV. The 11kV switchboard is located at west end of the Eltham Grid site.

Eltham Grid 33kV 3 x 45MVA: This substation is located at the west end of the Eltham Grid site.

Eltham Grid 33kV feeds the following 33/11kV substations:

<u>Eltham High St 11kV 3 x 15MVA</u>: the site is supplied by 3 x 33/11kV 15MVA transformers. Access to the site is through the rear of a restaurant in the high street, the switchboard being located on a floor above the restaurant and the transformers at the rear of the building.

<u>Dermody Rd 11kV 3 x 15MVA</u>: The substation consists of 3 x 33/11kV 15 MVA transformers. The site is located at the corner of Dermody Road and Eastdown Park.

<u>Farjeon Rd 11kV 4 x 15MVA</u>: The site consists of 4 x 33/11kV 15MVA transformers and is located in a residential area. The site provides supplies to some high profile customers, including the Thames Barrier South.

Bromley Grid 132kV

This outdoor 132kV substation is located in Petts Wood on a spacious site, surrounded by woodland on all sides.

There are 4 x 132kV connections to:

<u>Bromley Grid 33kV:</u> The 132/33kV 60MVA transformers for this site are located on the same footprint as the 132kV switchgear. The 33kV switchboard consists of a mixture of Reyrolle L42 and L45 circuit breakers.

In turn Bromley Grid 33kV then supplies:

<u>Chislehurst BR</u>: this is a customer driven site which will therefore, be excluded from the scope of this development plan.

<u>Chislehurst 11kV:</u> This is a standard LPN 4 x 15MVA transformer site. The 11kV switchboard is Reyrolle C5 C7T switchgear, which is now obsolete.



Beddington – Hurst

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<u>Bromley South 11kV</u>: the substation consists of 4 x 15MVA 33/11kV transformers. Transformers T1, T2 and T3 are teed with T1, T2 and T3 at Chislehurst. T4 has a direct connection from Bromley Grid 33kV. The substation is located at the rear of a residential street in Bromley. The 11kV switchboard has been retrofitted with Reyrolle RETVAC C gear.

Sydenham Park 132kV

Sydenham Park 132kV consists of two 132kV circuit breakers, with four double banked circuits to Sydenham Park 33kV and Sydenham Park 11kV.

<u>Sydenham Park 11kV:</u> The substation consists of 4 x 132/11kV 15MVA transformers and a 25 panel ABB VAC switchboard. T4A and T2A are fed from Beddington whilst T1A and T3A are fed from Hurst.

<u>Sydenham Park 33kV:</u> This is a 132/33kV 4 x 45MVA substation which in turn supplies Forest Hill 11kV, Winlaton Road 11kV and Churchfields Road 11kV. Normal running at Sydenham Park 33 has the top bar fed from Beddington and the bottom bar from Hurst.

In turn Sydenham Park 33kV feeds:

<u>Forest Hill 11kV</u>: This substation consists of 3 x 33/11kV 15 MVA transformers, all fed from the bottom bar of Sydenham Park 33kV (therefore, load is seen on Hurst under normal running conditions). The 11kV switchboard is rated at 1200A and the breakers are AEI oil filled.

<u>Winlaton Road 11kV:</u> This substation is also fed from the bottom bar of Sydenham Park 33kV and it has 4 x 33/11kV 15MVA transformers. The switchboard is rated at 1200A and consists of Reyrolle oil filled switchgear.

<u>Churchfields Road 11kV</u>: Churchfields is fed from the top bar of Sydenham Park 33kV (Beddington). The substation consists of 4 x 33/11kV 15MVA transformers and a 24 panel 1200A rated Reyrolle oil filled switchboard.

The network geographic diagram is shown in Appendix A and the single line diagrams are in Appendix B.

2.2 Embedded Generation

According to ER P2/6 generation on a network can be counted towards the substation capability if the aggregated nominal generation capacity (excluding Diesel and PV) exceeds 5% of the connected load.

The Beddington Hurst network generation is below 5% on all substations and is therefore not included in this report.

2.3 **Projects in progress**

NAMP table J less indirect 19th February 2014

Cat.	Reference	Description	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23
R	1.35.01.2579	Eltham Grid: Install 4th 132/33 kV Transformer	226,729	1,275,352	1,582,381	23,618	0	0	0	0	0	0

Table 2. Extract from Network Asset Management Plan 19th February 2014

1.35.01.2579 Eltham Grid: Install 4th 132/33kV Transformer

This scheme provides for the reinforcement of Eltham Grid with a 4th 45MVA 132/33kV transformer. The substation was originally designed to accept a 4th transformer and both 132kV banking connections and space to extend the 33kV busbar are already available. A 2nd 33kV bus section switch is required and, whereas L42 spare feeders panels are available, the requirement for a section switch and through wall bushings are likely to necessitate the use of modern equivalent switchgear with a 'joggle' interface box.

The scheme to establish a new 132/11kV substation at Eglinton removes the need for load growth reinforcement at Eltham Grid 33kV. However, this scheme is to progress as a customer driven scheme due to the large Kidbrooke development described in section 3.1.



Beddington – Hurst

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Beddington – Hurst



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3 Network Development Considerations

3.1 Development areas

<u>Kidbrooke</u>

Kidbrooke is a district of South East London in the Royal Borough of Greenwich. The Ferrier Estate was one of the largest and most deprived council housing estates in London. The area is now being redeveloped under the Kidbrooke Regeneration project. This is a £1 billion regeneration scheme, which plans to build 4,000 private and affordable homes, a new 100 acre public park, health centre, community facilities and shops over 15 - 20 years. Approval was gained in 2009.

The plan is to create 4 new neighbourhoods, Blackheath Quarter, Kidbrooke Village Centre, Kidbrooke Park and Eltham Green West.







Beddington – Hurst

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3.2 Asset Health

The Asset Replacement programme has been developed using the outputs from the Asset Risk Prioritisation model version July 2013.

The following tables show the forecast HI figures for all asset groups without investment for 2015 and 2023.

It should be noted that HIs presented in the RDP will not align with the RIGS. The HI's presented in the RDP are the outcome of our ARP models on an asset by asset basis. Different rules are applied for RIGs reporting, as agreed with Ofgem, where assets may be grouped and all assets in the group take the same HI.

The 2015 HI figures include any projects that are currently in progress (see section 2.3 for details) and are due to be completed by the end of DPCR5.

HV Circuit breakers

			2015					2023		
Substation	No. HI1	No. HI2	No. HI3	No. HI4	No. HI5	No. HI1	No. HI2	No. HI3	No. HI4	No. HI5
BROMLEY SOUTH		18	3					19	2	
CHISLEHURST		20						20		
CHURCHFIELDS		21	3					24		
DERMODY RD	1	16	4			1		20		
ELTHAM GRID 11KV		28					1	27		
ELTHAM HIGH ST		20					6	14		
FARJEON RD	1	24	2			1	8	17	1	
FOREST HILL			19	1					15	5
SYDENHAM PARK 11KV	1	24					9	16		
WINLATON RD		20	4					23	1	

Table 3. Health Indices of HV Circuit Breakers

EHV Circuit breakers

			2015					2023		
Substation	No. HI1	No. HI2	No. HI3	No. HI4	No. HI5	No. HI1	No. HI2	No. HI3	No. HI4	No. HI5
BROMLEY GRID 33KV		11	6					13	3	1
ELTHAM GRID 33KV		10	3				2	11		
SYDENHAM PARK 33KV		17	2				2	16		1

Table 4. Health Indices of EHV Circuit Breakers

132kV Circuit Breakers

			2015					2023		
Substation	No. HI1	No. HI2	No. HI3	No. HI4	No. HI5	No. HI1	No. HI2	No. HI3	No. HI4	No. HI5
BROMLEY GRID 132KV			2					2		
ELTHAM GRID 132KV	4	1	8				4	1	6	2
SYDENHAM PARK 132KV		2						2		

Table 5. Health Indices of 132kV Circuit Breakers



Beddington – Hurst

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Primary Transformers

			2015					2023		
Substation	No. HI1	No. HI2	No. HI3	No. HI4	No. HI5	No. HI1	No. HI2	No. HI3	No. HI4	No. HI5
BROMLEY SOUTH		4					4			
CHISLEHURST		4					4			
CHURCHFIELDS		4					4			
DERMODY RD		3					1	2		
ELTHAM HIGH ST		3					2	1		
FARJEON RD		4						4		
FOREST HILL		3						3		
WINLATON RD		4					4			

Table 6. Health Indices of Primary Transformers

Grid Transformers

			2015					2023		
Substation	No. HI1	No. HI2	No. HI3	No. HI4	No. HI5	No. HI1	No. HI2	No. HI3	No. HI4	No. HI5
BROMLEY GRID 33KV		4						4		
ELTHAM GRID 11KV		2	2					4		
ELTHAM GRID 33KV		3						3		
SYDENHAM PARK 11KV		2	1	1		(1	1	1	1
SYDENHAM PARK 33KV		2	2				1	2	1	

Table 7. Health Indices of Grid Transformers

Fluid Filled Cables

			2015					2023		
Substation	No. HI1	No. HI2	No. HI3	No. HI4	No. HI5	No. HI1	No. HI2	No. HI3	No. HI4	No. HI5
BEDDINGTON-SYDENHAM PARK 132KV		1	1		2			1	1	2
BROMLEY GRID 132KV-HURST 132KV		4	3		1		2	4		2
BROMLEY GRID 33KV-BROMLEY SOUTH		4					4			
BROMLEY GRID 33KV-CHISLEHURST		9	3				8	3	1	
ELTHAM GRID 132KV-BROMLEY GRID 132KV		3	1				1	3		
ELTHAM GRID 132KV-ELTHAM GRID 33KV			1					1		
ELTHAM GRID 132KV-RESERVE BAR		1	2				1	2		
ELTHAM GRID 33KV –ELTHAM HIGH ST		4					4			
HURST 132KV-ELTHAM GRID 132KV		1					1			
SYDENHAM PARK 33KV-CHURCHFIELDS		7	2	1			3	6		1
SYDENHAM PARK 33KV-FOREST HILL		8					8			
SYDENHAM PARK 33KV-WINLATON RD		11	1				2	9	1	

Table 8. Health Indices of EHV Fluid Filled Cables



Beddington – Hurst

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Gas Cables

			2015					2023		
	No.		No.		No.					No.
Circuit Name Containing Section	HI1	No. HI2	HI3	No. HI4	HI5	No. HI1	No. HI2	No. HI3	No. HI4	HI5
ELTHAM GRID 132KV – SYDENHAM 132KV				19						19

Table 9. Health Indices of EHV Gas Cables (km)



Beddington – Hurst

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3.3 Security of supply and load index analysis

Table 10 shows the load growth predicted on the substations on the Beddington Hurst network. Where loads exceed the substation firm capacity plus any post fault transfer capability are shown in orange. (Yellow is a customer owned site and therefore not measured against P2/6.)

Sub-station	P2/6	Type of substation	Secondary Voltage	Firm Capacity (MW)	Transfer (MW)	P. F.	Winter 12/13 Summer 2012 (MW)	Winter 13/14 Summer 2013 (MW)	Winter 14/15 Summer 2014 (MW)	Winter 15/16 Summer 2015 (MW)	Winter 16/17 Summer 2016 (MW)	Winter 17/18 Summer 2017 (MW)	Winter 18/19 Summer 2018 (MW)	Winter 19/20 Summer 2019 (MW)	Winter 20/21 Summer 2020 (M W)	Winter 21/22 Summer 2021 (MW)	Winter 22/23 Summer 2022 (MW)
BEDDINGTON 132kV	NO		132kV	138.20		0.96	142.42	143.10	144.37	145.81	147.07	148.47	149.93	151.42	152.97	155.20	157.47
BEDDINGTON 132kV	YES		132kV	122.10		0.96	95.80	96.24	97.07	98.02	98.84	99.76	100.72	101.70	102.71	104.17	105.65
Beddington 132kV Hurst 132kV	YES		kV	829.40		0.96	445.06	447.01	450.67	454.85	458.51	476.45	480.62	484.91	489.35	495.72	502.19
Beddington 132kV Hurst 132kV	YES		kV	732.70		0.96	280.20	281.40	283.71	286.35	288.67	300.10	302.74	305.46	308.28	312.31	316.41
Bromley Grid 33kV	YES		33kV	197.54		0.96	140.88	141.22	142.01	142.97	143.84	144.73	145.67	146.65	147.67	149.29	150.92
Bromley Grid 33kV	YES		33kV	165.60		0.92	9150	91.68	92.16	92.76	93.31	93.87	94.46	95.08	95.72	96.74	97.77
Bromley South	YES		11kV	56.75		0.97	4102	4128	41.73	42.22	42.64	43.11	43.61	44.12	44.65	45.34	46.05
Bromley South	YES		11kV	41.85		0.93	28.39	28.57	28.87	29.20	29.48	29.80	30.13	30.47	30.82	3128	31.75
Chislehurst	YES		11kV	54.10		0.99	46.60	46.80	47.17	47.59	47.94	48.33	48.74	49.16	49.59	50.19	50.80
Chislehurst	YES		11kV	40.30		0.96	29.90	30.03	30.26	30.52	30.74	30.99	3124	3150	3177	32.15	32.53
Chislehurst BR	NO	Customer		0.00		0.96	18.30	18.30	18.30	18.30	18.30	18.30	18.30	18.30	18.30	18.30	18.30
Chislehurst BR	NO	Customer		0.00		0.92	14.20	14.20	14.20	14.20	14.20	14.20	14.20	14.20	14.20	14.20	14.20
Churchfields	YES		11kV	52.43		0.98	38.77	38.98	39.35	39.76	40.12	40.52	40.94	4137	4182	42.43	43.06
Churchfields	YES		11kV	40.58		0.97	25.05	25.18	25.41	25.66	25.88	26.12	26.38	26.64	26.92	27.29	27.67
Dermody Road	YES		11kV	34.45	6.89	0.97	28.74	28.91	29.21	29.54	29.83	30.15	30.48	30.82	31.18	31.65	32.14
Dermody Road	YES		11kV	28.80	5.76	0.96	22.60	22.73	22.96	23.21	23.43	23.67	23.92	24.18	24.45	24.81	25.18
Eglinton	YES		11kV	82.37		0.96	0.00	0.00	0.00	0.00	0.00	60.00	60.00	60.00	60.00	60.00	60.00
Eglinton	YES		11kV	60.72		0.92	0.00	0.00	0.00	0.00	0.00	60.00	60.00	60.00	60.00	60.00	60.00
Eltham Grid	NO		11kV	46.10	7.00	0.96	53.58	53.84	54.31	54.84	55.29	29.09	29.61	30.13	30.67	31.43	32.21
Eltham Grid	YES		11kV	42.70		0.95	33.42	33.58	33.86	34.17	34.44	18.94	19.24	19.55	19.87	20.32	20.78
Eltham Grid 132kV	YES		132kV	254.50		0.96	143.84	144.77	146.39	148.17	149.71	165.37	167.14	168.96	170.84	173.36	175.94
Eltham Grid 132kV	YES		132kV	198.80		0.92	92.80	93.38	94.37	95.47	96.42	106.36	107.46	108.58	109.74	111.29	112.88
Eltham Grid 33kV	YES		33kV	109.70		0.96	9148	92.15	93.29	94.54	95.62	77.47	78.72	80.01	8135	83.11	84.90
Eltham Grid 33kV	YES		33kV	77.40		0.86	65.19	65.65	66.42	67.28	68.02	55.78	56.63	57.52	58.43	59.63	60.86
Eltham High Street	YES		11kV	37.44	7.49	0.96	28.53	28.72	29.07	29.46	29.80	20.58	20.97	2138	2180	22.37	22.96
Eltham High Street	YES		11kV	29.10	5.82	0.97	18.58	18.70	18.92	19.16	19.37	13.58	13.83	14.09	14.35	14.71	15.08
Farjeon	YES		11kV	55.58	10.97	0.95	33.96	34.26	34.75	35.27	35.72	26.42	26.95	27.48	28.04	28.74	29.46
Farjeon	YES		11kV	41.40	8.30	0.92	25.45	25.67	26.01	26.39	26.72	20.01	20.39	20.77	21.17	21.68	22.20
Forest Hill	YES		11kV	36.48		0.97	24.10	24.23	24.46	24.73	24.95	25.21	25.48	25.75	26.03	26.45	26.87
Forest Hill	YES		11kV	28.20		0.96	17.92	18.01	18.18	18.37	18.53	18.72	18.91	19.11	19.31	19.61	19.91
HURST 132kV	YES		132kV	461.20		0.96	277.65	278.91	28132	284.05	286.46	302.99	305.70	308.50	311.39	315.52	319.73
HURST 132kV	YES		132kV	446.00		0.96	184.30	185.05	186.53	188.23	189.73	200.23	20192	203.66	205.46	208.04	210.65
Sydenham Park	YES		11kV	55.58		0.95	40.67	40.86	41.20	41.59	4191	42.28	42.66	43.05	43.45	44.03	44.61
Sydenham Park	YES		11kV	41.85		0.93	29.27	29.40	29.66	29.95	30.19	30.48	30.76	3105	3135	3178	32.22
Sydenham Park 33kV	YES		33kV	144.71		0.97	101.99	102.48	103.41	104.47	105.40	106.43	107.52	108.63	109.78	111.44	113.13
Sydenham Park 33kV	YES		33kV	128.25		0.95	68.90	69.22	69.81	70.49	7109	71.75	72.44	73.16	73.89	74.96	76.04
Winlaton	YES		11kV	54.28		0.98	44.99	45.16	45.52	45.94	46.32	46.74	47.18	47.63	48.10	48.79	49.51
Winlaton	YES		11kV	41.64		0.96	29.30	29.41	29.64	29.91	30.15	30.42	30.69	30.98	3128	31.72	32.17

Table 10. P2/6 Assessment Table

The latest version of the Planning Load Estimates (Aug 2013), upon which the P2/6 assessment is carried out, included the proposed Eglinton Substation. This means the P2/6 assessment does not accurately reflect the loading at Eltham Grid 11kV, Eltham Grid 33kV, Eltham High St and Farjeon Road Main Substations. Table 11 shows the substation loadings without Eglinton included.

Sub-station	P2/6	Type of substation	Secondary Voltage ▼	Firm Capacity (MW)	Transfer (MW)	P. F.	Winter 12/13 Summer 2012 (MW)	Winter 13/14 Summer 2013 (MW)	Winter 14/15 Summer 2014 (MW)	Winter 15/16 Summer 2015 (MW)	Winter 16/17 Summer 2016 (MW)	Winter 17/18 Summer 2017 (MW)	Winter 18/19 Summer 2018 (MW)	Winter 19/20 Summer 2019 (MW)	Winter 20/21 Summer 2020 (MW)	Winter 21/22 Summer 2021 (MW)	Winter 22/23 Summer 2022 (MW)
Sew ell Road	YES		11kV	57.13	4.00	0.98	51.03	5128	5176	52.29	52.73	53.22	53.73	54.25	54.78	55.53	56.31
Sew ell Road	YES		11kV	42.30	4.00	0.94	34.35	34.51	34.81	35.15	35.43	35.69	36.01	36.34	36.68	37.16	37.65
Dermody Road	YES		11kV	34.45	6.89	0.97	28.74	28.91	29.21	29.54	29.83	30.15	30.48	30.82	31.18	3165	32.14
Dermody Road	YES		11kV	28.80	5.76	0.96	22.60	22.73	22.96	23.21	23.43	23.67	23.92	24.18	24.45	24.81	25.18
Eltham Grid	NO		11kV	46.10	7.00	0.96	53.58	53.84	54.31	54.84	55.29	55.79	56.31	56.83	57.37	58.13	58.91
Eltham Grid	YES		11kV	42.70		0.95	33.42	33.58	33.86	34.17	34.44	35.74	36.04	36.35	36.67	37.12	37.58
Eltham High Street	YES		11kV	37.44	7.49	0.96	28.53	28.72	29.07	29.46	29.80	30.18	30.57	30.98	3140	3197	32.56
Eltham High Street	YES		11kV	29.10	5.82	0.97	18.58	18.70	18.92	19.16	19.37	19.58	19.83	20.09	20.35	20.71	21.08
Farjeon	YES		11kV	55.58	10.97	0.95	33.96	34.26	34.75	35.27	35.72	36.22	36.75	37.28	37.84	38.54	39.26
Farjeon	YES		11kV	41.40	8.30	0.92	25.45	25.67	26.01	26.39	26.72	26.21	26.59	26.97	27.37	27.88	28.40

Table 11. P2/6 Assessment Table without Eglinton



Beddington – Hurst

All of the cost numbers displayed in this document are before the application of on-going efficiencies and real price effects.

LI Profile (Without Investment)

Substation	Voltago kV	Load	Index
Substation	Voltage KV	2015	2023
Beddington 132kV Hurst 132kV			
Bromley Grid 33kV	132/33	1	1
Bromley South	33/11	1	2
Chislehurst	33/11	2	2
Churchfields	33/11	1	2
Dermody Road	33/11	2	2
Eltham Grid	132/11	5	5
Eltham Grid 33kV	132/33	2	2
Eltham High Street	33/11	1	2
Farjeon	33/11	1	1
Forest Hill	33/11	1	1
Sydenham Park	132/11	1	2
Sydenham Park 33kV	132/33	1	1
Winlaton	33/11	2	2

Table 12. Load Indices without Investment

3.4 **Operational and technical restrictions**

No operational restraints have been identified on the Beddington / Hurst Network.

Locations where an incident can cause complete or partial loss of a substation (such as cable bridges, cable tunnels or railway crossings) have been identified.

The following is a list of pinch points in the Beddington Hurst network area.

Greenwich

Shepherdleas Wood Railway Embankment Cable Bridge 0061 TQ 4427575364

Beckenham

Access into Churchfields over brook Cable Bridge 0061 TQ 3602269038

3.5 National Grid

Beddington SGT2A Replacement

National Grid have identified that Beddington SGT2A is due for asset replacement.

Beddington – Hurst

UK Power Networks

All of the cost numbers displayed in this document are before the application of on-going efficiencies and real price effects.

4 **Recommended strategy**

4.1 Asset Replacement

4.1.1 Transformers

Sydenham Park 11kV: Replace Grid Transformers GT1A & GT3A

The condition assessment of the 1960 Hackbridge Hewitt Grid Transformers with Fuller HS tap changers installed at Sydenham Park 132/11kV Grid Substation has shown that the probability of failure due to degradation will become unacceptable. It is not possible to keep these assets in use without compromising operational requirements, therefore this project recommends its replacement.

Completion of the project will see 2 Grid Transformers replaced with 2 new Grid Transformers.

Sydenham Park 33kV: Replace Grid Transformer GT2B

The condition assessment of the 1962 Hackbridge Hewitt Grid Transformer with AEI M52 tap changer installed at Sydenham Park 132/33kV Grid Substation has shown that the probability of failure due to degradation will become unacceptable. It is not possible to keep these assets in use without compromising operational requirements, therefore this project recommends its replacement.

Completion of the project will see 1 Grid Transformer replaced with 1 new Grid Transformer.

4.1.2 Switchgear

Eltham Grid 132kV: Replace 132kV Switchgear

The condition assessment of the 1965 AEI OW410 BULK OIL CBs installed at Eltham Grid has shown that the probability of failure due to degradation will become unacceptable. It is not possible to keep these assets in use without compromising operational requirements, therefore this project recommends its Replacement.

Completion of the project will see 9 circuit breakers replaced with 9 new circuit breakers.

Bromley Grid 33kV: Replace 33kV Switchgear

The condition assessment of the 1965 Reyrolle L42T Oil Switchgear installed at Bromley Grid 33kV has shown that the probability of failure due to degradation will become unacceptable. It is not possible to keep these assets in use without compromising operational requirements, therefore this project recommends its Replacement.

Completion of the project will see 17 circuit breakers replaced with 17 new circuit breakers.

Forest Hill 11kV: Retrofit 11kV Switchgear

The condition assessment of the 1968 AEI QF Oil Switchgear installed at Forest Hill has shown that the probability of failure due to degradation will become unacceptable. It is not possible to keep these assets in use without compromising operational requirements, therefore this project recommends its Refurbishment.

Completion of the project will see 20 circuit breakers replaced with 20 new circuit breakers.

Beddington – Hurst



All of the cost numbers displayed in this document are before the application of on-going efficiencies and real price effects.

4.1.3 Gas Cable

Eltham – Sydenham Park 132kV: Gas Cable Replacement

The condition assessment of the Eltham-Sydenham 132kV gas cable has shown that the probability of failure due to degradation will become unacceptable. It is not possible to keep these assets in use without compromising CI and CML performance, therefore this project recommends the replacement.

Completion of the project will see 19km of 132kV gas cable replaced.

4.1.4 Fluid Filled Cable

Sydenham Park 33kV – Churchfield: 33kV FFC Replacement

The condition assessment of the Sydenham Park 33kV-Churchfield (Circuit 4-A) 33kV fluid filled cable has shown that the probability of failure due to degradation will become unacceptable. It is not possible to keep these assets in use without compromising CI and CML performance, therefore this project recommends the replacement.

Completion of the project will see 2.3km of 33kV fluid filled cable replaced.

Bromley Grid – Hurst 132kV: 132kV FFC Replacement

The condition assessment of the Bromley Grid-Hurst 132kV fluid filled cable has shown that the probability of failure due to degradation will become unacceptable. It is not possible to keep these assets in use without compromising CI and CML performance, therefore this project recommends the replacement.

Completion of the project will see 8.1km of 132kV fluid filled cable replaced.

Beddington – Sydenham Park 132kV: 132kV FFC Replacement

The condition assessment of the Beddington - Sydenham 132kV fluid filled cable has shown that the probability of failure due to degradation will become unacceptable. It is not possible to keep these assets in use without compromising CI and CML performance, therefore this project recommends the replacement.

Completion of the project will see 9.1km of 132kV fluid filled cable replaced.

4.2 Reinforcement

Establish 2 x 66MVA 132/11kV Substation at Eglinton

The load at Eltham Grid 11kV substation currently exceeds the existing firm capacity and regulatory compliance is being maintained by 7MW of transfers to Sewell Rd, Broadway and Eltham High St, the site will no longer be compliant in the winter of 2015/16. There is insufficient space at Eltham Grid 11kV to extend the switchgear. In addition Sewell Road will reach its firm capacity by the end of ED1. Farjeon Road (which supplies the Thames Barrier) is restricted for space and there is no room for extension. The switchgear at Eltham High Street is obsolete and cannot be extended.

It is therefore proposed to establish a new 132/11kV substation at the existing Eglinton site. The switchboard at Eltham Grid 132kV will be extended with 3 GIS panels and two new circuits laid to Eglinton. Eglinton will be equipped with 2 x 66MVA 132/11kV transformers and a 28 panel 2000A, 11kV switchboard. The existing building at Eglinton will need to be removed and a new building established at the site as part of the project. Project 5806 will then transfer load from Eltham Grid 11kV, Eltham High Street, Sewell Road and Farjeon Road to the new Eglinton site.

Completion of this project will see the addition of 2 new 132/11kV 66MVA transformers, 28 panels of 2000A, 11kV switchgear, 3 panels of 132kV GIS and 2 x 2.5 km of new 132kV underground cables from Eltham Grid 132kV.

Based on current forecasts the substation should be commissioned in 2017.

Beddington – Hurst



All of the cost numbers displayed in this document are before the application of on-going efficiencies and real price effects.

Transferring of the 11kV circuits will be carried out under separate 1.34 schemes totalling approximately £1.8m.

Demand Side Response: Eltham Grid

The P2/6 analysis identifies Eltham Grid 11kV as being non-compliant from Winter 2013. The scheme to install a new substation at Eglinton will resolve this non-compliance but it is proposed to install Demand Side Response at Eltham Grid 11kV to minimise the impact of an outage.

4.3 Costs and Phasing

Cat.		Reference	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23
A	1.07.07.8401	Eltham-Sydenham 132kV Gas Cable Replacement	0	0	0	0	0	0	5,648,592	7,531,457	7,531,457	5,648,592
A	1.48.01.7779	Eltham Grid - Replace 132kV Switchgear	0	0	0	0	0	0	393,806	1,015,223	420,944	150,954
A	1.48.02.7783	Bromley Grid 33kV - Replace 33kV Switchgear	0	0	0	0	0	0	0	0	0	428,609
A	1.50.01.7787	Forest Hill - Retrofit 11kV Switchgear	0	0	0	0	0	0	0	0	114,768	195,113
A	1.51.01.7850	Sydenham Park 33kV - Replace Grid Transformer (GT2B)	0	0	0	0	0	0	389,719	1,051,730	0	0
A	1.51.01.7862	Sydenham Park 11kV - Replace Grid Transformers (GT1A, GT3A)	0	0	0	0	76,965	1,541,795	1,541,798	0	0	0
н	1.29.01.7944	Sydenham Park 33kV-Churchfield (Circuit 4-A) - 33kV FFC Replacement	0	0	0	0	0	0	0	236,676	556,967	0
н	1.29.02.7954	Bromley Grid-Hurst (Circuit 1-B-C & Circuit 2 B-C) - 132kV FFC Replacement	0	0	0	0	0	0	0	0	2,847,696	8,390,030
н	1.29.02.7955	Beddington - Sydenham (Circuit 2 A-B) - 132kV FFC Replacement	0	0	0	0	0	3,194,540	4,715,000	4,715,560	0	0
R	1.33.01.4363	Winlaton Road 33/11kV - ITC (add 1x15MVA)	0	0	0	0	0	0	0	0	0	0
R	1.34.02.5806	Eglinton: 11kV Network Reconfiguration	0	0	895,378	800,125	381,012	0	0	0	0	0
R	1.35.07.5799	Eglinton New 132/11kV Substation - (2x66MVA)	117,048	1,769,410	4,114,096	5,711,670	739,641	0	0	0	0	0
R	1.35.05.8559	Demand Side Response at Eltham Grid 11kV	75,000	75,000	75,000	75,000	0	0	0	0	0	0

Table 13. Summary of Proposed Interventions

Substation	Driver	Commissioning Year	Scope of works	New Firm capacity
Eglinton	Reinforcement	2017	Establish new 2x66MVA 132/11kV substation	86MVA (W) 66MVA(S)

Table 14. Planned Reinforcement Projects



Beddington – Hurst

All of the cost numbers displayed in this document are before the application of on-going efficiencies and real price effects.

4.4 HI / LI Improvement

HV Circuit breakers

			2015				2023	with Interve	ention	
Substation	No. HI1	No. HI2	No. HI3	No. HI4	No. HI5	No. HI1	No. HI2	No. HI3	No. HI4	No. HI5
BROMLEY SOUTH		18	3					19	2	
CHISLEHURST		20						20		
CHURCHFIELDS		21	3					24		
DERMODY RD	1	16	4			1		20		
ELTHAM GRID 11KV		28					1	27		
ELTHAM HIGH ST		20					6	14		
FARJEON RD	1	24	2			1	8	17	1	
FOREST HILL			19	1			20			
SYDENHAM PARK 11KV	1	24					9	16		
WINLATON RD		20	4					23	1	
EGLINTON						28				

Table 15. Health Indices of HV Circuit Breakers with Investment

EHV Circuit breakers

			2015				2023	with Interve	ention	
Substation	No. HI1	No. HI2	No. HI3	No. HI4	No. HI5	No. HI1	No. HI2	No. HI3	No. HI4	No. HI5
BROMLEY GRID 33KV		11	6			17				
ELTHAM GRID 33KV		10	3			4	2	11		
SYDENHAM PARK 33KV		17	2				2	16		1

Table 16. Health Indices of EHV Circuit Breakers with Investment

132kV Circuit Breakers

			2015				2023	with Interv	ention	
Substation	No. HI1	No. HI2	No. HI3	No. HI4	No. HI5	No. HI1	No. HI2	No. HI3	No. HI4	No. HI5
BROMLEY GRID 132KV			2					2		
ELTHAM GRID 132KV	4	1	8			12	4			
SYDENHAM PARK 132KV		2						2		

Table 17. Health Indices of 132kV Circuit Breakers with Investment



Beddington – Hurst

All of the cost numbers displayed in this document are before the application of on-going efficiencies and real price effects.

Primary Transformers

			2015					2023		
Substation	No. HI1	No. HI2	No. HI3	No. HI4	No. HI5	No. HI1	No. HI2	No. HI3	No. HI4	No. HI5
BROMLEY SOUTH		4					4			
CHISLEHURST		4					4			
CHURCHFIELDS		4					4			
DERMODY RD		3					1	2		
ELTHAM HIGH ST		3					2	1		
FARJEON RD		4						4		
FOREST HILL		3						3		
WINLATON RD		4					4			

Table 18. Health Indices of Primary Transformers with Investment

Grid Transformers

			2015				2023	with Interv	ention	
Substation	No. HI1	No. HI2	No. HI3	No. HI4	No. HI5	No. HI1	No. HI2	No. HI3	No. HI4	No. HI5
BROMLEY GRID 33KV		4						4		
ELTHAM GRID 11KV		2	2					4		
ELTHAM GRID 33KV		3				1		3		
SYDENHAM PARK 11KV		2	1	1		2	1	1		
SYDENHAM PARK 33KV		2	2			1	1	2		
EGLINTON 11KV						2				

 Table 19. Health Indices of Grid Transformers with Investment

FFC Sections

			2015				2023	with Interve	ention	
Substation	No. HI1	No. HI2	No. HI3	No. HI4	No. HI5	No. HI1	No. HI2	No. HI3	No. HI4	No. HI5
BEDDINGTON-SYDENHAM PARK 33KV		1	1		2	0		1	1	
BROMLEY GRID 132KV-HURST 132KV		4	3		1	0	2	4		
BROMLEY GRID 33KV-BROMLEY SOUTH		4					4			
BROMLEY GRID 33KV-CHISLEHURST		9	3				8	3	1	
ELTHAM GRID 132KV-BROMLEY GRID 132KV		3	1				1	3		
ELTHAM GRID 132KV-ELTHAM GRID 33KV			1					1		
ELTHAM GRID 132KV-RESERVE BAR		1	2				1	2		
ELTHAM GRID 33KV –ELTHAM HIGH ST		4					4			
HURST 132KV-ELTHAM GRID 132KV		1					1			
SYDENHAM PARK 33KV-CHURCHFIELDS		7	2	1		0	3	6		
SYDENHAM PARK 33KV-FOREST HILL		8					8			
SYDENHAM PARK 33KV-WINLATON RD		11	1				2	9	1	

Table 20. Health Indices of Fluid Filled Cables with Investment



Beddington – Hurst

All of the cost numbers displayed in this document are before the application of on-going efficiencies and real price effects.

Fluid filled cables are replaced with solid cables, so their HI value is no longer calculated and is shown here as being 0.

Gas Cables

	2015			2023						
Circuit Name Containing Section	No. HI1	No. HI2	No. HI3	No. HI4	No. HI5	No. HI1	No. HI2	No. HI3	No. HI4	No. HI5
ELTHAM GRID 132KV – SYDENHAM 132KV				19		0				

Table 21. Health Indices of EHV Gas Cables (km)

LI Profile (Post Intervention)

Substation	Voltage	2023 Load Index			
Substation	kV	Without	With		
		Investment	Investment		
Beddington 132kV Hurst 132kV					
Bromley Grid 33kV	132/33	1	1		
Bromley South	33/11	1	2		
Chislehurst	33/11	2	2		
Churchfields	33/11	2	2		
Dermody Road	33/11	2	2		
Eltham Grid	132/11	5	1		
Eltham Grid 33kV	132/33	2	1		
Eltham High Street	33/11	1	1		
Farjeon	33/11	1	1		
Forest Hill	33/11	1	1		
Sydenham Park	132/11	1	2		
Sydenham Park 33kV	132/33	1	1		
Winlaton	33/11	2	2		
Eglinton	132/11	N/A	1		

Table 22. Load Indices with Investment



Beddington – Hurst

All of the cost numbers displayed in this document are before the application of on-going efficiencies and real price effects.

5 Alternatives Strategies

5.1 Use AIS at Eltham 132 for supplying new Eglinton Substation

Approximate Costs: £11.7m

The proposed project includes extending the 132kV system at Eltham Grid via 5 new GIS panels, this option would specify AIS instead due to its being significantly cheaper than the modern GIS equivalent. However, it has been rejected as there is insufficient space at Eltham Grid 132 for this much larger switchgear.

5.2 Establish a new 2 x 66MVA Belvedere Substation

Approximate Costs: £16.7m

This scheme would alleviate the load problems in the Sewell Road area but would provide no relief for the Eltham substations. The Eglinton project will alleviate load issues for both, therefore, the Belvedere project can be deferred for a number of years to beyond the ED1 period.



Beddington – Hurst

All of the cost numbers displayed in this document are before the application of on-going efficiencies and real price effects.

6 References

References	Description
Reference 1	Planning Load Estimates LPN Area 2011 – 2023 (27 February 2013)
Reference 2	Primary Distribution Systems Standard Running Arrangements 2012 Overview Diagrams
Reference 3	NAMP LPN Table J Less Ind 19 th February 2014
Reference 4	A.R.P. Model July 2013
Reference 5	Engineering Recommendation P2/6

6.1 Appendices

Appendix	Description
Appendix A	Geographical diagram
Appendix B	Single Line Diagram – Existing Network
Appendix C	Single Line Diagram – Recommended Strategy

6.2 **Document History**

Version	Date of Issue	Author	Details
1.0	December 2012	Sharon Green	Draft for review
1.1	25 th June 2013	Sharon Green	PA Consulting comments included
2.0	20 th Feb 2014	Martin Jones	Updated costs according to 12th Feb NAMP
2.1	12 th March 2014	Sharon Green	Updated costs and projects according to 19 th Feb NAMP
2.2	20 th March 2014	Sophie Motte	Changed format and font



Beddington – Hurst

All of the cost numbers displayed in this document are before the application of on-going efficiencies and real price effects.

7 Document sign off

Sign-off of this Mandate certifies that the Sponsor has ratified the above and approval is sought to proceed to the development of the necessary PG&C Gate B documentation.

Recommended by:

Name	Role	Signature	Date
Sharon Green	Infrastructure Planner		
Sophie Motte	IDP Coordinator (LPN)		
Chris Winch	Planning Manager (South)		

Approval by:

Name	Role	Signature	Date
Robert Kemp	Head of System Development	Robert Kemp	
Barry Hatton	Director of Asset Management		

Beddington – Hurst

APPENDIX A: GEOGRAPHICAL DIAGRAM







Beddington – Hurst

APPENDIX B: SINGLE LINE DIAGRAM – EXISTING NETWORK

Hurst to Bromley Grid 132kV



Beddington – Hurst

Eltham Grid 132kV







Beddington – Hurst

Beddington to Sydenham Park 132kV





Beddington – Hurst

APPENDIX C: SINGLE LINE DIAGRAM – RECOMMENDED STRATEGY

New 2 x 132/11 66MVA Eglinton Substation



Regional Development Plan





Beddington – Hurst

Eltham Grid 33kV – 4 x 132/33kV 45MVA Substation



Page 34 of 34