



Title: Kingsnorth

SPN Regional Development Plan

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

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1 Introduction

1.1 Executive Summary

This Regional Development Plan (RDP) reviews UK Power Networks (UKPN) (SPN) HV and EHV network supplied from Kingsnorth Grid Supply Point. The plan forms the basis for investment to support replacement of assets and to reinforce the network to cater for increased demand criteria.

The areas covered by these distribution assets are geographically condensed and comprise the Hoo peninsular and the Eastern Medway towns of Chatham and Strood. A mesh substation at Medway supplies the balance of the Medway towns demand via the 33kV distribution system. The system comprises predominantly underground cable assets at 132kV with mixed underground cables and overhead lines at 33kV.

Within the GSP area of supply there are two grid substations at Chatham and Medway. These supply a further fifteen primary substations. Of these seventeen substations, it is predicted that fourteen will have equipment that reaches Health Index 4 or 5 within the review period. These will require interventions to replace network equipment, or refurbishment to increase the lifespan.

It is further noted that two substations are predicted to exceed firm capacity within the study period, thus requiring reinforcement interventions.

From the regional development plans circulated by local and country councils, it has been noted that 5600 new dwellings will be built in the next ten years. Although these will be subject to the usual connection arrangements, it is anticipated that further network reinforcement will be required to sustain this development and the expected increased demand of 14MW, especially to the EHV system.

There are two large embedded generation assets in the area, both of which are associated with paper mills. These are at Townsend Hook and Medway and have a total output of 96MW. These are run at base load providing process steam/heat and electrical power. In total 105.5MW of generation is embedded within the UKPN network fed by Kingsnorth GSP

With the substation being located close to the coast it is envisaged that additional renewable generation will be connected; whilst the majority will be connected to the super-grid system operated by National Grid, some onshore generation may be connected to the SPN system.

The Thames Estuary has seen a huge increase in the connection of offshore wind farms, and it is likely that further renewable energy generation will be connected in the near future, to support the governments and industry's low carbon targets. Further wind farms and tidal generation facilities are expected to be connected. The region also has a high solar energy density and it is envisaged that new solar farms will be connected into the distribution network.

The system generally has high fault level in-feeds with the many of the substations having split running arrangements to ensure that equipment remains within their fault level rating. This will only be exacerbated by the expected connection of new renewable energy generation to the distribution network.

There is limited interconnection between the two GSP's of Kingsnorth and Northfleet East. However these two are normally operated split to avoid pre and post fault through flows affecting the UKPN network.

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Figure 1: General GSP area of supply

1.2 Proposed projects >£1M

Asset Replacement:

- Chatham Hill Primary - Replace 11KV Switchgear £1.5m
- Kingsnorth Grid-Strood 132kV FFC Replacement (Circuit 2-3) £2.6m

1.3 Costs profile

Table 1 below provides the forecast aggregate NAMP cost for network expenditure under this RDP during the last two years of DPCR5 and the ED1 period subject to project feasibility studies and final approval.

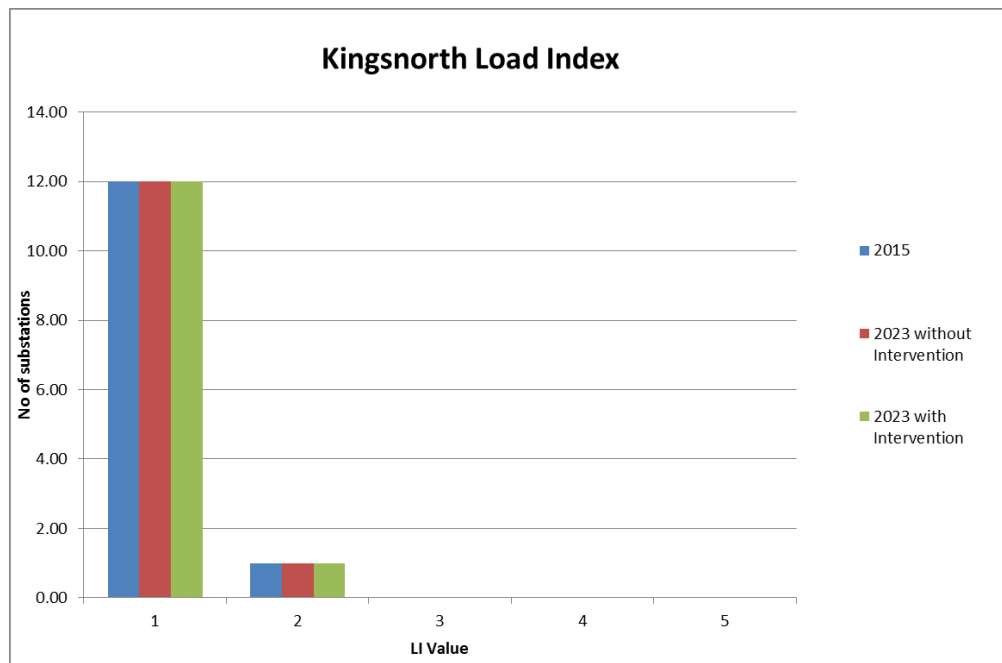
SR_Table J - S&R - Baseline_Final ED1 Re-submission_19th February 2014_15:15 (£)												
Description	2013/2014	2014/2015	2015/2016	2016/2017	2017/2018	2018/2019	2019/2020	2020/2021	2021/2022	2022/2023	DPCR5 Total	ED1 Total
A & H Total Asset Replacement	99,325	0	0	577,102	1,756,286	1,026,119	253,711	89,349	644,317	1,932,952	99,325	6,279,836
Q & R Total Reinforcement	148,723	0	0	0	0	0	0	0	0	0	148,723	0
Grand Total	248,048	0	0	577,102	1,756,286	1,026,119	253,711	89,349	644,317	1,932,952	248,048	6,279,836

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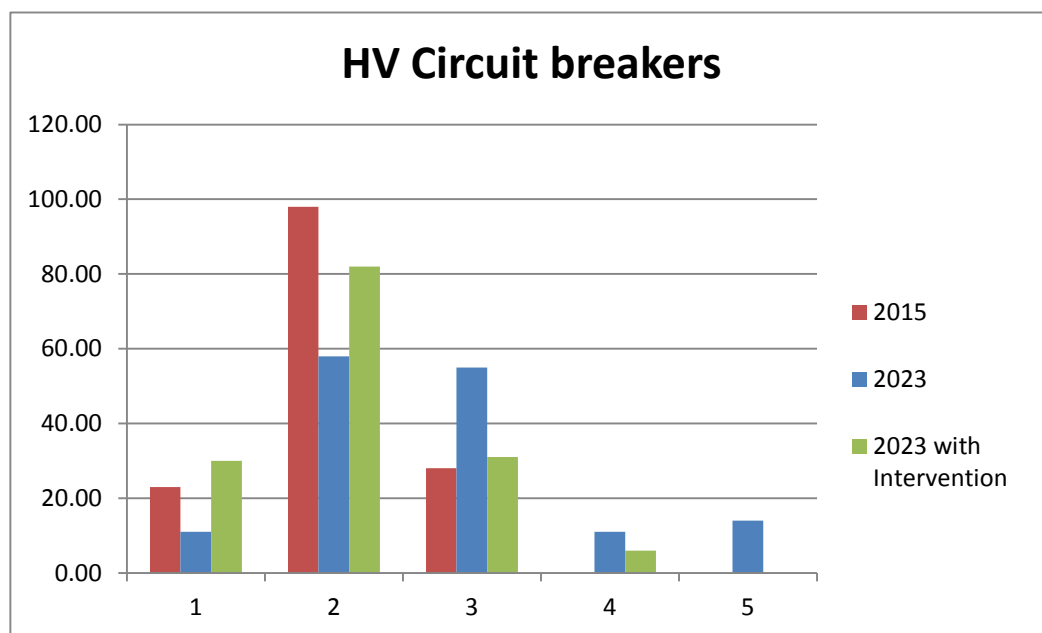
1.4 Output Measures Load Index

The chart below provides the expected Load Indices in 2015 and then again in 2023 both with and without interventions for all substations covered in this RDP.



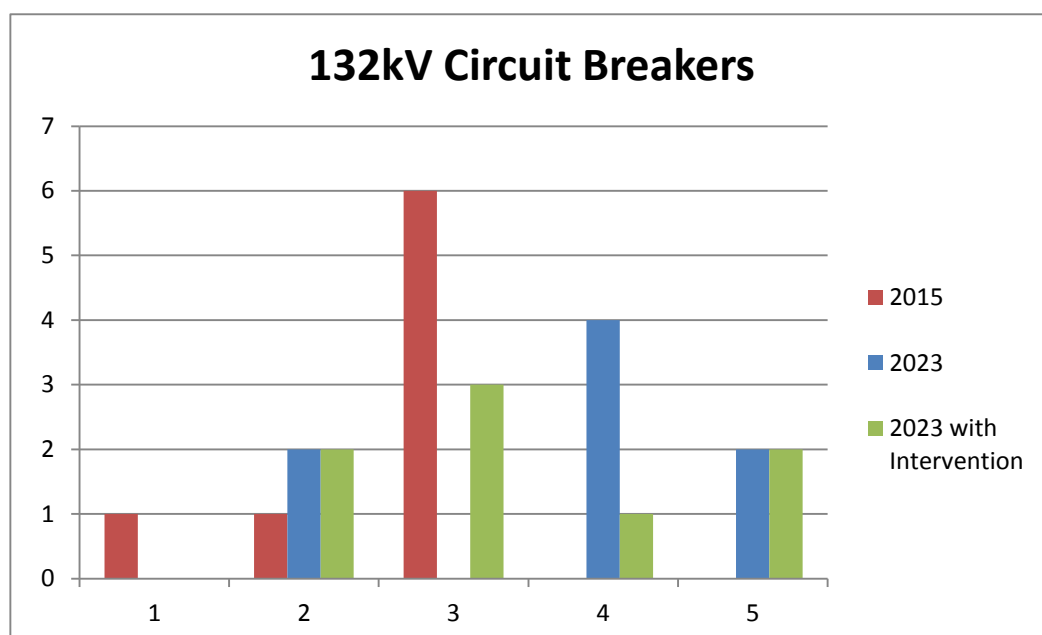
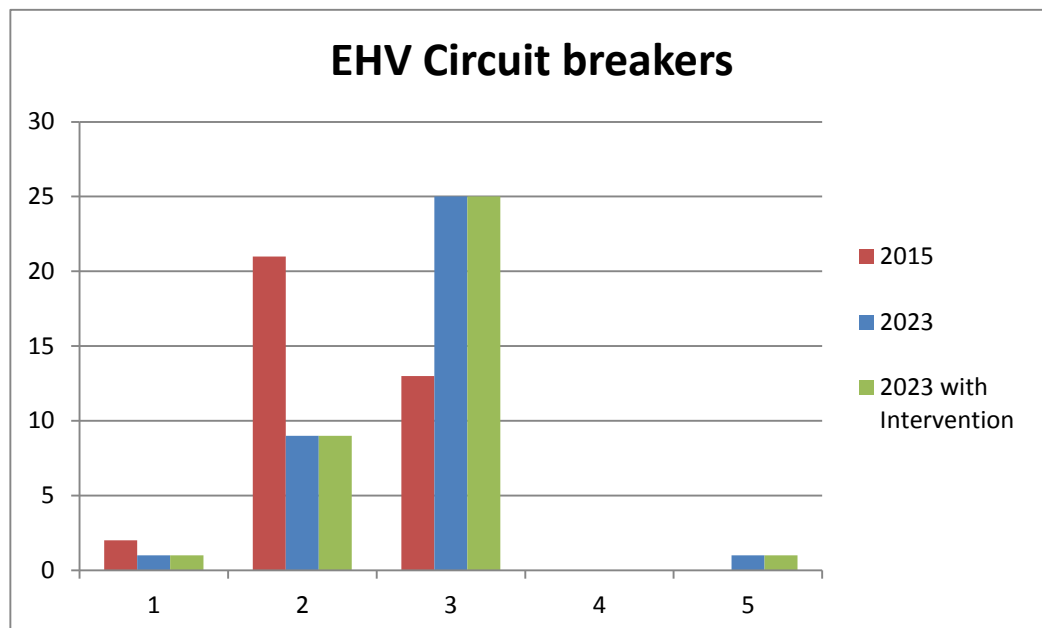
1.5 Output Measures Health Index

The charts below provide the projected health index status of various assets covered in this RDP by 2023. Without interventions it is predicted that there will be 10 substations with HI5 apparatus by the year 2024.

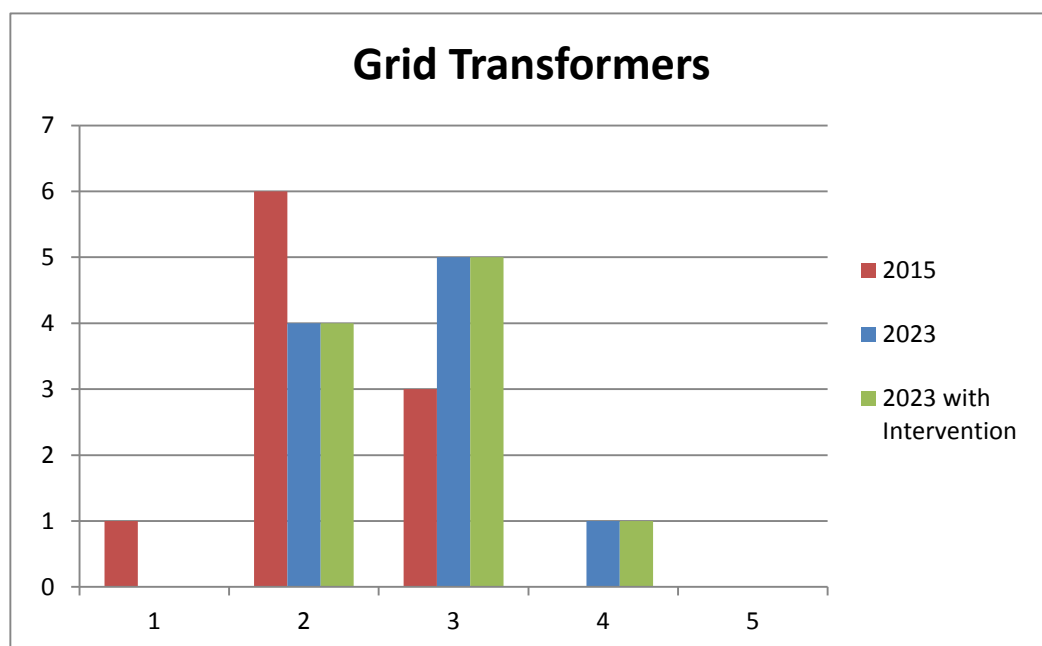
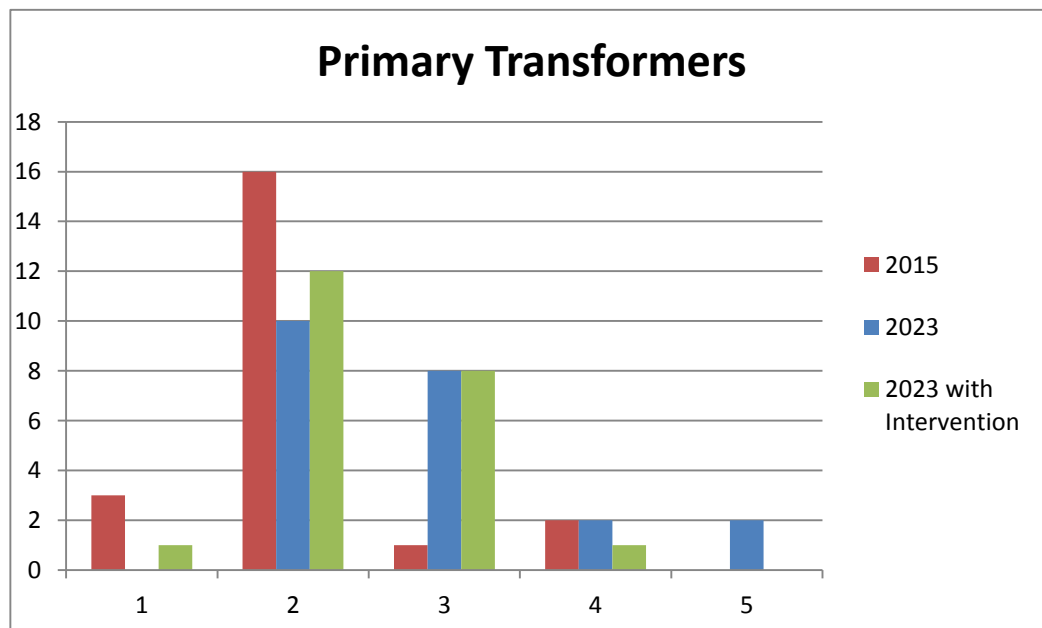


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1.6 Principal Risks and Dependencies

The schemes covered in this RDP have been planned based on the planning load estimates 2013 with the 2011/12 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.

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2 Network configuration

2.1 Existing Network

The Kingsnorth supply area is centred along the River Medway estuary including the towns of Strood, Chatham and Dickensian Rochester. It is supplied by 2x240MVA super grid transformers located at Kingsnorth 400/132kV grid supply point (GSP).

From Kingsnorth 132kV circuits connect to Strood, Chatham and Medway with interconnection available via Burham to the adjacent Northfleet, Kemsley and Canterbury GSP's (a geographical diagram is shown in Appendix A).

The aggregated group demand is 210MW which is forecast to increase to 248MW by 2023 (August 2012 PLE refers).

Figure 2: Aerial view of Kingsnorth 132kV Substation (top centre)



The group substation hierarchy is detailed in Table 2, below:

Table 2. Group Substations

Substation & Voltage	
Kingsnorth 132kV Kingsnorth 132/11kV Strood 132/11kV	Medway 132kV Medway 132/33kV Cobham (Kent) 33/11kV Chatham West 33/11kV Townsend Hook 33/6.6kV Wrotham Heath 33/11kV Medway Local 33/11kV Halling 33/11kV
Chatham 132kV Chatham Grid 132/33kV Chatham Hill 33/11kV Rainham Mark 33/11kV Lordswood 33/11kV	

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Kingsnorth 132kV

Kingsnorth 132kV GSP is an indoor AIS (air insulated substation) located within the ex-Kingsnorth Power Station boundary. It is a wrap-around double busbar configuration equipped with Reyrolle OBYR14 circuit breakers. National Grid owns a number of spare bays that were previously utilised for power station service supplies.

Strood 132kV & Chatham 132/33kV

From Kingsnorth, double circuit cable connections are routed to Strood Primary equipped with 2x 60MVA double wound 132/11kV transformers and Chatham Grid equipped with 2x 90MVA 132/33kV transformers.

Chatham Grid supplies three 33/11kV primary substations at Chatham Hill, Rainham Mark and Lordswood.

Medway 132/33kV

The two 132kV feeders from Kingsnorth connect to a three switch mesh with each corner supplying two banked 45MVA 132/33kV transformers with a third transformer, rated at 60MVA, supplying generation at a local Paper Mill.

Medway 33kV switchboard consists of a Reyrolle L42 double-busbar configuration equipped with one bus section and two bus coupler circuit breakers. The site is normally operated with the bus coupler open to maintain fault levels within the equipment ratings. An auto-close facility is installed to maintain supplies for an (n-1) condition.

Medway Grid supplies six primary 33/11kV substations including the Halling, the new replacement for Rugby.

2.2 Embedded Generation (G59/2)

There is a total of 105MVA of G59/2 embedded generation within group with the principal contribution from Medway Power Station and Townsend Hook Paper Mill, detailed in Table 5, below.

Table 3. List of G59/2 Embedded Generators Connected to the Network covered by this RDP

Site Name	Type	Mode of Operation	Installed DG (MW)	No. of Generators	Operating Voltage (kV)	Substation Name	Grid Group	GSP/BSP
WHITE LADIES	Landfill gas	LONG TERM PARALLEL	1.200	1	11.000	Medway 11kV	Medway Grid	Kingsnorth SGT
OFFHAM QUARRY LANDFILL SITE	Landfill gas	LONG TERM PARALLEL	2.000	1	11.000	Medway 11kV	Medway Grid	Kingsnorth SGT
AYLESFORD PAPER MILLS PHS 3 (SCA AYLESFORD)	CHP	LONG TERM PARALLEL	43.000	1	33.000	Medway Grid	Medway Grid	Kingsnorth SGT
AYLESFORD PAPER MILLS PHS 2 (SCA AYLESFORD)	CHP	LONG TERM PARALLEL	20.000	1	33.000	Medway Grid	Medway Grid	Kingsnorth SGT
AYLESFORD PAPER MILLS PHS 1 (SCA AYLESFORD)	CHP	LONG TERM PARALLEL	38.340	1	33.000	Medway Grid	Medway Grid	Kingsnorth SGT
PAPER MILL	CHP	LONG TERM PARALLEL	56.000	1	33.000	Medway 11kV	Medway Grid	Kingsnorth SGT
BURNHAM TREATMENT WORKS	Biogas	LONG TERM PARALLEL	1.700	1	11.000	Medway 11kV	Medway Grid	Kingsnorth SGT
HAM HILL WTW	Diesel	LONG TERM PARALLEL	0.342	1	11.000	Townsend Hook 6.6kV	Medway Grid	Kingsnorth SGT
SHAKESPEARE FARM	Diesel	LONG TERM PARALLEL	0.330	1	11.000	Kingsnorth 11kV	Kingsnorth Grid	Kingsnorth SGT
MEDWAY MARITIME HOSPITAL	CHP	LONG TERM PARALLEL	1.400	1	11.000	Chatham Hill 11kV	Chatham Grid	Kingsnorth SGT
KINGSFERRY COACH STATION	PV	LONG TERM PARALLEL	0.050	1	0.400	Rainham Mark 11kV	Chatham Grid	Kingsnorth SGT
RSPB	PV	LONG TERM PARALLEL	0.006	2	0.230	Strood 11kV	Strood Grid	Kingsnorth SGT
EXTRA CARE BLOCK, FLATS 1-41, BELLEROPHON HSE	PV	LONG TERM PARALLEL	0.020	2	0.400	Chatham West 11kV	Medway Grid	Kingsnorth SGT

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2.3 Projects in Progress

DPCR5 Projects in Progress There are two Reinforcement Projects; 3047 and 3099 outlined below:

Table 4. NAMP Extract for DPCR5 Kingsnorth Projects

Project ID	Description	2013/2014	2014/2015	2015/2016
8469	Kingsnorth Grid 132kV: ABCB Refurbishment	99,325	0	0
3047	Halling Primary (Replacement for Rugby Substation) - Relocation & Increased Capacity	5,403	0	0
3099	Medway - Burham - 132kV Interconnector	143,320	0	0

Scheme 8469: Kingsnorth Grid 132kV: ABCB Refurbishment

Kingsnorth Grid 132kV is a shared site with National Grid supplied by 2 x 240MVA transformers via the National Grid owned busbars. There are four UK Power Networks 132kV circuit breakers installed at the site with a fifth currently being installed to feed a new 132/11kV transformer at the new Kingsnorth Grid 11kV site. Of the four circuit breakers one was recently replaced in 2010.

The three remaining breakers are all Reyrolle OBYR air blast circuit breakers. There have been numerous failures of Reyrolle OB/OBYR type CB nationally as well as within UK Power Networks. Four main potential failure modes have been identified in examination of post failure investigations and all result through long term degradation of some element of the overall CB structure or components.

The aim of this project is to refurbish the three Reyrolle OBYR air blast circuit breakers at Kingsnorth substation.

Scheme 3047: Establish Halling Primary

This project involves relocation of Rugby primary substation to a new location at Halling together with associated asset replacement and reinforcement. The timing of the work was initiated by termination of the existing site to facilitate the landowner to redevelop his site

The existing Rugby Local 33/11kV transformers are equipped with obsolete tap changers which do not have remote control facilities and are required to be replaced due to deteriorating condition. Furthermore the demand is forecast to exceed firm capacity and it is therefore necessary to increase the rating of the replacement transformers and replace the switchboard to remove a continuous rating constraint.

Halling Primary is now commissioned with only minor remedial works outstanding.

Scheme 3099: Route PE - Establish permanent 132kV double circuit OHL connection between Medway and Burham

Medway is supplied at 132kV from Strood and Burham via single circuit cable and overhead line (Route PE) connections respectively. Route PE is 132kV double circuit construction with 1 circuit operated at 132kV and the other at 33kV.

Under abnormal operating conditions it is possible to re-jumper the tower line connections to operate both circuits at 132kV thereby providing additional support to Medway. Due to the switching and physical re-connections this contingency takes approximately 12 hours to implement. It has been utilised three times in the last five years following third party damage to the cables from Kingsnorth GSP. This project is designed to upgrade the contingency arrangement to become a fully switchable connection.

To achieve this it is proposed to transfer the 33kV circuit from Route PE to the redundant ex-Reeds No3 33kV cable connection and permanently reconfigure the tower line 'jumpers' to establish a 132kV double circuit connection between Burham and Medway.

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3 Network Development Considerations

3.1 District / Local Development Plans

The majority of the Kingsnorth network is contained within Medway Council boundary.



The Medway Local Development Framework identifies Lodge Hill and Chattenden on the Hoo peninsular as locations for new housing development with a combined forecast of up to 5,000 domestic units. Another area identified for redevelopment is the disused Halling Cemex cement factory at Halling where provision for 624 residential units is proposed.

It is recognised that timescales for these developments will be influenced by economic factors however the Local Development Framework forecasts a peak of housing delivery between 2015 and 2021.

The Medway Local Development Framework quotes the 2010 population as 255,000 for the year 2010, with a predicted increase of 25,000 to 280,000 by the year 2028.

Table 5. Forecast housing increase

Area	Dwellings	Average increase in MW	Substation
Chattenden	5000	12.5	Strood
Halling	624	1.6	Halling
Total	5624	14	

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3.2 Asset Health

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

The existing and forecast health indices 2015-2023 without intervention are detailed below:

Table 6. HV Circuit breakers

Substation	2015					2023				
	No. HI1	No. HI2	No. HI3	No. HI4	No. HI5	No. HI1	No. HI2	No. HI3	No. HI4	No. HI5
CHATHAM HILL 33/11KV		5	14				5			14
CHATHAM WEST	1	23	4			1		24	3	
COBHAM (KENT) 33/11KV		7	1					7	1	
HALLING 33/11KV	9					9				
KINGSNORTH GRID 11KV			5						5	
KINGSNORTH GRID 132/11KV			1						1	
LORDSWOOD 33/11KV	9						9			
MEDWAY LOCAL 33/11KV		7	3					9	1	
RAINHAM MARK 33/11KV	3	10				1	12			
STROOD 132 KV		4					4			
STROOD 132/11KV		25					25			
TOWNSEND HOOK 33/6.6KV		8					2	6		
WROTHAM HEATH 33/11KV	1	9				1	9			

Table 7. 33kV Circuit breakers

Substation	2015					2023				
	No. HI1	No. HI2	No. HI3	No. HI4	No. HI5	No. HI1	No. HI2	No. HI3	No. HI4	No. HI5
CHATHAM GRID 132 KV		2					2			
CHATHAM GRID 33 KV	2	8				1	2	7		
MEDWAY GRID 132 KV		5					1	4		
MEDWAY GRID 33KV		6	13				4	14		1

Table 8. 132kV Circuit Breakers

Substation	2015					2023				
	No. HI1	No. HI2	No. HI3	No. HI4	No. HI5	No. HI1	No. HI2	No. HI3	No. HI4	No. HI5
KINGSNORTH 132 KV	1		3				1		3	
MEDWAY GRID 132 KV		1	3				1		1	2

Table 9. Primary Transformers

Substation	2015					2023				
	No. HI1	No. HI2	No. HI3	No. HI4	No. HI5	No. HI1	No. HI2	No. HI3	No. HI4	No. HI5
CHATHAM HILL 33/11KV	1	2					2	1		
CHATHAM WEST		4						4		
COBHAM (KENT) 33/11KV		2					2			
HALLING 33/11KV	2						2			
LORDSWOOD 33/11KV		2					1		1	
MEDWAY LOCAL 33/11KV		2						2		
RAINHAM MARK 33/11KV		1	1	1			1		1	1
TOWNSEND HOOK 33/6.6KV		1		1				1		1
WROTHAM HEATH 33/11KV		2					2			

Table 10. Grid Transformers

Substation	2015					2023				
	No. HI1	No. HI2	No. HI3	No. HI4	No. HI5	No. HI1	No. HI2	No. HI3	No. HI4	No. HI5
CHATHAM GRID 132 KV		2					2			
KINGSNORTH GRID 132/11KV	1						1			
MEDWAY GRID 132 KV		2	3				1	3	1	
STROOD 132 KV		2						2		

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Kingsnorth

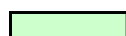
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3.3 Security of supply and load index analysis

Table 11. P2/6 Assessment Table

Sub-station	P2/6	Secondary Voltage	Firm Capacity (MW)	Transfer (MW)	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)
Chatham Grid	YES	33kV	113.20	0.00	65.90	65.89	66.18	66.55	66.92	66.99	67.09	67.19	67.31	67.78	68.24
Chatham Grid	YES	33kV	89.10	0.00	51.13	51.10	51.34	51.65	51.96	52.01	52.09	52.17	52.26	52.62	52.97
Chatham Hill	YES	11kV	45.10	0.00	32.54	32.43	32.39	32.40	32.45	32.48	32.52	32.57	32.62	32.88	33.13
Chatham Hill	YES	11kV	32.40	0.00	23.05	22.95	22.90	22.91	22.94	22.96	22.99	23.02	23.06	23.23	23.40
Chatham West	YES	11kV	55.86	0.00	41.81	41.65	41.58	41.58	41.65	41.68	41.73	41.79	41.86	42.22	42.55
Chatham West	YES	11kV	55.86	0.00	34.80	34.64	34.57	34.57	34.62	34.65	34.69	34.74	34.79	35.08	35.35
Cobham (Kent)	YES	11kV	13.00	0.00	7.80	7.84	7.99	8.16	8.30	8.33	8.36	8.39	8.43	8.54	8.65
Cobham (Kent)	YES	11kV	9.70	0.00	3.93	3.95	4.02	4.10	4.17	4.18	4.20	4.22	4.23	4.29	4.34
Halling	YES	11kV	23.00	0.00	5.75	5.75	5.75	5.75	5.75	5.75	5.75	5.75	5.75	5.75	5.75
Halling	YES	11kV	17.30	0.00	5.23	5.23	5.23	5.23	5.23	5.23	5.23	5.23	5.23	5.23	5.23
Kingsnorth	NO	11kV	6.30	0.00	7.98	7.99	8.03	8.08	8.13	8.14	8.16	8.18	8.20	8.25	8.29
Kingsnorth	NO	11kV	3.80	0.00	5.49	5.50	5.52	5.55	5.58	5.59	5.60	5.61	5.62	5.65	5.68
Kingsnorth SGT	YES	400kV	276.50	0.00	200.21	200.26	201.39	202.78	204.14	204.38	204.72	205.09	205.51	207.08	208.61
Kingsnorth SGT	YES	400kV	244.20	0.00	144.30	144.23	145.02	146.03	147.01	147.19	147.43	147.69	147.99	149.11	150.21
Lordwood	YES	11kV	22.90	0.00	9.62	9.62	9.62	9.62	9.62	9.62	9.62	9.62	9.62	9.62	9.62
Lordwood	YES	11kV	22.90	0.00	6.94	6.94	6.94	6.94	6.94	6.94	6.94	6.94	6.94	6.94	6.94
Medway 132kV	NO	132kV	0.00	0.00	86.98	87.13	87.97	88.92	89.78	89.90	90.05	90.23	90.43	91.17	91.91
Medway 132kV	NO	132kV	0.00	0.00	62.83	62.89	63.45	64.12	64.73	64.80	64.91	65.03	65.18	65.71	66.23
Medway Grid	YES	33kV	168.50	0.00	86.25	86.40	87.23	88.18	89.05	89.16	89.32	89.49	89.70	90.44	91.17
Medway Grid	YES	33kV	129.60	0.00	62.83	62.89	63.45	64.12	64.73	64.80	64.91	65.03	65.18	65.71	66.23
Medway Local	YES	11kV	21.90	0.00	11.90	12.11	12.69	13.29	13.79	13.84	13.91	13.98	14.06	14.28	14.51
Medway Local	YES	11kV	16.56	0.00	8.78	8.93	9.35	9.78	10.15	10.19	10.23	10.28	10.34	10.50	10.67
Medway Scottish Hydro	NO	132kV	19.20	0.00	30.43	30.43	30.43	30.43	30.43	30.43	30.43	30.43	30.43	30.43	30.43
Medway Scottish Hydro	NO	132kV	19.20	0.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00
Medway Townsend Hook Wrotham Group	YES	kV	34.70	0.00	18.76	18.82	19.01	19.20	19.35	19.36	19.37	19.38	19.40	19.46	19.52
Medway Townsend Hook Wrotham Group	YES	kV	34.70	0.00	13.22	13.28	13.45	13.63	13.78	13.79	13.80	13.81	13.83	13.89	13.95
Rainham Mark	YES	11kV	46.56	0.00	23.42	23.51	23.85	24.22	24.54	24.58	24.63	24.69	24.76	24.98	25.19
Rainham Mark	YES	11kV	34.92	0.00	19.73	19.81	20.08	20.38	20.64	20.68	20.72	20.77	20.83	21.00	21.18
Strood 132/11	YES	11kV	74.10	0.00	37.58	37.48	37.45	37.48	37.57	37.61	37.68	37.76	37.84	38.15	38.45
Strood 132/11	YES	11kV	57.00	0.00	27.14	27.03	27.01	27.03	27.09	27.12	27.17	27.22	27.28	27.50	27.71
Townsend Hook	YES	6.6kV	14.40	0.00	5.51	5.57	5.76	5.95	6.11	6.12	6.13	6.14	6.16	6.22	6.28
Townsend Hook	YES	6.6kV	10.60	0.00	5.41	5.47	5.64	5.83	5.98	5.99	6.00	6.01	6.02	6.08	6.15
Wrotham	YES	11kV	16.60	0.00	13.84	13.84	13.84	13.84	13.84	13.84	13.84	13.84	13.84	13.84	13.84
Wrotham	YES	11kV	13.00	0.00	7.90	7.90	7.90	7.90	7.90	7.90	7.90	7.90	7.90	7.90	7.90

Key



Compliant with P2/6



Approaching limit of P2/6 compliance

Table 12. LI Profile

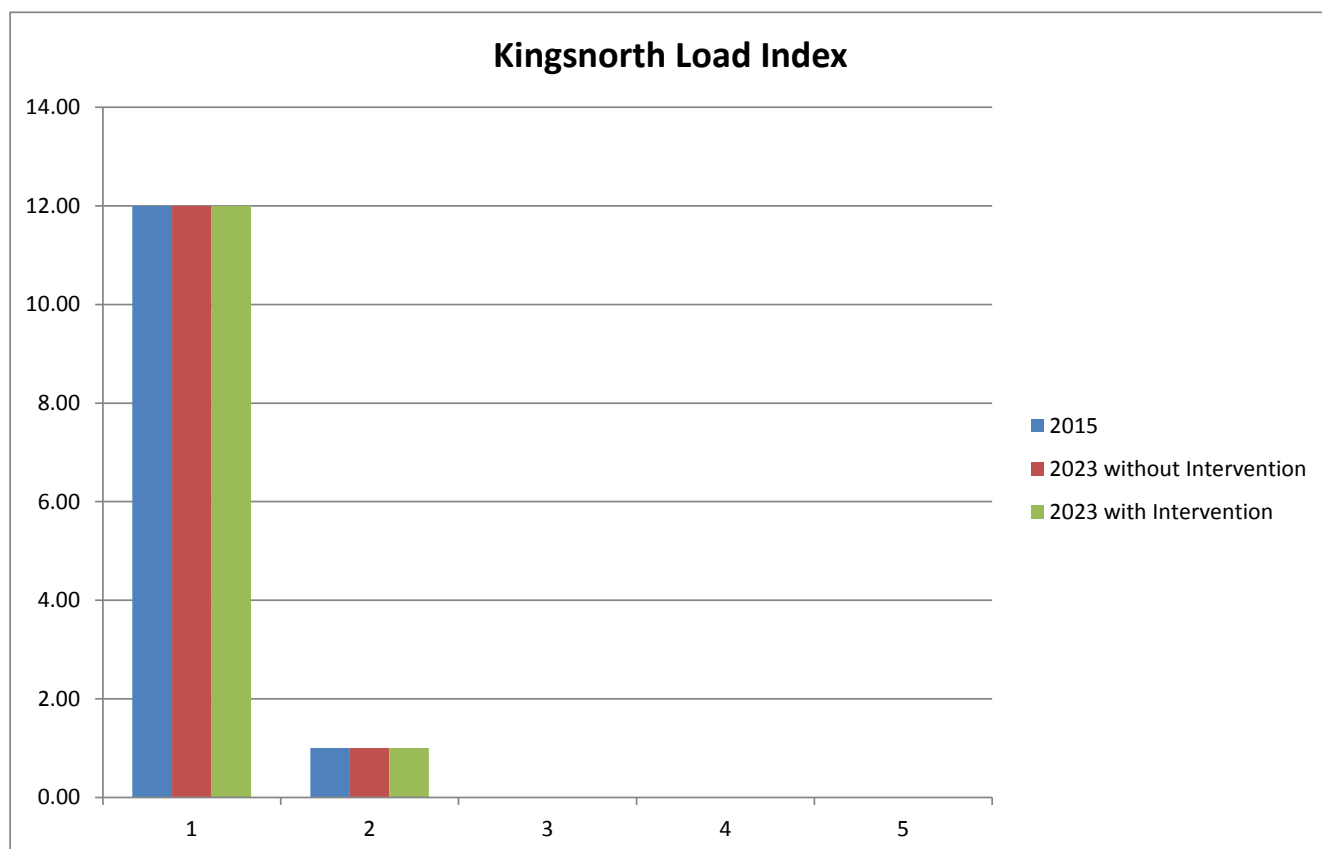
Kingsnorth

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

LI Profile (Without Intervention)

Substation	Voltage kV	Load Index	
		2015	2023
Kingsnorth 132kV			
Kingsnorth 132/11kV	11	1	1
Strood 132/11kV	11	1	1
Chatham Grid 132/33kV	33	1	1
Chatham Hill 33/11kV	11	1	1
Rainham Mark 33/11kV	11	1	1
Lordswood 33/11kV	11	1	1
Medway Grid 132/33kV	33	1	1
Cobham (Kent) 33/11kV	11	1	1
Chatham West 33/11kV	11	1	1
Townsend Hook 33/6.6kV	6.6	1	1
Wrotham Heath 33/11kV	11	2	2
Medway Local 33/11kV	11	1	1
Halling 33/11kV	11	1	1

Table 13. Forecast LI Profile without intervention



3.4 Operational and technical restrictions

No operational or technical restrictions have been identified.

Kingsnorth

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3.5 National Grid

There is no scheduled works at Kingsnorth 400kV substation with the National Grid Seven Year Statement identifying one major infrastructure project in the Kent area which is the re-conductoring of the Canterbury - Sellindge overhead line during 2013.

The RWE Kingsnorth Power Station may be decommissioned during ED1, Should this occur, UK Power Networks would become the 'sole user' of the 132kV substation and it is expected that ownership of the building and electrical equipment would be transferred from National Grid to UK Power Networks.

3.6 Network Constraints

There is a 132kV cable constraint cited for this group associated with circuits crossing north and south drains on the Kingsnorth site.

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

4 Recommended strategy

The recommended network strategy for the network is designed to ensure:

- Continued adherence to security of supply criteria defined in Engineering recommendation P2/6
- Maintaining reliable network operation by replacement or refurbishment of poorly performing equipment or assets approaching the end of their operational life identified by the use of condition monitoring (HI) techniques

Wherever possible, reinforcement and asset replacement works are to be harmonised to achieve an efficient economic and resourced solution.

4.1 Asset Replacement

4.1.1 Transformers

7900: Rainham Mark 33/11kV - Refurbish Primary Transformer (T1, T2)

Rainham Mark is supplied by three 33/11 kV 12/24MVA transformers. The condition assessment of the 1982 Hawker Siddeley Primary Transformers with ATL AT tap changers installed has identified a risk of failure due to degradation. It is therefore proposed to refurbish both units in situ.

The site has a firm capacity of 46.6MVA during the winter, which is not forecast to be exceeded within the study period.

7913: Townsend Hook 33/6.6kV - Replace Primary Transformer (T2)

Townsend Hook is fed by two 7.5/15MVA 33/6.6kV transformers. The condition assessment of the 1972 Ferranti Primary Transformer with Ferranti DS2 tap changer installed at has identified a risk of failure due to degradation. This project therefore recommends replacement. Completion of the project will see 1 Primary Transformer replaced with a 15MVA unit.

The firm capacity of the site is not due to be exceeded within the study period.

4.1.2 Switchgear

7924: Chatham Hill - Replace 11kV Switchgear

The condition assessment of the 1984 GEC VMX vacuum switchgear installed at Chatham Hill has identified a risk of failure due to degradation. Of the 19 circuit breakers 14 will become HI5 by 2023. It is therefore proposed to asset replace the switchboard. Completion of the project will see 19 circuit breakers replaced with new circuit breakers.

Note: Chatham Hill 11kV substation is supplied by three 33/11kV transformers. T2 is rated at 12/24MVA, T3 is rated at 11.5/23MVA and T4 is rated at 12/18/24MVA to give a site firm capacity of 45MVA. The firm capacity is not forecast to be exceeded within the study period.

4158: Chatham West Primary - Retrofit 11KV Switchgear (part)

The 11kV switchboard consists of a double busbar arrangement with two bus coupler and three bus section circuit breakers. The site is split via the bus couplers for fault level constraint purposes. The existing Reyrolle C 11kV switchboard (1964) at Chatham West Primary 33/11kV is to become HI4 by 2024 (four circuit breakers). The switchboard is therefore being partially retrofitted as part of the plan.

The site is fed by four 33/11kV transformers, each rated at 16/20MVA. The firm capacity of the site is 55.9MVA winter. The site is predicted to remain within the firm capacity during the study review period.

Kingsnorth

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

7927: Cobham (Kent) 33/11kV - Retrofit 11kV Switchgear

The 11kV switchboard consists of a single busbar with one bus section. The condition assessment of the 1967 Reyrolle LMT oil switchgear installed at Cobham (Kent) 33/11kV has identified a risk of failure due to degradation. One of the circuit breakers is due to reach HI4 by 2023. It is therefore recommended to retrofit the 8 circuit breakers.

The site is supplied by two transformers each rated at 10MVA and is due to exceed firm capacity by 2020 with an associated reinforcement project proposed during ED1. To obtain the most economical delivery solution it is proposed that delivery of these two projects is coordinated.

7830: Medway Local 33/11kV - Retrofit 11kV Switchgear

Medway Local consists of a single busbar switchboard with a single bus section switch. The condition assessment (HI4 by 2024) of the 1972 Reyrolle LMT Oil Switchgear installed at Medway Local 33/11kV has identified a risk of failure due to degradation. It is therefore proposed to refurbish the 5 circuit breakers.

The switchboard is supplied by two 12/24MVA transformers, and the site has a firm winter capacity of 21.9MVA. This firm capacity is not forecast to be exceeded within the review period.

4.1.3 Circuits

7962: PE Route Burham Grid to Medway Grid 132kV Tower Line – 132kV tower line refurbishment

The condition assessment of the Burham Grid to Medway Grid 132kV Tower Line (PE) has identified the need to undertake selective refurbishment of fixtures, fittings and painting of the 10km route.

8173: Medway Grid 33kV – Wrotham Heath No 33kV Pole – 33kV Pole replacement

Condition assessment of the Medway Grid 33KV - Wrotham Heath No 2 33KV Pole has identified the need for selective replacement and refurbishment of the 11 km of 33KV pole route.

8652: Kingsnorth – Strood 132KV FFC

Condition assessment of the fluid filled cable has identified the requirement to undertake selective section replacement due to deteriorating condition.

4.2 Reinforcement

P2/6 analysis confirms that the existing network capacity is well matched to the forecast maximum demands and no reinforcement projects are proposed for ED1.

Strood substation capacity headroom will be regularly monitored due to the Local Development Framework predicted increase of new residential development.

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

4.3 Summary of Proposed Interventions

Substation	Driver	Commissioning Year	Scope of works	New Firm capacity
Chatham Hill	Asset Replacement	2017	Replacement 11kV switchgear	Remains at 45MVA
Burham to Medway (Route PE) 132kV Tower Line	Asset Replacement	2017	132kV tower line refurbishment	N/A
Rainham Mark 33/11kV	Asset Replacement	2018	Refurbish primary transformers T1 & T2	N/A
Medway – Wrotham Heath No2 Wood Pole 33kV Line	Asset Replacement	2018	33kV Pole replacement	N/A
Medway Local 33/11kV	Asset Replacement	2019	Retrofit 11kV switchgear	N/A
Chatham West Primary	Asset Replacement	2019	Retrofit 11kV switchgear	N/A
Townsend Hook 33/6.6kV	Asset Replacement	2019	Replace transformer (T2)	N/A
Cobham (Kent) 33/11kV	Asset Replacement	2020	Retrofit 11kV switchgear	N/A
Kingsnorth-Strood 132kV FF cable	Asset Replacement	2023	Cable section asset replacement	No change

4.4 Costs and Phasing

Table 14. NAMP Table (2014-2023)

SR_Table J - S&R - Baseline_Final ED1 Re-submission_19th February 2014_15:15													
Cat	Namp Line	Project ID	Description	2013/2014	2014/2015	2015/2016	2016/2017	2017/2018	2018/2019	2019/2020	2020/2021	2021/2022	2022/2023
A	1.55.02	8469	Kingsnorth Grid 132kV: ABCB Refurbishment	99,325	0	0	0	0	0	0	0	0	0
A	1.51.11	7900	Rainham Mark 33/11kV - Refurbish Primary Transformer (T1, T2)	0	0	0	0	113,672	187,958	0	0	0	0
A	1.51.03	7913	Townsend Hook 33/6.6kV - Replace Primary Transformer (T2)	0	0	0	0	82,574	492,054	0	0	0	0
A	1.50.01	7924	Chatham Hill - Replace 11kV Switchgear	0	0	0	411,608	1,086,210	0	0	0	0	0
A	1.50.01	4158	Chatham West Primary - Retrofit 11kV Switchgear	0	0	0	0	0	101,848	152,484	0	0	0
A	1.50.01	7927	Cobham (Kent) 33/11kV - Retrofit 11kV Switchgear	0	0	0	0	0	0	29,783	89,349	0	0
A	1.50.01	7830	Medway Local 33/11kV - Retrofit 11kV Switchgear	0	0	0	0	0	0	71,444	0	0	0
A	1.02.03	7962	PE - Burham Grid - Medway Grid - Conductor Replacement	0	0	0	165,494	343,423	0	0	0	0	0
A	1.09.01	8173	100913314 - 33kV Medway Grid/Wrotham Heath No2 - OHL Replacement	0	0	0	0	130,407	244,259	0	0	0	0
H	1.29.02	8652	Kingsnorth Grid-Strood 132kV FFC Replacement (Circuit 2-3)	0	0	0	0	0	0	0	0	644,317	1,932,952
R	1.33.07	3047	Halling Primary (Replacement for Rugby Substation) - Relocation & Increased Capacity	5,403	0	0	0	0	0	0	0	0	0
R	1.37.06	3099	Medway - Burham - 132kV Interconnector	143,320	0	0	0	0	0	0	0	0	0

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

4.5 HI / LI Profile Post Intervention

HI profile (all substations) pre and post intervention at the end of the review period - 2023

Table 15. 11kV Circuit Breakers

Substation	2015					2023 with Intervention				
	No. HI1	No. HI2	No. HI3	No. HI4	No. HI5	No. HI1	No. HI2	No. HI3	No. HI4	No. HI5
CHATHAM HILL 33/11KV		5	14			19				
CHATHAM WEST	1	23	4			1	16	11		
COBHAM (KENT) 33/11KV		7	1				8			
HALLING 33/11KV	9					9				
KINGSNORTH GRID 11KV			5						5	
KINGSNORTH GRID 132/11KV			1						1	
LORDSWOOD 33/11KV	9						9			
MEDWAY LOCAL 33/11KV		7	3				5	5		
RAINHAM MARK 33/11KV	3	10				1	12			
STROOD 132 KV		4					4			
STROOD 132/11KV		25					25			
TOWNSEND HOOK 33/6.6KV		8					2	6		
WROTHAM HEATH 33/11KV	1	9					1	9		

Table 16. 33kV Circuit Breakers

Substation	2015					2023 with Intervention				
	No. HI1	No. HI2	No. HI3	No. HI4	No. HI5	No. HI1	No. HI2	No. HI3	No. HI4	No. HI5
CHATHAM GRID 132 KV		2					2			
CHATHAM GRID 33 KV	2	8				1	2	7		
MEDWAY GRID 132 KV		5					1	4		
MEDWAY GRID 33KV		6	13				4	14		1

Table 17. 132kV Circuit Breakers

Substation	2015					2023 with Intervention				
	No. HI1	No. HI2	No. HI3	No. HI4	No. HI5	No. HI1	No. HI2	No. HI3	No. HI4	No. HI5
KINGSNORTH 132 KV	1		3				1	3		
MEDWAY GRID 132 KV		1	3				1		1	2

Table 18. Primary Transformers

Substation	2015					2023 with Intervention				
	No. HI1	No. HI2	No. HI3	No. HI4	No. HI5	No. HI1	No. HI2	No. HI3	No. HI4	No. HI5
CHATHAM HILL 33/11KV	1	2					2	1		
CHATHAM WEST		4						4		
COBHAM (KENT) 33/11KV		2					2			
HALLING 33/11KV	2						2			
LORDSWOOD 33/11KV		2					1		1	
MEDWAY LOCAL 33/11KV		2						2		
RAINHAM MARK 33/11KV		1	1	1			3			
TOWNSEND HOOK 33/6.6KV		1		1		1		1		
WROTHAM HEATH 33/11KV		2					2			

Kingsnorth

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

Table 19. Grid Transformers

Substation	2015					2023 with Intervention				
	No. HI1	No. HI2	No. HI3	No. HI4	No. HI5	No. HI1	No. HI2	No. HI3	No. HI4	No. HI5
CHATHAM GRID 132 KV		2					2			
KINGSNORTH GRID 132/11KV	1						1			
MEDWAY GRID 132 KV		2	3				1	3	1	
STROOD 132 KV		2						2		

Table 20. Load Indices Post-intervention

Substation	Voltage kV	Load Index	
		2015	2023
Kingsnorth 132kV			
Kingsnorth 132/11kV	11	1	1
Strood 132/11kV	11	1	1
Chatham Grid 132/33kV	33	1	1
Chatham Hill 33/11kV	11	1	1
Rainham Mark 33/11kV	11	1	1
Lordswood 33/11kV	11	1	1
Medway Grid 132/33kV	33	1	1
Cobham (Kent) 33/11kV	11	1	1
Chatham West 33/11kV	11	1	1
Townsend Hook 33/6.6kV	6.6	1	1
Wrotham Heath 33/11kV	11	2	2
Medway Local 33/11kV	11	1	1
Halling 33/11kV	11	1	1

5 Alternatives considered

3285: Medway Grid - Replace 33kV Switchgear

Medway Grid is equipped with 23 panels of Reyrolle L42 double busbar switchgear. The highest health index at this site is 5 by 2024. This solution attempts to rectify the fault by replacing the contact fixed portion leak oil onto the circuit breakers through the spout seals. A programme of inspection and topping up is in hand - however replacement is deemed necessary.

Newhaven Grid had a similar leak and was routinely monitored and topped up. Despite regular monitoring, in 2000 there was a flashover and explosion which badly damaged the switch-house wall and roof which collapsed on the switchgear.

The increased risk to the system and the health and safety of personnel has rendered this solution as rejected.

5.1 References

References	Description
Reference 1	Planning Load Estimates SPN Area 2011 – 2023 (20 August 2012)
Reference 2	SPN 132kV System Diagram East
Reference 3	SPN 132kV System Diagram West
Reference 4	SPN LTDS Network Schematics
Reference 5	NAMP SPN Table J Less Ind 1 Sept 2012
Reference 6	ED1 Update September 2012 v10.3.1

5.2 Appendices

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

5.3 Document History

Version	Date of Issue	Author	Details
1.0	December 12	URS	
1.1-1.4	27/02/13	C Winch	Amendments incorporating feedback
1.5	17/06/12	C Winch	Final revisions
1.6	25/06/13	Z Musanhi & T Matiringe	Updated with PA's firms review comments
1.7	26/02/14	M White	ED1 Resubmission
2.0	27/03/14	Regulation	Final publication

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

6 Document Approval

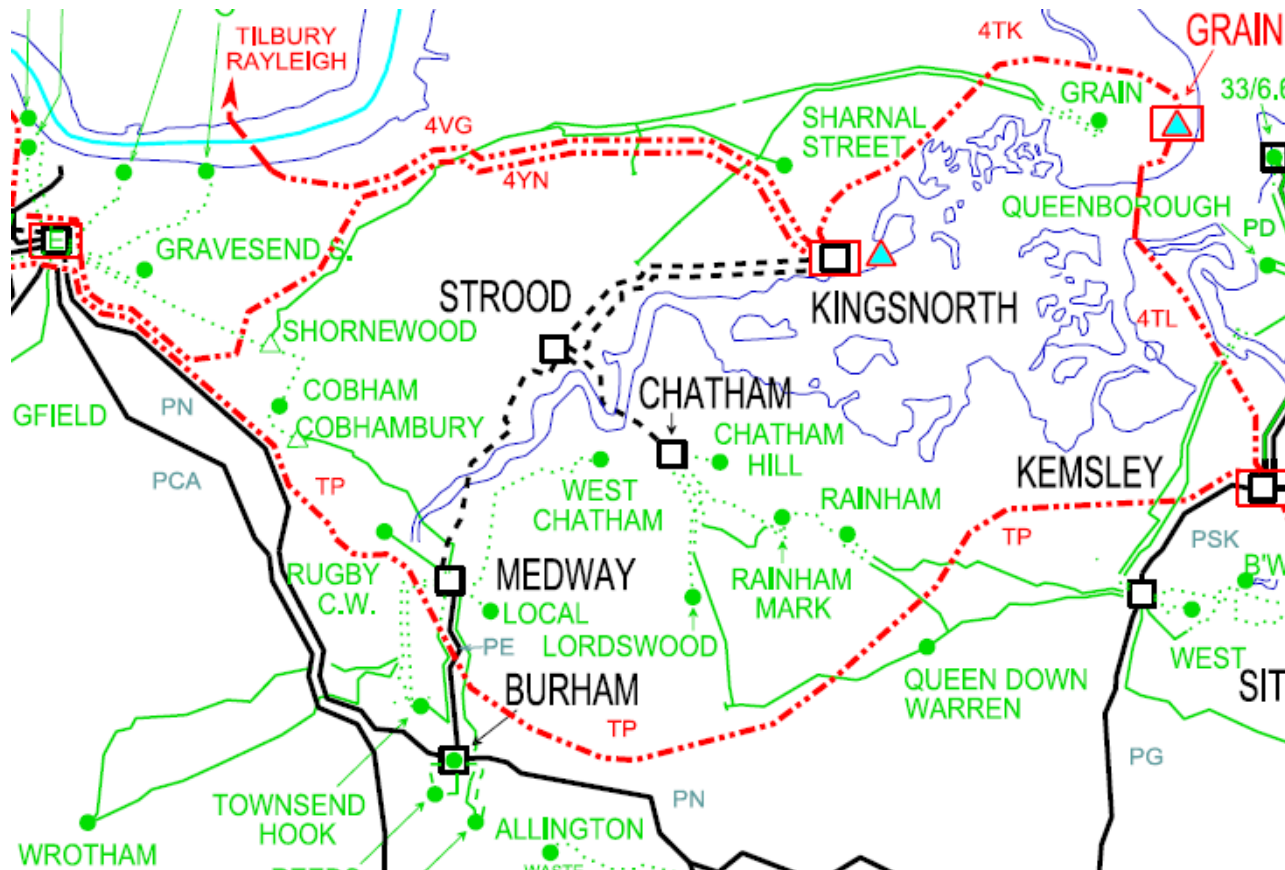
Recommended by:

Name	Role	Signature	Date
Chris Winch	Infrastructure Planner		
Tendai Matiringe	IDP Coordinator SPN		
Chris Winch	Infrastructure Planning Manager - South		

Approval by:

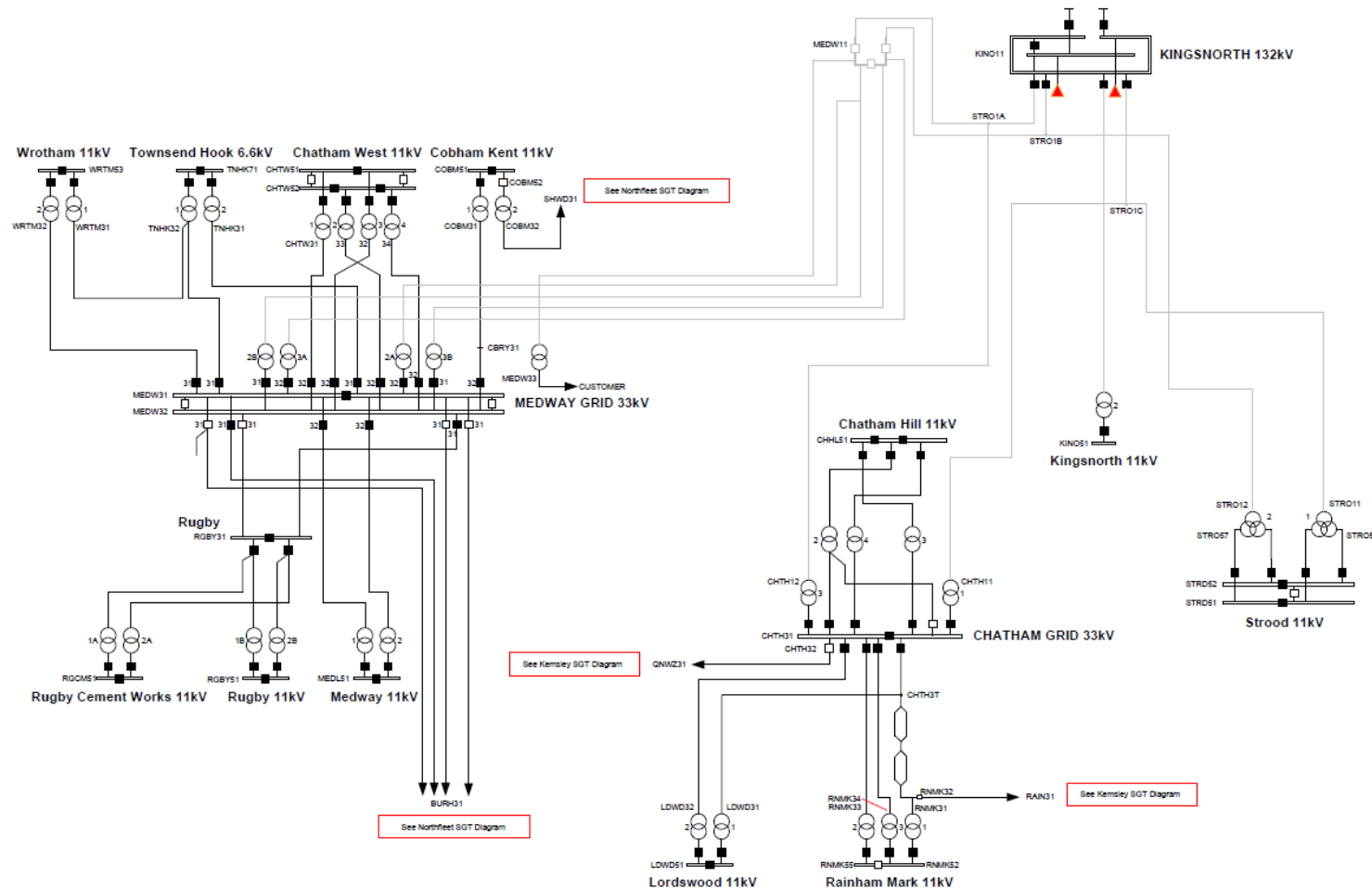
Name	Role	Signature	Date
Robert Kemp	Head of System Development	Robert Kemp	
Barry Hatton	Director of Asset Management	Barry Hatton	

APPENDIX A: GEOGRAPHICAL DIAGRAM



Kingsnorth

APPENDIX B: SINGLE LINE DIAGRAM - EXISTING NETWORK



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APPENDIX C: SINGLE LINE DIAGRAM EXISTING 132KV NETWORK

