



Regional Development Plan

RDP10 Bramford GSP (East) – Diss and Stowmarket (EPN)

Planner D J Whiteley

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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 Executive Summary

This Regional Development Plan (RDP) reviews UK Power Networks (UKPN) EPN HV and EHV network of Diss and Stowmarket Grids, supplied from Bramford Grid Supply Point (GSP). Due to the interconnected nature of the 33kV network, there is an overlap with Bury/Thetford grids at 132kV level, so the 132kV suggestions made here are influenced by those other loads.

The area of Central Suffolk and south Norfolk is characterized as mostly rural and includes the towns of Needham Market, Stowmarket and Diss, covering an area of circa 871km² and circa 100 thousand people.

Key Infrastructure in the region is the Network Rail supply at Stowmarket (2x 10MVA transformers) feeding the main line from London to Norwich, where there is a further supply. Both sites are due to be upgraded in the Network Rail ongoing plans. There is one RAF base at Wattisham, fed from Hitcham Primary. This has recently had a second 11kV supply giving a total MPR of 7.2MVA, MD 3.7MVA. There is a possibility that a new larger firm supply may be needed fed direct from Stowmarket Grid.

There is significant generation support from Eye Power Station with a 16.5MW single generator connected to the Stowmarket Grid/Cotton/Eye/Diss Grid 33kV circuit.

1.1 Summary of issues addressed

The network covered in this document appears to have no major 33kV challenges during the period under review. There will of course be general load growth due to housing and employment but appropriately timed work at 33/11kV sites should cover the likely scale of growth. The effect of the latest Building Regulations and ‘green energy’ from domestic solar installations will affect the load shape but may not necessarily reduce peak demands. Electric vehicle charging during off-peak hours may begin to appear during the later part of the period. Larger ‘solar farms’ will also add variability to the mixture.

A major decision will eventually involve the two dual-circuit 132kV tower lines from Bramford feeding Bury/Stowmarket and Diss/Thetford. Load on the Bramford-Bury/Stowmarket lines (including generation contribution) is predicted to reach firm capacity around 2025. Loss of the British Sugar generator at the same time at peak load would cause overload of the Bramford-Stowmarket section by around 2017 which would only just be recovered through considerable 33kV switching leaving several sites on single circuit risk. The Diss/Thetford circuits would follow (predictions uncertain but probably beyond 2025), although the combined load on these circuits would cause low n-1 volts at Thetford by then. Using 2022/23 predictions, the line ratings are adequate, but with no generation the volts at Thetford drop to 32.1kV although the surrounding Primary s/stns have sufficient taps to compensate. Rebuilding the lines to 400mm² would probably require a completely new route or an equivalent underground route. If all the associated generation is also discounted then both routes are presently close to firm capacity. The three major generators are all single machines with a single connection to our network. All are subject to the normal commercial pressures and therefore for both these reasons cannot be considered as guaranteed long-term supplies.

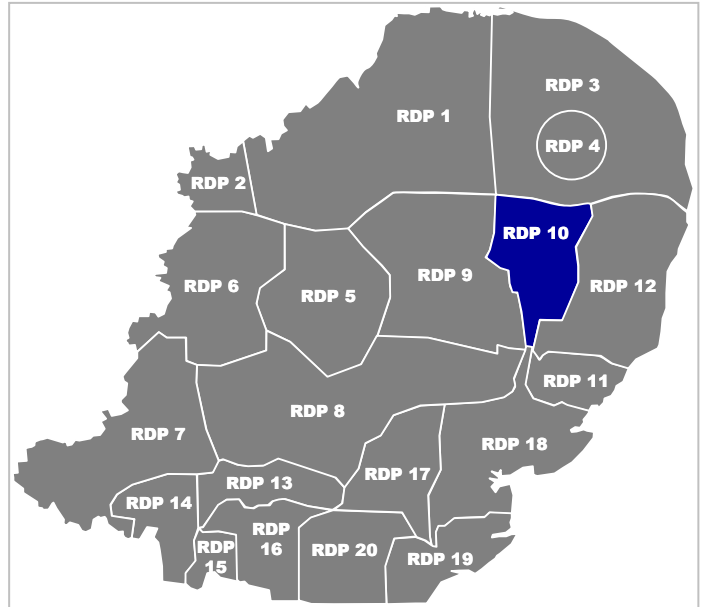


Figure 1 – Area covered by the RDP

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

The latest PLE tables listed in Appendix D are dated 27/2/13. This ‘EE’ version has reduced the growth on most sites significantly which would, if actually the case, defer the dates mentioned in the above paragraph by several years.

1.2 Recommended strategy

At the 33/11kV level, all the predicted load increases can be accommodated by individual schemes, either as ITC and associated switchgear and/or circuit reinforcement, or new Primary sites.

The main challenge will be the load on the 132kV circuits between Bramford and Stowmarket, which also feature in the RDP for Bury and Thetford. It would be sensible to consider these two dual-circuit lines together, as any individual solution would affect the other.

The Burwell – Red Lodge link suggested in the Bramford West RDP will transfer load off both Bury and Thetford. It will enable an ‘n-1 & NoGen’ situation at either site to be recoverable by further 33kV switching until c. 2021, but any later than this will require the EEPK circuit to be reinforced in some way.

Investment Profile

Table 1 provides the projected expenditure profile for reinforcement and asset replacement projects (LRE and NLRE) in this RDP for both DPCR5 and ED1. This information is taken from the NAMP version 19th February 2014

Table 1. LRE and NLRE expenditure profile

IDP	DPCR5 2013-15	2015 /2016	2016 /2017	2017 /2018	2018 /2019	2019 /2020	2020 /2021	2021 /2022	2022 /2023	RIIO- ED1 Total
LRE	£6.6m	£0.7m	£0.0m	£2.1m	£7.2m	£10.7m	£5.9m	£4.7m	£0.0m	£31.4m
NLRE	£1.6m	£2.2m	£2.4m	£1.4m	£0.9m	£0.0m	£0.2m	£1.3m	£1.3m	£9.6m
TOTAL	£8.2m	£2.9m	£2.5m	£3.5m	£8.0m	£10.7m	£6.2m	£6.0m	£1.3m	£41.0m

Output Measures

The figure below provides the expected Load Indices (LI) for all substations covered in this RDP at the end of ED1 period (2022/23). Substations with a projected load index of LI4 and LI5 will be specifically targeted for improvement and are detailed in this document, with the resulting improvement also shown in figure 3.

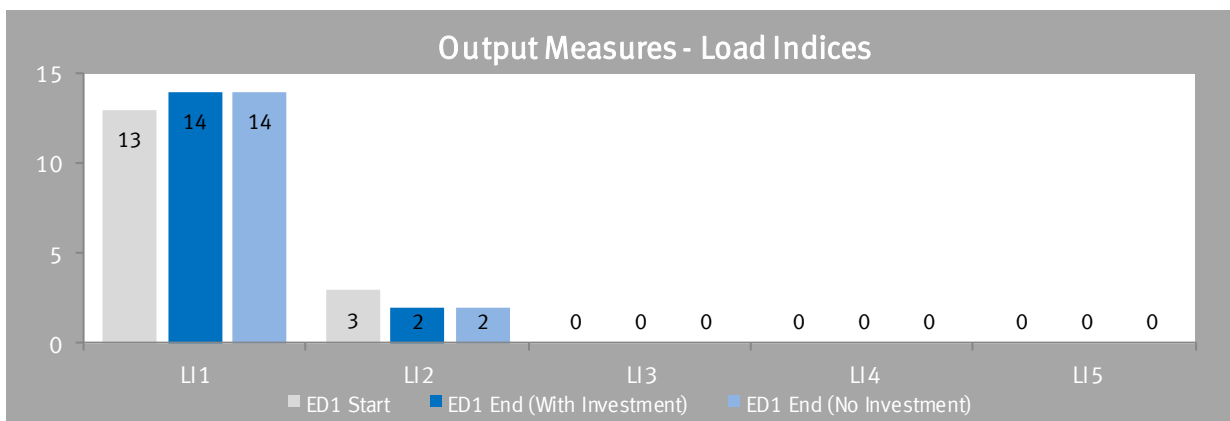
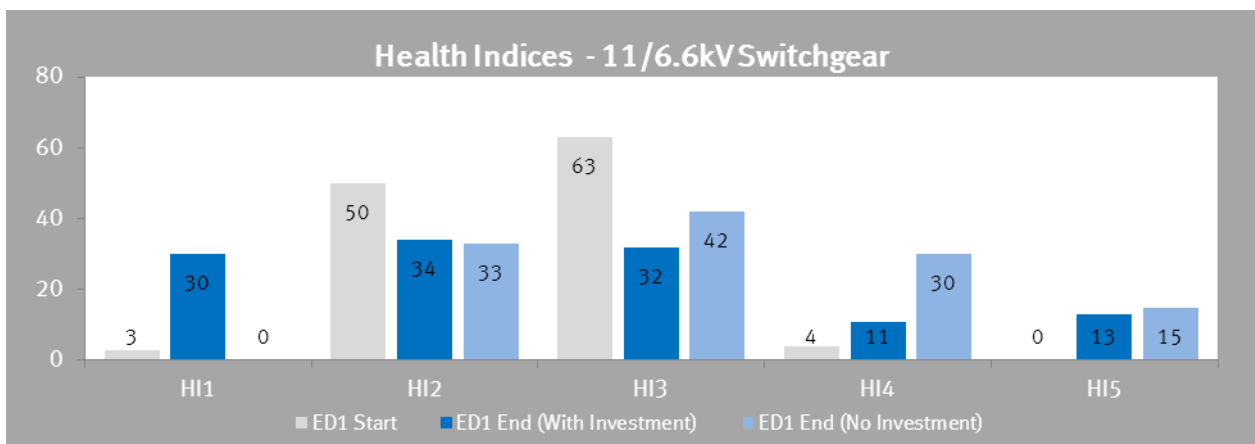
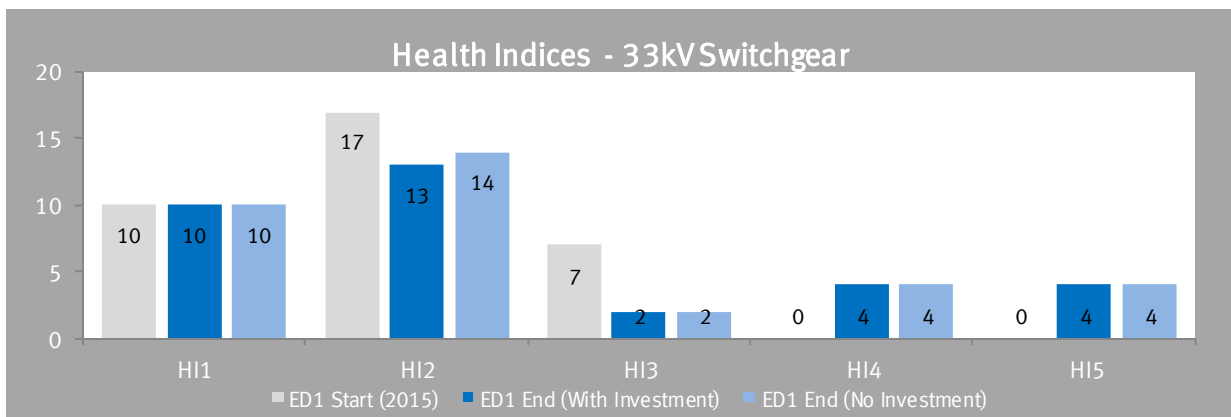
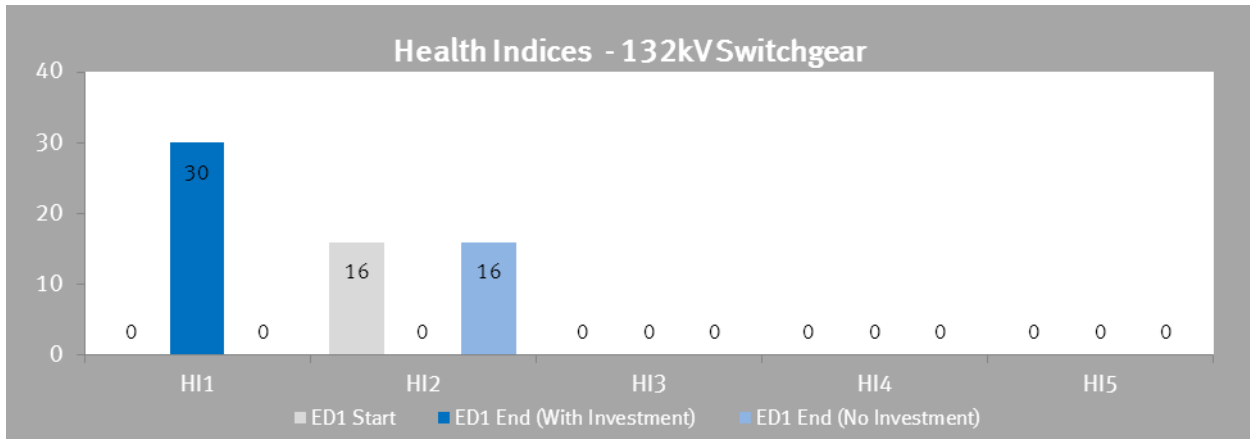


Figure 2. Load Indices (LI)

Bramford East – Diss & Stowmarket

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

The figures below provides the projected health index of various assets covered in this RDP at the beginning and end of ED1, with and without interventions as defined in the NAMP under asset replacement.



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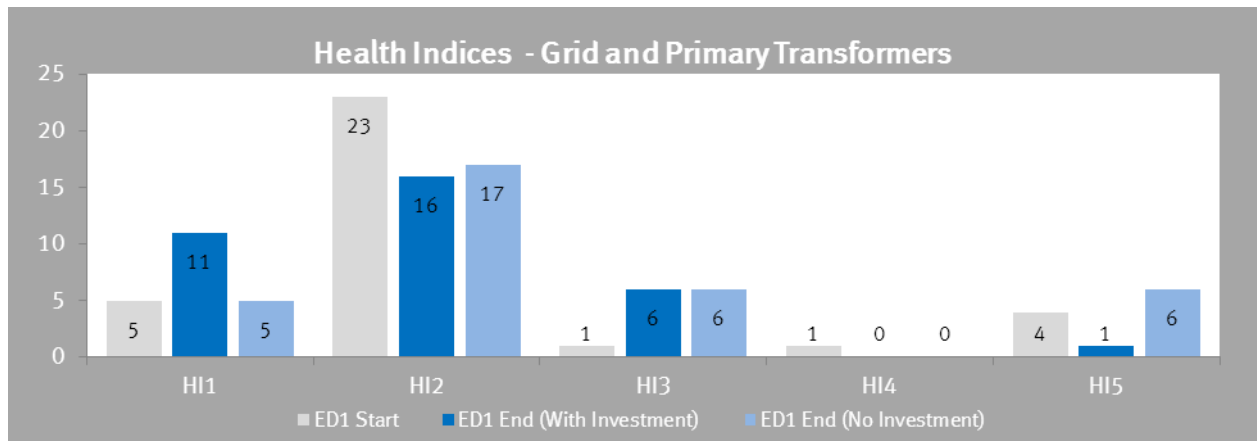


Figure 3. Health Indices by asset category

Scenarios Considered

1. Create a 132kV busbar and protected switching point at Stowmarket. This will provide a 3-from-4 firm capacity at Stowmarket to be shared with the other three Grids. The space at Stowmarket is limited and it will be necessary to build an indoor double-busbar switchboard which would require 16 panels if no circuits were banked.
2. Lay two 132kV circuits from Bramford to Stowmarket, to pick up the Diss/Thetford PNE circuits. This will release the PI circuits which can then be used to split Stowmarket and Bury. Additional CBs will be needed at Bramford. The cost of this option is very dependent on the route available, cross-country or via public. This option is preferable as it does not immediately create a common point of failure at Stowmarket, yet still allows the future busbar there.

RDP Dependencies and Interactions

The timing of most of these projects will be dictated by load growth and ongoing condition assessment of the plant. Other factors such as quality of supply, new connections and sustainability may change the overall priority and add previous unconsidered projects to the NAMP. The growth of embedded generation will require new approaches to network configuration and protection.

Interaction with Regional Development Plans of Twinstead GSP, Bramford GSP East and Bramford Ipswich/Cliff Quay.

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2 Network configuration

2.1 Existing Network

The 132kV network in West Suffolk is fed from Bramford Supergrid site near Ipswich. There are two double-circuit lines which run on slightly different routes to Stowmarket Grid. One pair feed Stowmarket and Bury Grids, the other pair feed Diss and Thetford Grids. Off one circuit of each pair at Stowmarket there is connected a Network Rail traction supply (increase requested for 2018). For this study the requirements of the 132kV network from Bramford to Stowmarket and Diss will be considered, thus being influenced by load and generation from the other two sites.

Diss and Stowmarket Grids run in 33kV parallel via Elmswell and Eye. There are connections at 33kV and 11kV between Stowmarket and Wickham Market Grids via Debenham and Manor Road respectively, and at 33kV between Diss and Halesworth/Wickham Market via Harleston. There is also a loose coupled connection between Thetford and Diss/Stowmarket at Stanton, and with Belchamp Grid at Groton. There are two normally-open remote controlled switches near Hadleigh connecting to the Cliff Quay network, but owing to the distance and load on the other circuits the interconnection would only provide limited emergency support. Two manual overhead line switches separate Stowmarket and Bury near Drinkstone.

There is one existing generator at Eye (table 2 below), although a confirmed Waste to Energy 33kV connection at Gt. Blakenham into Stowmarket Grid (due 2014?) will provide ~35MW peak (~20MW P2/6 allowable). A small wind generation site (5MW) has now been connected on Eye airfield at 11kVA. A small Solar Farm (5MW) at Snetterton is due to be connected into the Kenninghall 11kV network during 2012. A large generator (~40MW) has been proposed for the industrial site at Mendlesham. This would be connected to the 132kV circuits from Stowmarket towards Diss/Thetford which are relatively close. A specific connection date for this is not yet known.

Generation Plants	Type	DNC (MVA)	F (%)	pf	DG Output = F*DNC		
					MVA	MW	MVA _r
Eye	Waste to Energy	16.5	58	0.95	9.6	9.1	3.0
Eye Airfield	Wind (11kV)	5	14	0.98	0.7	0.69	0.14
(Snetterton)	PV	5	0				
(Gt. Blakenham)	Waste to Energy	35	58	0.95	20.4	19.3	6.4

Figure 4. Output of generating plants used in the analysis

A list of recent generation enquiries (to 23/5/13) is given in Appendix H. Geographic diagram in Appendix A and SLD in Appendix B.

2.2 Network changes in progress

Stowmarket 132/33kV Grid Substation - ITC (2 x 90MVA) & Uprate 33kV switchgear

The 33kV switchboard is rated at only 1250A which thus limits the winter rating of the transformers. A new building will be constructed to allow the new board to be built off-line for a changeover at greatly reduced network risk. At the same time the two 60MVA Grid transformers will be replaced with 90MVA units. Following this the old 33kV room can then be used for the future replacement of the 11kV switchboard.

Bramford GSP 132kV Exit Point - reinforce

At Bramford the reconfiguration of the 132kV circuits is proceeding as is the installation of the 5th SGT.

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3 Summary of Issues

The two dual 132kV circuits out of Bramford towards Diss/Thetford (PI) and Bury/Stowmarket (EEPK) converge at Stowmarket. Studies indicate that n-1 reinforcement of the section of both routes as far as Stowmarket will be required within the ED1 timeframe. Both are supported by generation and the simultaneous loss of this would compound the situation. The PI route has only single cable tails from Bramford to the terminal tower, whereas the EEPK route has double cables which are of greater capacity than the line. The table below shows the present and predicted loads with and without their embedded generation support.

Circuit amps N-1	Winter Firm (A)	2011/12		2016/7		2022/23	
		Gen	No Gen	Gen	No Gen	Gen	No Gen
PI (cable)	550	372	557				
PI (line)	770			442	609	462	631
EEPK(line)	770	437	630	495	672	522	675

Figure 5. Present and predicted loadings on 132kV circuits

For the PI route, NoGen is with both Thetford and Eye Power Stations off. 2011/12 No Gen is recoverable by remote and manual 33kV switching. The cable tails should be reinforced before the two later snapshot years (see National Grid). Before 2023 the voltage at Thetford Grid bars will be below 33kV, but 11kV volts are kept adequate by Primary tapchange.

For the EEPK route, NoGen is with British Sugar off and the line remains within rating until beyond 2022.

In all n-1 instances, the volts available at the 33kV bars are influenced by the sending voltage at Bramford. This appears to run at around 138kV at peak load times (and higher overnight). Any reduction would impact on the ability to recover from NoGen situations.

3.1 Development areas

Load

Load details for the substations in the area are given in the PLE-derived tables in Appendix E

The figures given are based on global estimates of growth and have not been adjusted for the estimates of new load given below as there is no firm timetable for any of the new developments to be built. The effect on each Primary and the response needed therefore cannot at this time be set to a particular year. Similarly the effect of low-carbon requirements on both domestic and commercial/industrial load may change the ADMD and/or profile of the load. The present economic downturn has depressed industrial load and any revival will affect some substations to a greater extent than others.

Generators / Solar Farms

A list of recent enquiries is given in Appendix H

Housing

Mid Suffolk

There are plans for around 3000 new homes by 2025, of which around 40% will be at Stowmarket with the remainder spread over other settlement areas. It is assumed that these will be accommodated via extensions to existing 11kV networks without major reinforcement. One specific site is on the former Cement Works site surrounding Claydon Primary and can be accommodated without reinforcement.

A small site of up to 270 homes is proposed at the former 'Bacon Factory' site adjacent to Elmswell Primary. This is in the early stages of public consultation (July 2012) but the outline plan does not seem to affect the Primary other than to ensure our access rights and route are adequately maintained. There may be some minor 11kV diversion/undergrounding.

South Norfolk

Bramford East – Diss & Stowmarket

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Diss is the only major settlement supplied from this network. Around 300 new homes will be built up to 2025, mainly in one new development area. It is assumed that these will be accommodated via extensions to existing 11kV networks without major reinforcement.

Breckland

A small area in the north-west of the network fed from Kenninghall Primary out of Diss Grid is within Breckland Council. There is no significant housing requirement here. An employment zone is mentioned below.

Employment

The 'load per job' is extremely variable, so no estimate has been made of the effect on the local network.

Mid Suffolk

Approximately 5500 new jobs are needed, spread over existing industrial zones at Stowmarket, Woolpit, Mendlesham and Eye. Of these sites, only Stowmarket would seem to be relatively well supplied. Woolpit is some 2km distant from Elmswell Primary (capacity available) but on the opposite side of the A14. Mendlesham, at 6km distance, is almost midway between Cotton and Debenham but under 2km from the Cotton – Eye 33kV line. Eye Airfield estate is 2.5km from Eye Primary, but with the Diss-Eye 33kV line across the site and the existing Eye Power Station close by, although neither would be any direct help if significant load appeared. A draft Development Brief has been issued which suggests some housing on the SW corner nearest to the town, a site for an undefined 'energy centre' near the existing power station with a possible 'power-hungry' plot adjacent and several areas for smaller business or industrial units. No specific details have been issued yet.

A specific enquiry is the Snoasis project for an indoor snow slope and associated leisure facilities on the former quarry site near Claydon Primary. The present economic situation has stalled the project and no start date is known. It is anticipated that this would be supplied at 11kV from Claydon.

An enquiry for light industrial load out of Stanton Primary is for an initial 2MVA with a possible maximum of 7MVA. At present the higher load could be taken by new 11kV circuits from Stanton but without upstream reinforcement.

South Norfolk

A minor expansion of the employment in Diss will be needed. This would be covered by reinforcement scheme 2501 presently predicted for 2017 and local 11kV.

Breckland

An employment zone already exists around Snetterton motor racing circuit fed by underground and overhead feeders from Kenninghall Primary. Breckland Council have designated the area for further employment expansion, but the scale of any development is not yet certain. An initial enquiry was received from them for ~20MVA which would have required a new Primary on the site fed from Diss Grid, as Kenninghall has insufficient capacity or potential for such a supply, and is also too far from the site for sensible transmission of that load. The cost of such a supply has therefore stalled any serious enquiries although smaller connections have been made which will reduce any remaining headroom.

There has been a proposal for a generator on the Snetterton site, recently approved by Breckland Council (straw-burning). This would be of sufficient size to warrant a 33kV connection to Diss Grid and may make the employment area more viable by sharing the connection costs.

3.2 Asset Replacement

A list of plant recommended for replacement has been included in the ED1 NAMP plan. Dates given are provisional and will change for operational or other reasons such as reinforcement. Costs are generic for the specific plant only and do not take account of any associated equipment which may need replacing at the same time (e.g. structures/bus/line isolators on outdoor CBs).

Stowmarket/Rickinghall 132kV Tower Line (PNE) – 132kV Insulator & Fitting Replacement

The condition assessment of the Stowmarket/Rickinghall 132kV Tower Line (PNE) has shown that the probability of failure due to degradation will become unacceptable. This project recommends the replacement of the 132kV insulators and fittings (earth).

Bramford East – Diss & Stowmarket

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Diss/Kenninghall 33kV OHL circuit – 33kV wood pole OHL replacement (575A)

The condition assessment of the Diss/Kenninghall 33kV OHL circuit has shown that the probability of failure due to degradation will become unacceptable. Completion of the project will see 24 km of 33kV OHL circuit replaced. The opportunity should be taken to rebuild the line to 200ACSR conductor in order to assist in the inevitable load increase at Kenninghall.

Stow/Debenham 33kV OHL Circuits – refurbish (575A)

Field reports indicate that this circuit requires considerable refurbishment. The existing line is mainly 0.2Cu. Condition assessment surveys are planned to determine the best solution – refurbishment or rebuild.

Stow/Manor Rd 33kV OHL Circuit – refurbish (530A W)

Line inspection and surveys carried out that certain condition issues on the circuit and recommended the replacement of decayed poles. It is proposed to refurbish the circuit including part of the Manor Road/Wickham/Melton circuit where it shares “H” poles.

Stowmarket 132/11kV Grid Substation – Replace 11kV Switchgear

The condition assessment of the 1967 SCO UAE20 indoor oil insulated switchgear installed at Stowmarket 132/11kV Grid Substation has shown that the probability of failure due to degradation will become unacceptable. Completion of the project will see 11 circuit breakers replaced with 11 new circuit breakers.

Hitcham 33/11kV Primary Substation – Replace 11kV Switchgear

The condition assessment of the 1951-57 CPA ALA1 indoor oil insulated switchgear installed at Hitcham 33/11kV Primary Substation has shown that the probability of failure due to degradation will become unacceptable. Completion of the project will see 8 circuit breakers replaced with 8 new circuit breakers.

Kenninghall 33/11kV Primary Substation – Replace 11kV Switchgear

The condition assessment of the 1957 CPA ALA1 indoor oil insulated switchgear installed at Kenninghall 33/11kV Primary Substation has shown that the probability of failure due to degradation will become unacceptable. Completion of the project will see 7 circuit breakers replaced with 7 new circuit breakers.

Claydon Cement 33/11kV Primary Substation – Retrofit 11kV Switchgear

The condition assessment of the 1967 REY LM23T indoor oil insulated switchgear installed at Calydon Cement 33/11kV Primary Substation has shown that the probability of failure due to degradation will become unacceptable. Completion of the project will see 3 circuit breakers retrofitted.

Cotton 33/11kV Primary Substation – Retrofit 11kV Switchgear

The condition assessment of the 1964 SWS C4X/D8-12X indoor oil insulated switchgear installed at Cotton 33/11kV Primary Substation has shown that the probability of failure due to degradation will become unacceptable. Completion of the project will see 7 circuit breakers retrofitted.

Claydon Cement 33/11kV Primary Substation – Replace Primary Transformers (T1, T2)

The condition assessment of the 1966 FUL Primary Transformer installed at Claydon Cement 33/11kV Primary Substation has shown that the probability of failure due to degradation will become unacceptable. Completion of the project will see 2 Primary Transformers replaced with 2 new Primary Transformers.

Eye 33/11kV Primary Substation – Replace Primary Transformers (T1, T2)

The condition assessment of the 1960 WAT Primary Transformer installed at Eye 33/11kV Primary Substation has shown that the probability of failure due to degradation will become unacceptable. Completion of the project will see 2 Primary Transformers replaced with 2 new Primary Transformers. This project is also highlighted in the reinforcement plan for Eye.

Elmswell 33/11kV Primary Substation – Refurbish Primary Transformers (T1)

Bramford East – Diss & Stowmarket

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The condition assessment of the 1965 WAT Primary Transformer installed at Elmswell 33/11kV Primary Substation has shown that the probability of failure due to degradation will become unacceptable. Completion of the project will see 1 Primary Transformer refurbished.

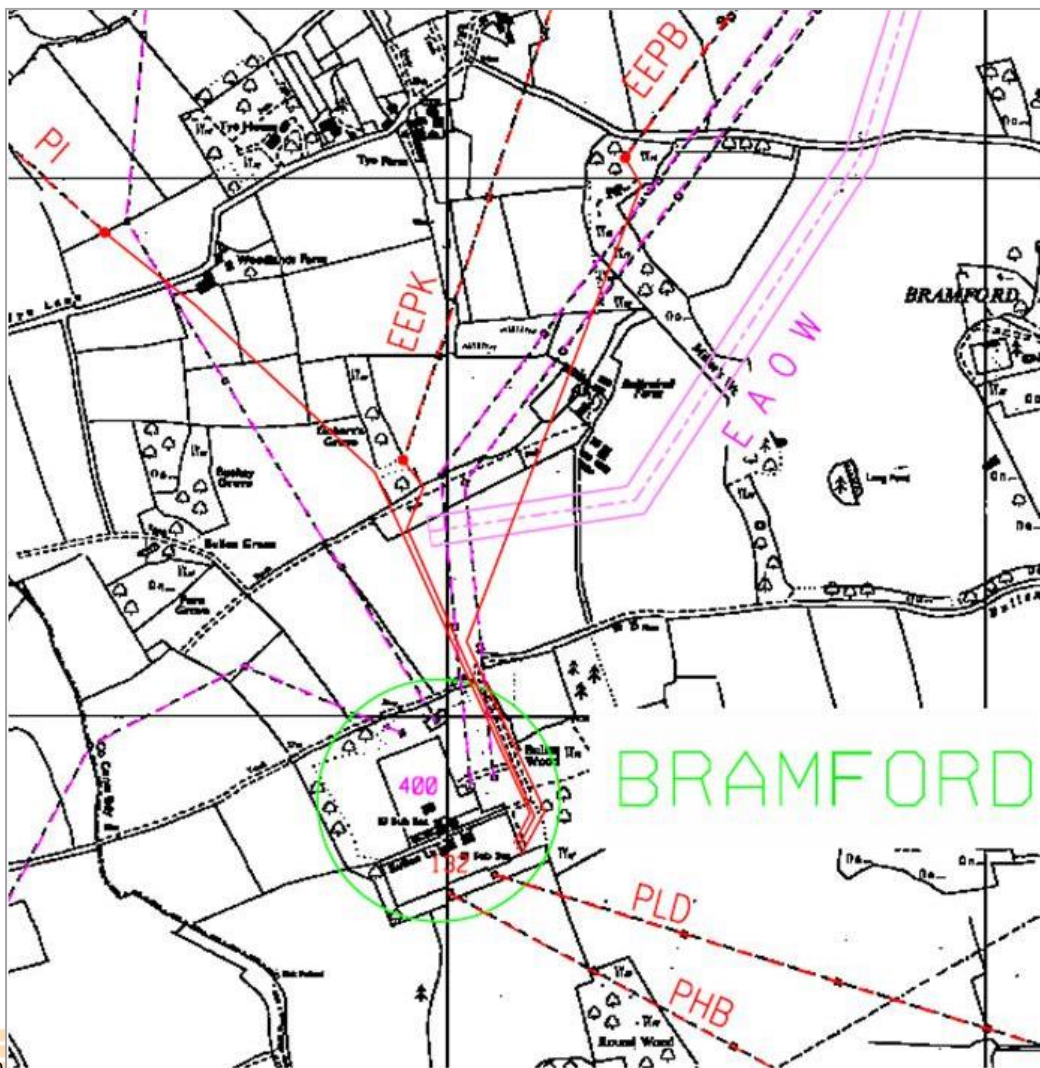
3.3 Security of supply analysis

Substation	Demand (MW)	Supply Class	Demand (MVA)			P2/6	Comments
			2015	2018	2022		
Bramford-Stowmarket-Bury tower line	117	D	141.1	150.8	162.4	Compliant	
Bramford-Diss-Thetford tower line	81.7	D	94.2	98.4	106.6	Compliant	

Figure 6.P2/6 Assessment table

3.4 Operational and technical constraints

The congested network around Bramford has resulted in four 132kV routes out of the site being undergrounded for different distances before changing to overhead tower construction. The diagram below shows how the two routes to Bury/Stowmarket (EEPK) and Diss/Thetford (PI) are affected.



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Figure 7. Disposition of circuits around Bramford

Stowmarket Grid site is at the confluence of the 132kV circuits feeding Stowmarket/Bury and Diss/Thetford. The terminal towers incoming from Bramford are quite close together and adjacent to the outgoing circuit to Bury. A dual circuit outage on either of the Bramford to Stowmarket circuits would each affect two Grid sites.

	C I	C M L per 24h
Diss/Thetford	51,600	74,304,000
Bury/Stowmarket	89,200	128,448,000

Protection on the interconnected network might change the number of consumers initially affected, and some could then be restored by switching, but it is unlikely that all could be restored before a first circuit is repaired.

The area will become more congested in the future when the DC cables for the East Anglia Offshore Wind project are installed. Three converter stations will ultimately be needed, to be installed on the northern boundary of the site and possibly conflicting with our EEPK and PI underground (oil-filled) routes. If our cables are to be replaced or reinforced prior to the EAOW works, there should be consultation to determine a new route to avoid any EAOW proposals.

There are no 400/132kV overhead crossings within this network. There are three crossings of 400/33kV which have been undergrounded with one remaining overhead, and two 132/33kV overhead crossings. There are no known cable bridges within this network.

This is part of the Suffolk interconnected 33kV network, described in 2.1 above.

3.5 National Grid

The area is fed from Bramford NG site where a fifth SGT is being installed. This will at present be run on hot standby with the 132kV busbars split main/reserve to reduce the fault level. Load will gradually increase which will mean that the split will be unacceptable, at which time the 132kV switchgear will need replacement to allow a full parallel running (PIMS 3585 presently due to begin 2016). No further reinforcement is presently predicted, but it was agreed with NG that at some time a sixth transformer could be accommodated on their proposed network configuration.

The situation has changed somewhat with the proposed Twinsted exit point, but this should not affect any Bramford load other than to remove the future transfer on of Belchamp Grid. The recent connection of Gunfleet wind farm (168MW peak) has made some impact, but of course this cannot be considered reliable or available when most needed.

One other consideration is the future connection into Bramford NG of circuits from the East Anglia Offshore Wind project. This will have two landing positions – one near Lowestoft feeding into the Norwich network and one near Bawdsey feeding into Bramford. There will ultimately be three underground DC circuits into Bramford with separate converter stations on the northern edge of the NG site. There will be minor interactions along the route with LV, 11kV, 33kV and 132kV circuits, but none will involve very major diversions. The third converter station is presently due to be sited over the route of the 132kV tails between Bramford 132 and the terminal towers on the PI route (Diss/Thetford). The proposed reinforcement of these cables (PIMS 2185 in 2015/16) should therefore take account of the final location of this building.

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4 Recommended strategy

A major decision will involve the two dual-circuit 132kV tower lines from Bramford feeding Bury/Stowmarket and Diss/Thetford. Load on the Bramford-Bury/Stowmarket lines (including generation contribution) is predicted to reach firm capacity by 2025. Rebuilding the lines to 400mm² would require a completely new route or an equivalent underground route. The Diss/Thetford circuits would follow but several years later (prediction uncertain but beyond 2025), although the combined load on these circuits would cause low n-1 volts at Thetford by then. If the associated generation is also discounted then both routes are presently approaching firm capacity.

Additional cabled circuits from Bramford to Stowmarket (est £14m) to pick up the Diss/Thetford circuits is the recommended solution. This provides adequate capacity circuits on the first section of the route and releases the existing overhead circuits to enable Stowmarket and Bury to be fed independently.

At some future date load increases on Thetford and Bury networks would introduce low voltage under outage conditions. The Red Lodge load transfer scheme to Burwell mentioned in the West Suffolk RDP would delay these problems at both Thetford and Bury by several years. With these solutions in place, the Bramford to Bury/Stowmarket/Diss/Thetford network is firm under all n-1 conditions for several years beyond 2025. The loss of generation plant coupled with the relevant single circuit outage would still require restoration switching but would be recoverable.

2023 loads **Busbars at Stowmarket**

Assume PI cable tails at Bramford uprated by 2015
Stowmarket GTx change ~2015

N-1 incoming outage

All ok at 2021 loads

N-1 outgoing outage

Thetford top tap with no-gen, Primary volts ok

N-1 Busbars outage

Thetford top tap with gen & no-gen, Primary volts ok

Cables Bramford – Stowmarket for Diss/Thetford circuits

Assume PI cable tails at Bramford uprated by 2015
Stowmarket GTx change ~2015
EEPW feeds Bury, PI feeds Stowmarket

N-1 Diss/Thetford

Thetford top tap with no-gen, Primary volts ok

4.1 Description

(RDP - West Suffolk) Stowmarket 132/33kV Grid Substation - ITC (2 x 90MVA)

The predicted load at Stowmarket Grid substation will exceed the existing firm capacity, including the transfer capacity to Bury and Diss Grid substations. It is therefore proposed to replace the existing transformers with larger 90MVA units. The existing switchgear is fully rated for this increased load. The existing circuits supplying the transformers are fully rated for the larger units.

Completion of this project will see the two 60MVA existing transformers replaced with two 90MVA new transformers.

Diss/Thetford 132kV (PI) Circuit - reinforce (770A)

The predicted load at Bramford/Diss/Thetford 132kV circuit will exceed the existing rating of 125MVA. It is not possible to lower the load without compromising operational and planning requirements. It is therefore proposed to replace 3km of underground circuits replaced from Bramford 132kV to terminal tower (removes this section of FFC).

Bramford East – Diss & Stowmarket

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

The Bramford - Stowmarket 132 and Burwell-Red Lodge projects both have the effect of providing capacity to the Bury- Thetford 33kV network and preventing a possible n-1 overload on the Bramford to Stowmarket leg of the OHL circuits feeding those areas. Only one scheme is needed at this time and further checks will be needed to determine the better first option.

Stowmarket 132/33kV Grid Substation - Uprate 33kV Switchgear (2000A)

The predicted load at Stowmarket Grid substation will exceed the rating 1250A of the existing switchgear. It is not possible to lower the load without compromising operational and planning requirements. It is therefore proposed to replace the existing switchgear with a new installation comprising 14 circuit breakers.

Stowmarket 132/33kV Grid Substation - New 132kV Switchboard Reinforcement (N-2)

The predicted combined load at Bury St Edmunds/Stowmarket S/S and Thetford/Diss will exceed the existing firm capacity of the 132 circuits from Bramford including transfer capacity. It is not possible to lower the load without compromising operational and planning requirements. It is therefore proposed to add a new switching installation at Stowmarket which will enable better utilisation of the existing 132 kV circuits from Bramford.

Bramford 132kV GSP Exit Point - Reinforce 132kV Switchgear (Fault Level)

The predicted fault level at Bramford GSP Substation will exceed the rating of the existing switchgear. It is not possible to lower the fault level without compromising operational and planning requirements. It is therefore proposed to replace the existing switchgear with a new installation comprising 21 circuit breakers.

Innovation: Demand Side Response

Studies have been undertaken to identify suitable sites for participation in smart demand response to reduce peak load with a view to delay proposed reinforcement work. These studies identified a Demand Side Response intervention as an option to defer the reinforcement of a Primary Substation (Eye) in this RDP.

4.2 Financial Appraisal and Benefits

Further information can be found in the Appendices.

5 Rejected Strategies

5.1 132kV Hub at Stowmarket

There are no rejected strategies at this stage to deal with the circuit complexity at Stowmarket Grid. Further feasibility studies and costing exercises are required to validate the best value solution to manage the loading and P2/6 compliance issues for the eight 132kV circuits that converge on the Stowmarket Grid site.

6 References

References	Description
Reference 1	Planning Load Estimates EPN Area 2011 - 2023
Reference 2	132kV Network HV Schematic Operating Diagrams East of England
Reference 3	33kV Network HV Schematic Operating Diagrams East of England
Reference 4	Council Masterplans, etc...

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

6.1 Appendices

Appendix	Description
Appendix A	Geographical diagram
Appendix B	Single Line Diagram – Existing Network
Appendix C	Single Line Diagram – Recommended Strategy
Appendix D	Detailed costs for recommended strategy
Appendix E	Output Measures – Load Indices (LI)
Appendix F	Output Measures – Health Indices (HI)
Appendix G	Generation Heat Map

6.2 Document History

Version	Date of Issue	Author	Details
1.0	30/01/2013	Ian Robertson	Final version
1.1	05/06/2013	Ian Robertson	Updated NAMP 05/06/2013
1.2	24/06/2013	Nuno da Fonseca	Final version
1.3	20/03/2014	D J Whiteley	Aligned for Re-submission

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
Ian Robertson	Infrastructure Planner		
D J Whiteley	Infrastructure Planner		19/03/14
Nuno Da Fonseca	Infrastructure Planning Manager (EPN)		

Approval by:

Name	Role	Signature	Date
Robert Kemp	Head of System Development		20/03/14
Barry Hatton	Director of Asset Management		

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

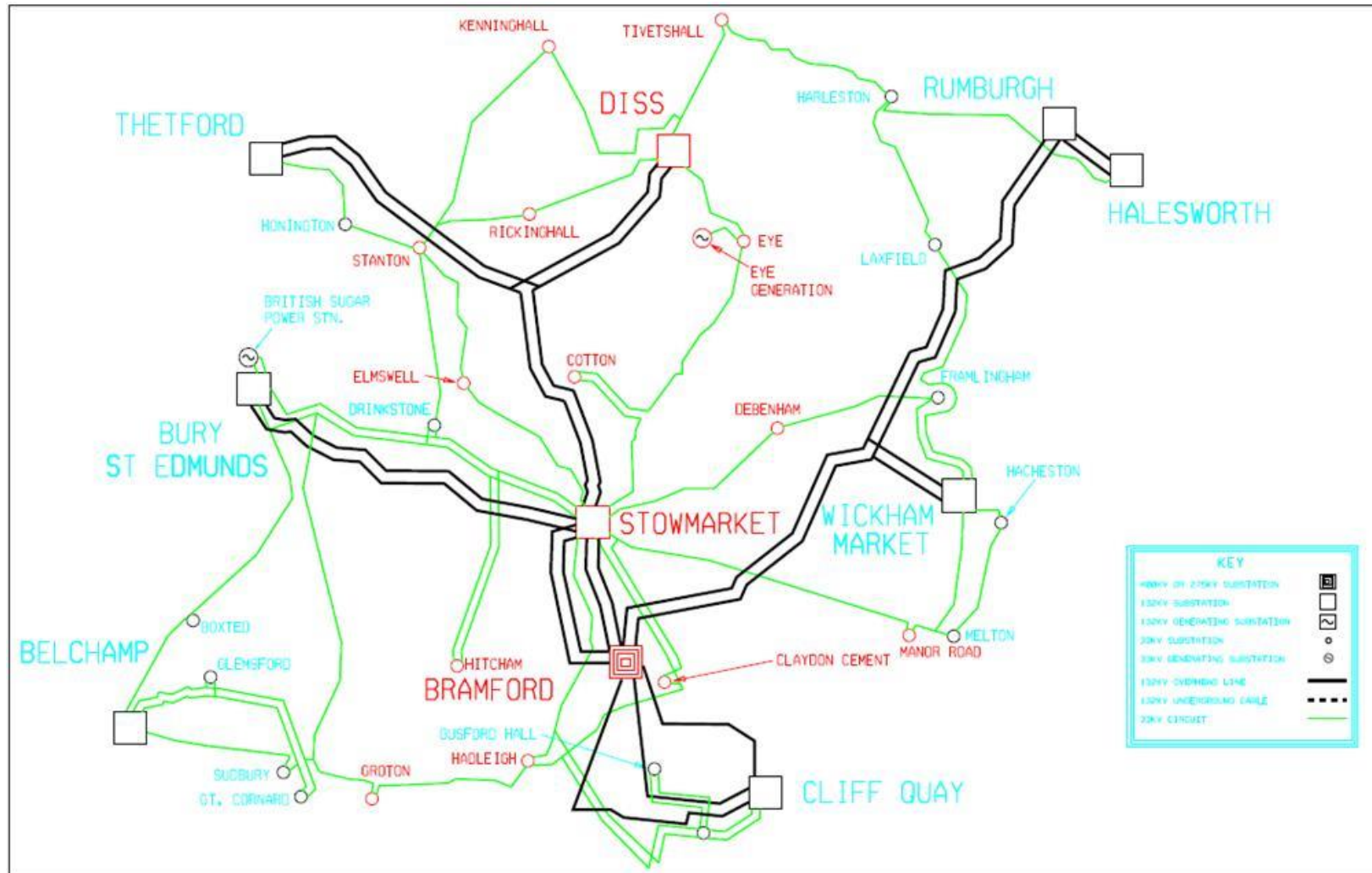
Regional Development Plan

Bramford East – Diss & Stowmarket

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

APPENDIX A: GEOGRAPHICAL DIAGRAM

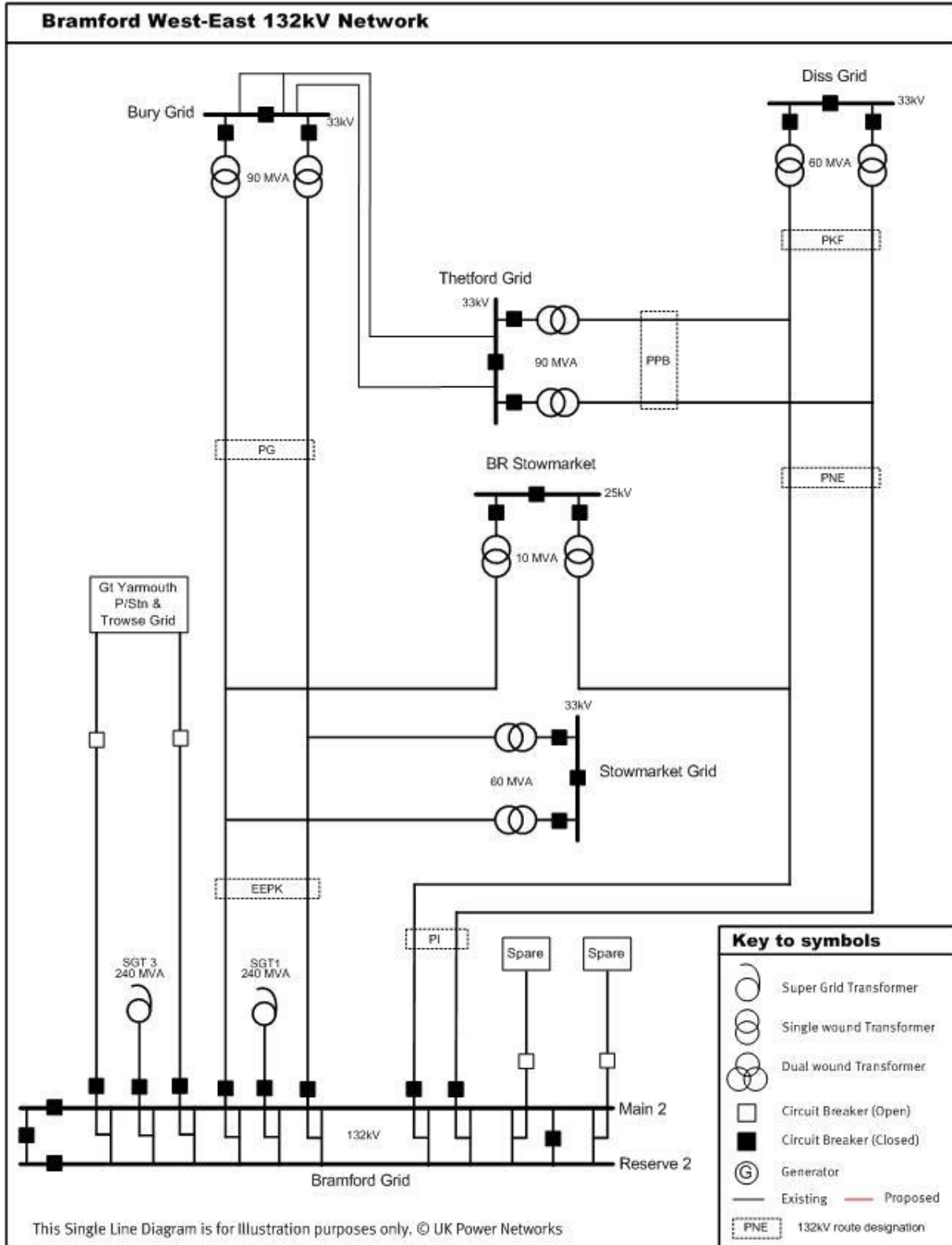
Showing East Suffolk network sites and surrounding circuits



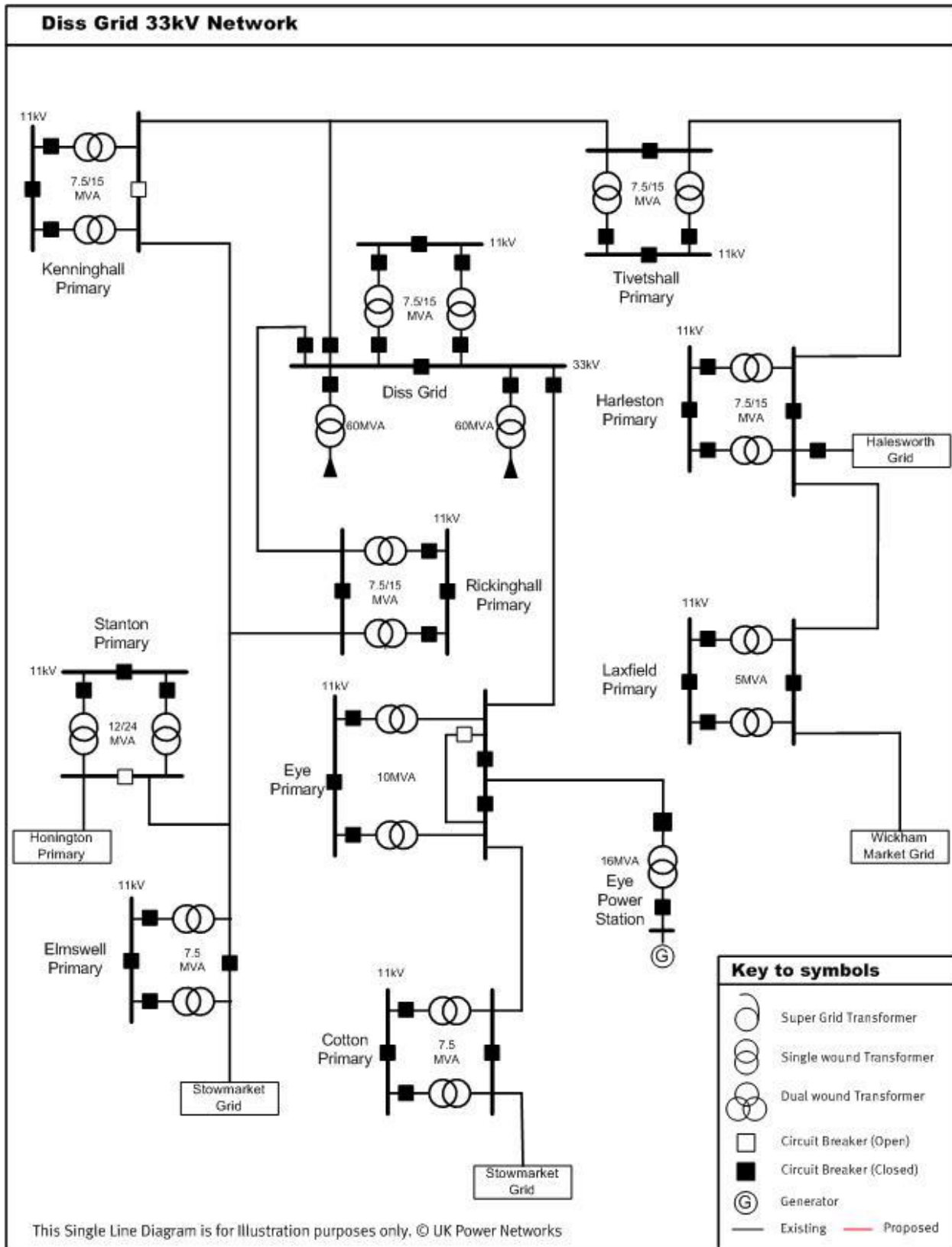
All of the cost numbers displayed in this document are before the application of on-going efficiencies and real price effects.

APPENDIX B: SINGLE LINE DIAGRAM – EXISTING NETWORK

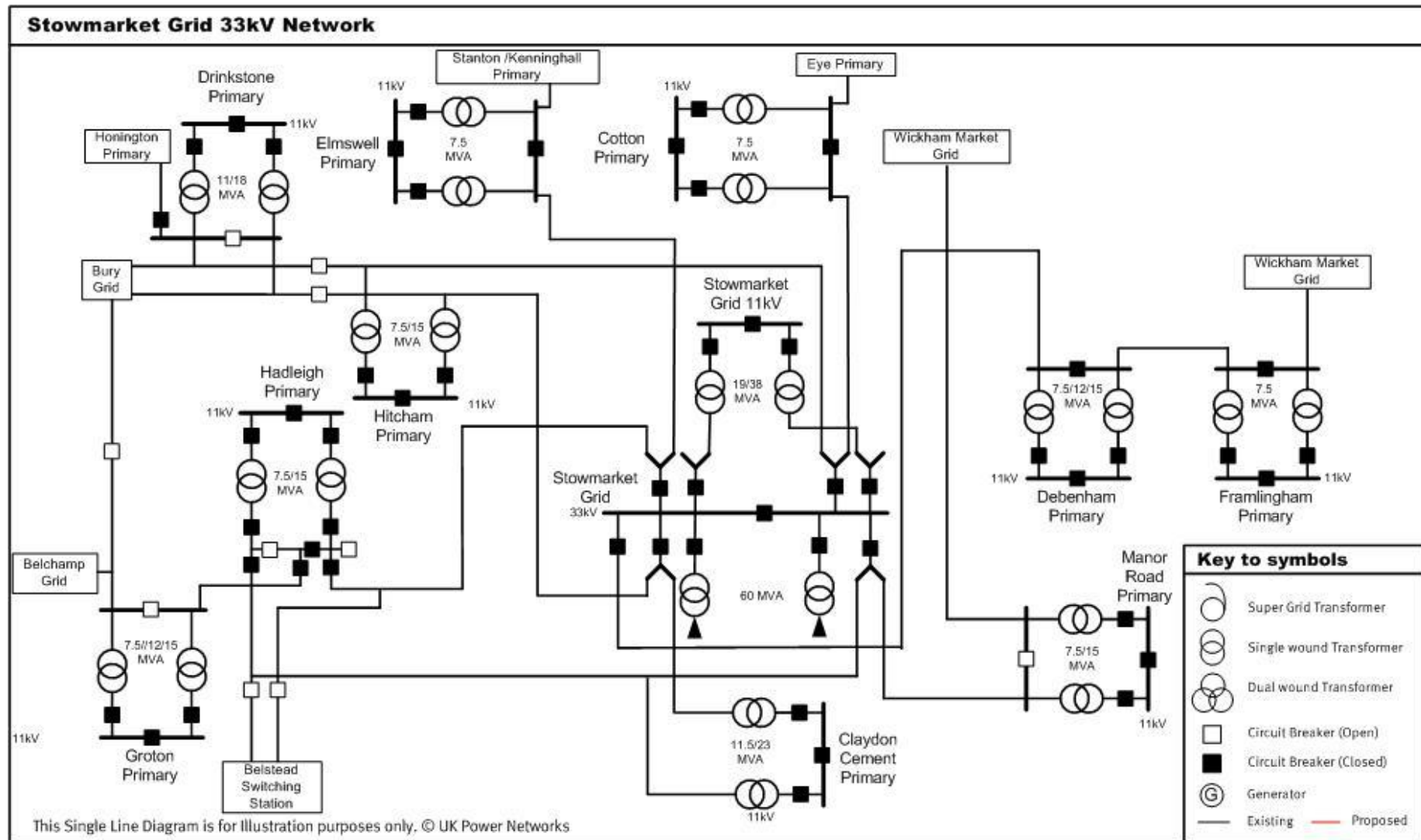
132kV Network



Bramford East – Diss & Stowmarket



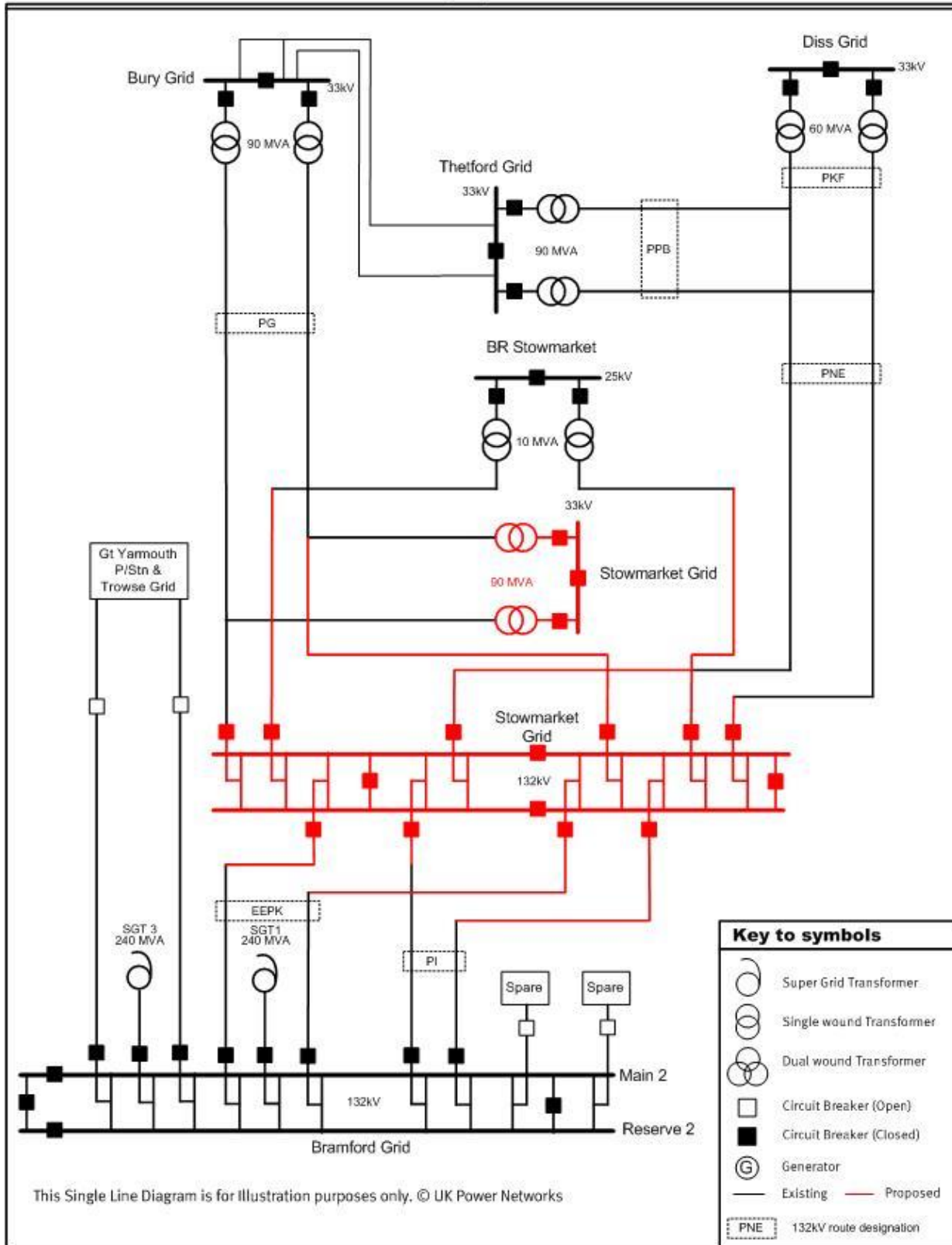
All of the cost numbers displayed in this document are before the application of on-going efficiencies and real price effects.



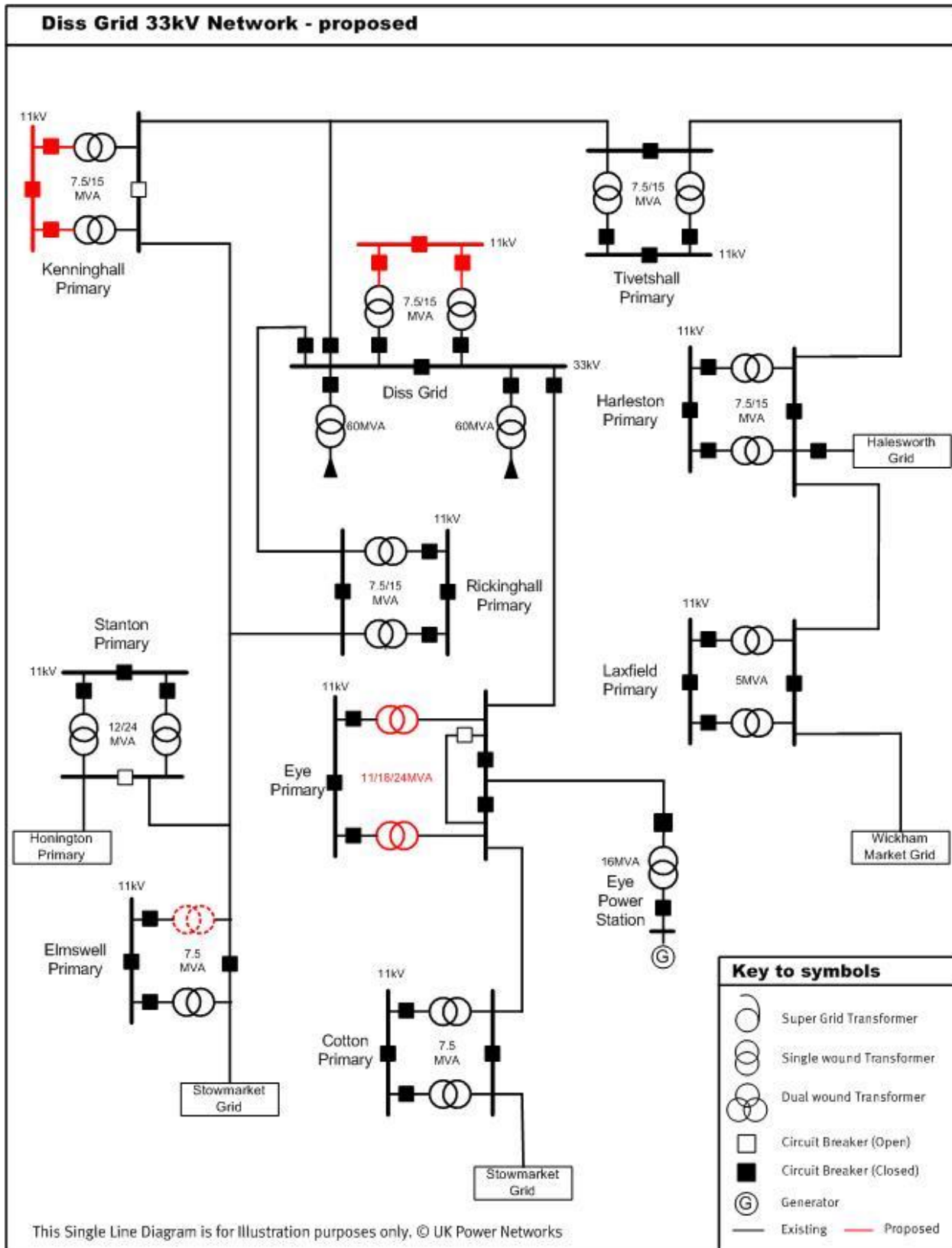
All of the cost numbers displayed in this document are before the application of on-going efficiencies and real price effects.

APPENDIX C: SINGLE LINE DIAGRAM – RECOMMENDED STRATEGY

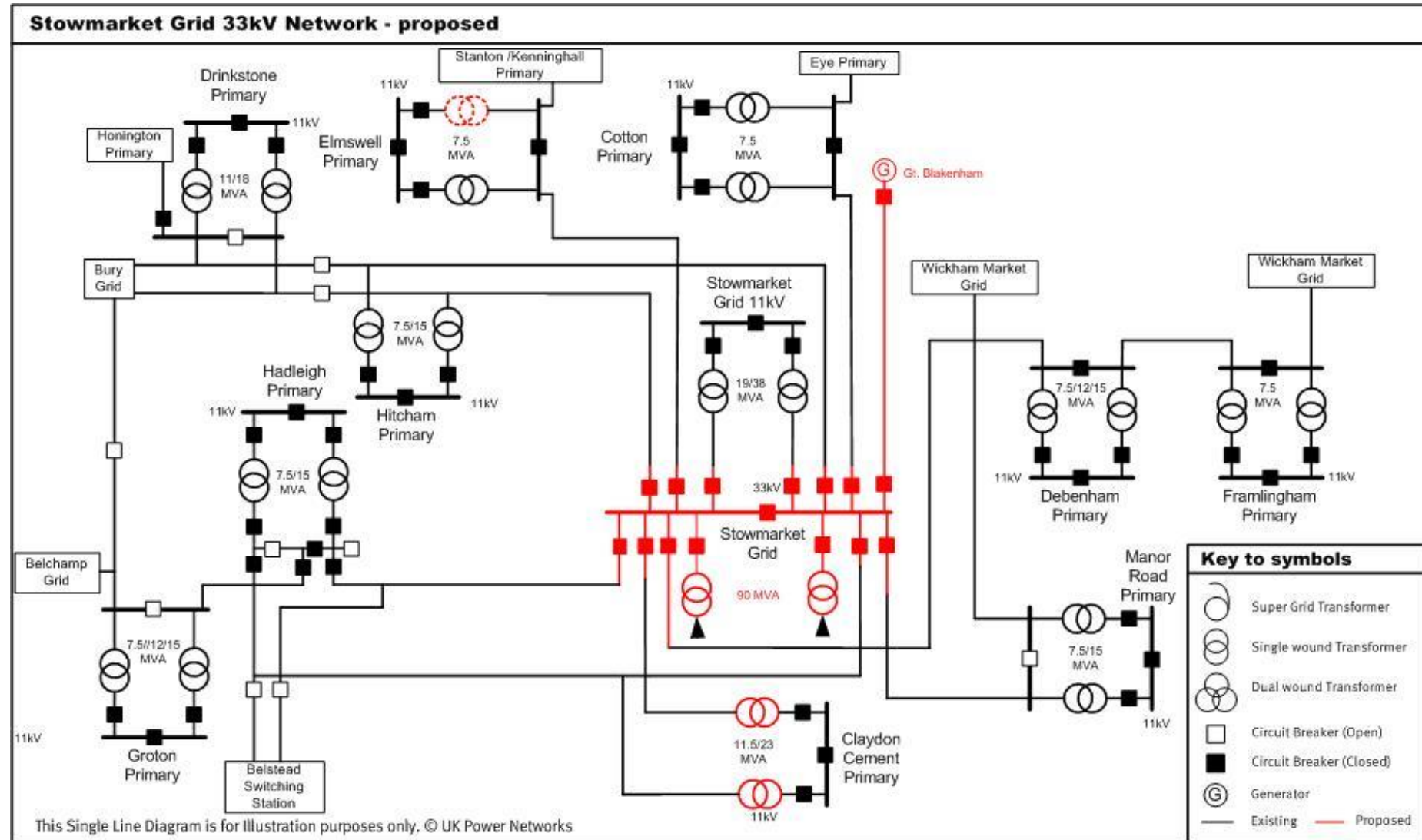
Bramford West-East 132kV Network - proposed



Bramford East – Diss & Stowmarket



Bramford East – Diss & Stowmarket



Regional Development Plan

Bramford East – Diss & Stowmarket

APPENDIX D: DETAILED COSTS FOR RECOMMENDED STRATEGY

NAMP version: Table J Less Ind Baseline 19th February 2014

Cat	Namp Line	Project ID	Description	2012/2013	2013/2014	2014/2015	2015/2016	2016/2017	2017/2018	2018/2019	2019/2020
A	1.02.03	5856	PNE/PKF/PPB - Stowmarket-Rickinghall Junction-Diss/Thetford - Insulator and Fittings Replacement		213,250	559,500	164,251				
A	1.09.01	2197	Diss/Kenninghall 33kV OHL Circuit - 33kV Wood Pole OHL Replacement (575A)					25,438	610,521	855,949	
A	1.09.01	2207	Stow/Debenham 33kV OHL Circuits - Refurbish (575A)	87,325	689,643						
A	1.09.01	2209	Stow/Manor Rd 33kV OHL Circuit - Refurbish (530A W)	317,281	102,903						
A	1.50.01	2499	Stowmarket 132/11kV Grid Substation - Replace 11kV Switchgear			40,026	930,421				
A	1.50.01	7648	Hitcham 33/11kV Primary Substation - Replace 11kV Switchgear								
A	1.50.01	7650	Kenninghall 33/11kV Primary Substation - Replace 11kV Switchgear								
A	1.50.01	7674	Claydon Cement 33/11kV Primary Substation - Retrofit 11kV Switchgear								
A	1.50.01	7676	Cotton 33/11kV Primary Substation - Retrofit 11kV Switchgear								
A	1.51.03	7751	Claydon Cement 33/11kV Primary Substation - Replace Primary Transformers (T1, T2)								
A	1.51.03	7754	Eye 33/11kV Primary Substation - Replace Primary Transformers (T1, T2)					394,039	748,364		
A	1.51.11	7729	Elmswell 33/11kV Primary Substation - Refurbish Primary Transformers (T1)			25,510	125,407				
H	1.29.02	2185	Diss/Thetford 132kV (PI) Circuit - Reinforce (770A)				993,565	2,008,799			
R	1.33.01	5396	Eye 33/11kV Primary Substation - Demand Side Response (DSR)					30,000	30,000	30,000	30,000
R	1.35.01	2159	Bramford GSP 132kV Exit Point - Reinforce	23,733	2,119,864	843,791					
R	1.35.01	2163	(RDP - West Suffolk) Stowmarket 132/33kV Grid Substation - ITC (2 x 90MVA)	4,107	713,304	2,109,131					
R	1.36.01	3501	Stowmarket 132/33kV Grid Substation - New 132kV Switchboard Reinforcement (N-2)							1,351,159	7,500,453
R	1.36.01	3585	Bramford 132kV GSP Exit Point - Reinforce 132kV Switchgear (Fault Level)						2,063,376	5,808,968	3,137,479
R	1.36.03	2508	Stowmarket 132/33kV Grid Substation - Uprate 33kV Switchgear (2000A)		72,068	745,591	733,158				

Regional Development Plan

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APPENDIX E: OUTPUT MEASURES – LOAD INDICES (LI)

PLE information to Table CV102 (LI) – Ofgem definition and Element Energy growth forecast.

Substation	Season	First Limitation	FC NOW (MVA)	DPCR5 Intervention		RIIO-ED1 without intervention				RIIO-ED1 with intervention			P2/6 at End of ED1	
				NAMP	FC ED1 Start (MVA)	2014 (S) 14/15 (w)	2022 (S) 22/23 (W)	2014 (S) 14/15 (w)	2022 (S) 22/23 (W)	NAMP	FC ED1 end (MVA)	2022 (S) 22/23 (W)	P2/6 Class	Comply
Claydon Cement	S	Transformer	17.3		17.3	7.3	8.1	LI1	LI1		17.3	LI1	B	Yes
Cotton	W	Transformer	10.0		10.0	4.8	5.5	LI1	LI1		10.0	LI1	B	Yes
Debenham	W	Transformer	15.0		15.0	6.3	6.4	LI1	LI1		15.0	LI1	B	Yes
Diss Grid	W	Transformer	15.0		15.0	12.1	12.5	LI2	LI2		15.0	LI2	C	Yes
Diss Grid 33	W	Switchgear	68.6		75.0	46.7	47.7	LI1	LI1		75.0	LI1	C	Yes
Elmswell	W	Transformer	9.0		9.0	5.8	6.3	LI1	LI1		9.0	LI1	B	Yes
Eye	S	Transformer	10.0		10.0	9.4	9.5	LI2	LI1	5396	17.4	LI1	B	Yes
Hadleigh Suffolk	W	Circuit Rating	19.2		19.2	11.1	12.3	LI1	LI1		19.2	LI1	C	Yes
Hitcham	W	Switchgear	15.2		15.2	8.5	8.8	LI1	LI1		15.2	LI1	B	Yes
Kenninghall	W	Transformer	15.0		15.0	9.3	9.3	LI1	LI1		15.0	LI1	B	Yes
Manor Road total	W	Transformer	15.0		15.0	9.1	10.4	LI1	LI1		15.0	LI1	B	Yes
Rickinghall	W	Transformer	15.0		15.0	6.2	6.2	LI1	LI1		15.0	LI1	B	Yes
Stanton total	W	Switchgear	23.9		23.9	9.0	9.9	LI1	LI1		23.9	LI1	B	Yes
Stowmarket Grid	W	Circuit Rating	32.6		32.6	25.8	28.1	LI1	LI2		32.6	LI2	C	Yes
Stowmarket Grid 33	W	Switchgear	71.4	2508	78.0	72.1	78.8	LI2	LI1	2163	114.3	LI1	D	Yes
Tivetshall	W	Switchgear	12.0		12.0	7.5	7.6	LI1	LI1		12.0	LI1	B	Yes

APPENDIX F: OUTPUT MEASURES - HEALTH INDICES (HI)

	132kV Switchgear														
	ED1 Start (2015)					ED1 End (2023) No Investment					End of ED1 (2023) With Investment				
Substation	HI1	HI2	HI3	HI4	HI5	HI1	HI2	HI3	HI4	HI5	HI1	HI2	HI3	HI4	HI5
BRAMFORD GRID	16					16					16				
STOWMARKET GRID											14				
TOTAL	16					16					30				

	33kV Switchgear														
	ED1 Start (2015)					ED1 End (2023) No Investment					End of ED1 (2023) With Investment				
Substation	HI1	HI2	HI3	HI4	HI5	HI1	HI2	HI3	HI4	HI5	HI1	HI2	HI3	HI4	HI5
COTTON PRIMARY	1					1					1				
DEBENHAM PRIMARY	1					1					1				
DISS GRID	4	1	3			4		1	2	1	4		1	2	1
ELMSWELL PRIMARY	1					1					1				
EYE PRIMARY	1 1					1 1					1 1				
HADLEIGH PRIMARY SUFFOLK	5					5					5				
KENNINGHALL PRIMARY	1					1					1				
MANOR ROAD PRIMARY	1					1					1				
RICKINGHALL PRIMARY	1					1					1				
STANTON PRIMARY	1					1					1				
STOWMARKET GRID	10					10					10				
TIVESHALL PRIMARY	1					1					1				
TOTAL	10	16	7			10	13	2	4	4	10	13	2	4	4

	11/6.6kV Switchgear														
	ED1 Start (2015)					ED1 End (2023) No Investment					End of ED1 (2023) With Investment				
Substation	HI1	HI2	HI3	HI4	HI5	HI1	HI2	HI3	HI4	HI5	HI1	HI2	HI3	HI4	HI5
CLAYDON CEMENT PRIMARY	8 2					4 6					10				
COTTON PRIMARY	3 4					3 4					7				
DEBENHAM PRIMARY	7					4 1 2					4 1 2				
DISS GRID	9 2					1 3 7					1 3 7				
ELMSWELL PRIMARY	6					6					6				
EYE PRIMARY	1	2	4	1		1	3	2	2		1	3	2	2	
HADLEIGH PRIMARY SUFFOLK	10					6 3 1					6 3 1				
HITCHAM PRIMARY	1 7					1 3 4					8				
KENNINGHALL PRIMARY	7					4 3					7				

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Substation	11/6.6kV Switchgear														
	ED1 Start (2015)					ED1 End (2023) No Investment					End of ED1 (2023) With Investment				
	HI1	HI2	HI3	HI4	HI5	HI1	HI2	HI3	HI4	HI5	HI1	HI2	HI3	HI4	HI5
MANOR ROAD PRIMARY		6	3					6	2	1			6	2	1
RICKINGHALL PRIMARY		7					7					7			
STANTON PRIMARY		8					8					8			
STOWMARKET GRID	2	2	10	1		4	1	8	2		15				
TIVETSHALL PRIMARY		7					2	5				2	5		
TOTAL	3	50	63	4		33	42	30	15		30	34	32	11	13

Substation	Grid and Primary Transformers														
	ED1 Start (2015)					End of ED1 (2023) No Investment					End of ED1 (2023) With Investment				
	HI1	HI2	HI3	HI4	HI5	HI1	HI2	HI3	HI4	HI5	HI1	HI2	HI3	HI4	HI5
CLAYDON CEMENT PRIMARY		1		1			1			1	2				
COTTON PRIMARY		2					2					2			
DEBENHAM PRIMARY	1	1				1	1				1	1			
DISS GRID		4					4					4			
ELMSWELL PRIMARY		1			1		1			1		1	1		
EYE PRIMARY					2					2		2			
HADLEIGH PRIMARY SUFFOLK	2					2					2				
HITCHAM PRIMARY	2					2					2				
KENNINGHALL PRIMARY		2					1	1				1	1		
MANOR ROAD PRIMARY		2					2					2			
RICKINGHALL PRIMARY		2					2					2			
STANTON PRIMARY		1	1					1		1			1		1
STOWMARKET GRID		5			1		2	3		1	2	2	2		
TIVETSHALL PRIMARY		2					1	1				1	1		
TOTAL	5	23	1	1	4	5	17	6		6	11	16	6		1

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 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

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APPENDIX G: GENERATION HEAT MAP

The heat map presented in this page is indicative of the capability of the high voltage electrical network to accept connection of new generation equipment. The area in red indicates that the network in that area is effectively at saturation point with respect to existing generation connections. The amber and green areas indicate parts of the network that currently have limited and spare capacity to connect new generation equipment at HV or above.

