



Regional Development Plan

RDP09 Bramford GSP - West Suffolk 33kV Network (EPN)

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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.

Contents

1. EXECUTIVE SUMMARY	3
1.1 SUMMARY OF ISSUES ADDRESSED	3
1.2 RECOMMENDED STRATEGY	3
2. NETWORK CONFIGURATION	6
2.2 NETWORK CHANGES IN PROGRESS	7
3. SUMMARY OF ISSUES	7
3.1 DEVELOPMENT AREAS	7
3.2 ASSET REPLACEMENT.....	9
3.3 SECURITY OF SUPPLY ANALYSIS.....	11
3.4 OPERATIONAL AND TECHNICAL CONSTRAINTS	11
3.5 NATIONAL GRID.....	11
4. RECOMMENDED STRATEGY.....	11
4.1 DESCRIPTION.....	12
4.2 FINANCIAL APPRAISAL AND BENEFITS	13
5. STRATEGIES CONSIDERED	13
5.1 REINFORCE WESTERN FRINGE FROM BURY	13
5.2 BRAMFORD-STOWMARKET 132kV CIRCUITS	13
6. REFERENCES	14
6.1 APPENDICES.....	14
6.2 DOCUMENT HISTORY.....	14
7. DOCUMENT SIGN OFF.....	15

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1. Executive Summary

This Regional Development Plan (RDP) reviews UK Power Networks (UKPN) EPN HV and EHV network of Bury and Thetford Grids, supplied from Bramford Grid Supply Point (GSP). These are directly interconnected via Fornham Primary and on a longer route via Drinkstone Primary. There is also an 11kV interconnection via the busbars at Mildenhall Primary (33kV possible via N.O. manual isolator). Similar 11kV interconnections with 33kV NOPs occur at Boxted towards Belchamp Grid and at Stanton towards the Stowmarket/Diss interconnected network which will be covered in separate documents.

The area of West Suffolk and Breckland (Norfolk) is characterized as mostly rural and includes the towns of Bury St Edmunds, Mildenhall and Thetford, covering an area of circa 320km² and circa 150 thousand people.

Key Infrastructure in the region is RAF Mildenhall, with a maximum power requirement (MPR) of 11MVA at 11kV supplied from Mildenhall Primary and RAF Lakenheath, with a MPR of 12MVA at 11kV supplied from Lakenheath Primary.

There is significant generation support from British Sugar (~55MW for Bury Grid) and Thetford Power Station (~40MW for Thetford Grid).

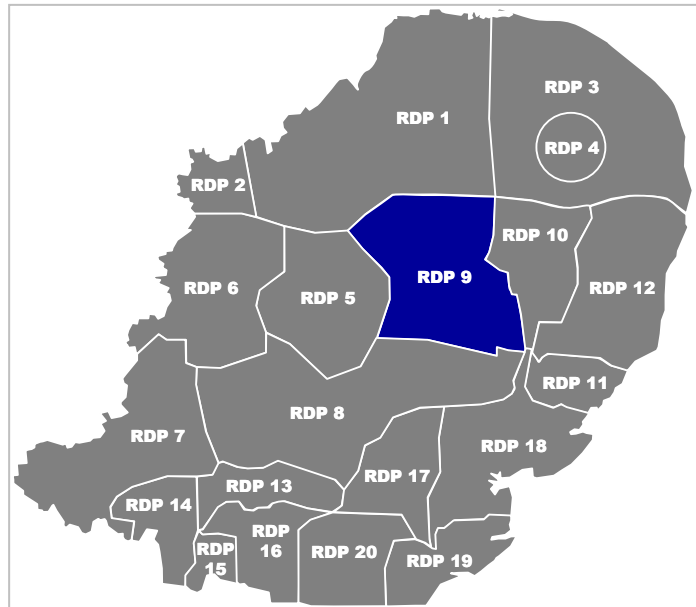


Figure 1 – Area covered by the RDP

1.1 Summary of issues addressed

This document covers the future development of the network based on the latest Planning Load Estimate (PLE) predictions coupled with outline increases from Local Authority Development Plans. Condition-based plant replacement as the method of assessing the Health Index (HI) of plant has been taken into account.

The significant development areas are around the two main towns of Bury St. Edmunds and Thetford but the western fringe of the 33kV network also needs consideration. A major project proposed will be the transfer of this western fringe onto Burwell Grid. This will secure the available transformer capacity in the region, provide interlink to a previously separate source, and defer the need for major 132kV reinforcement from Bramford. It would however probably require ITC at Burwell if that had not been carried out already. A transfer of Histon Grid, approximately 45MVA, away from Burwell Supergrid is already planned for ED1 for P2/6 compliance, but this is dependent on SGT reinforcement at Eaton Socon (5619 & 3614) plus switchgear replacement at Lt. Barford (5593) and a firm transfer is unlikely before 2017. The predicted load growth around Cambridge plus the transfer from the West Suffolk network will negate the Histon transfer and once more raise a P2/6 issue at Burwell Supergrid.

1.2 Recommended Strategy

The major load increases foreseen will be around the two major towns – Bury St. Edmunds and Thetford, with smaller but perhaps more challenging increases around Mildenhall and Red Lodge. All these areas will see both domestic and job-related increases.

For Bury St. Edmunds the western and north-eastern edge-of-town developments may both require new Primary sites. At Thetford the expansion will be in one new area to the north of the town, for which a new Primary is necessary.

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The Mildenhall/Red Lodge area is on the very western edge of the 33kV network fed from Bury and Thetford. It is proposed to create a new 33kV link from Burwell Grid to a switching station (and future Primary site) in the Red Lodge area to provide a more robust supply to Mildenhall/Kennett and also transfer load away from Bury/Thetford. This will reduce the load on the overhead lines between Bramford and Stowmarket and thus delay the need for their further reinforcement. When this does eventually become necessary a 132kV busbar at Stowmarket will allow the two pairs of lines to be run with 3-from-4 overall security or alternatively two new cables from Bramford to Stowmarket feeding the Thetford/Diss lines will allow the Bury and Stowmarket transformers to be run on separated circuits.

Present and forecast loads for the Grid and Primary substations on the West Suffolk network are given in the Planning Load Estimate (PLE) data in Appendix E. Unless there are specific reasons (e.g. confirmed Connections projects) any load increase shown is based on global predictions and does not account for possible development areas such as discussed in section 3. The predictions for future years must therefore be treated with caution.

Generation

There are two major generators in this area which provide considerable support to the 33kV network.

Thetford Power Station	MPR 48.1MVA	MD 42.8MVA
British Sugar (Bury)	MPR 58MVA	MD 56MVA

Investment Profile

Figure 2 provides the projected expenditure profile for reinforcement and asset replacement projects (LRE and NLRE) in this RDP for both DCPR5 and ED1. This information is taken from the NAMP version 05-06-2013.

Figure 2.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	£1.6m	£0.0m	£0.2m	£0.9m	£0.7m	£0.0m	£0.3m	£2.9m	£3.0m	£8.1m
NLRE	£0.5m	£0.0m	£0.0m	£0.3m	£0.9m	£0.8m	£0.8m	£0.6m	£1.2m	£4.6m
TOTAL	£2.1m	£0.0m	£0.2m	£1.1m	£1.6m	£0.8m	£1.1m	£3.5m	£4.2m	£12.7m

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.

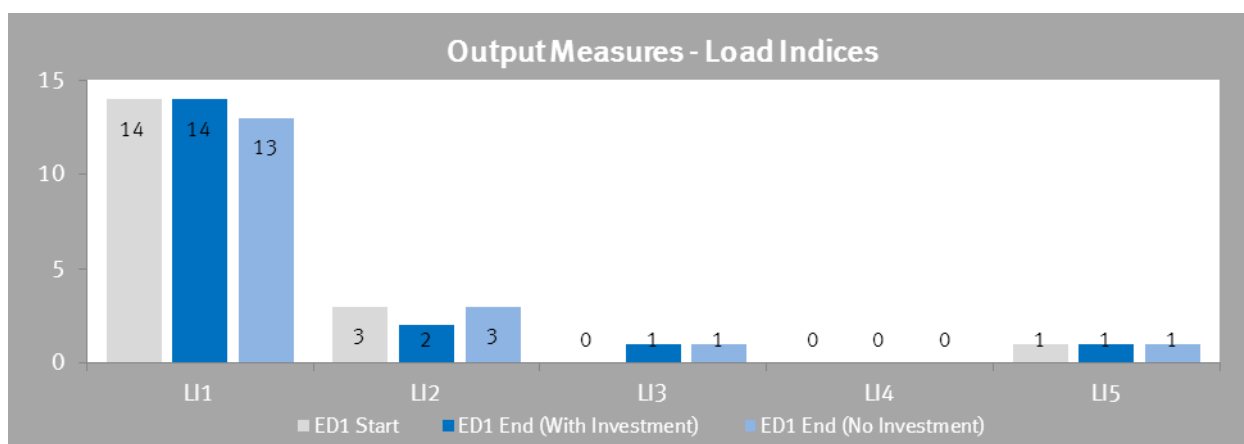
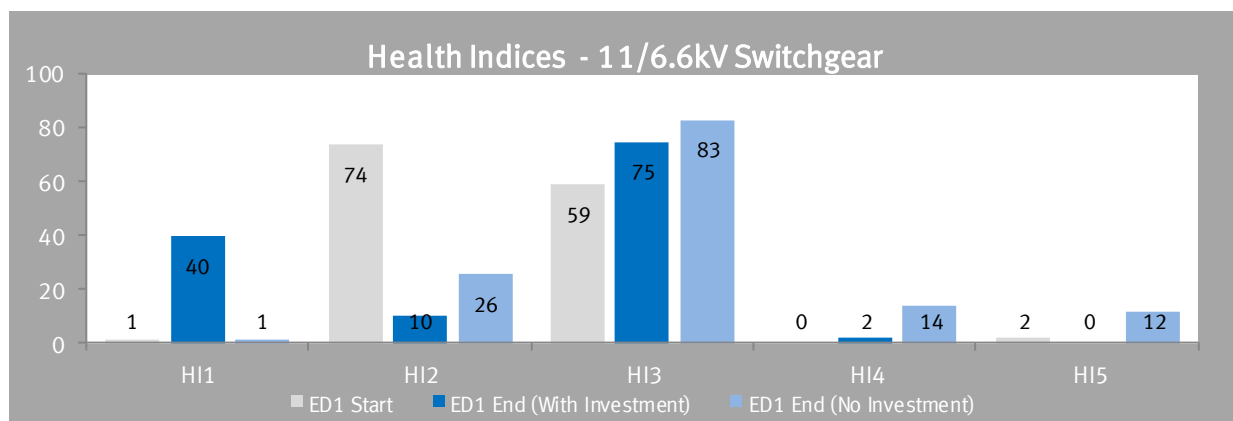
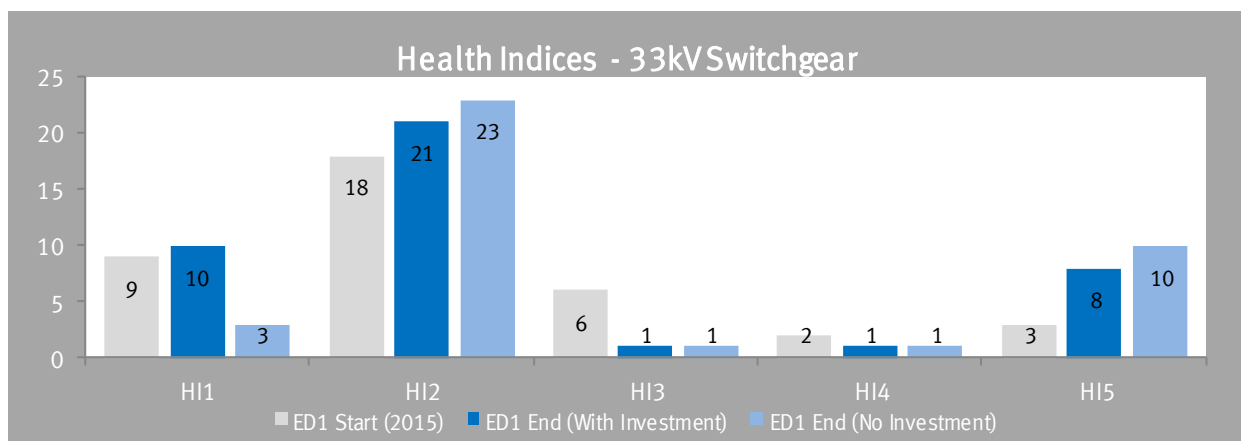
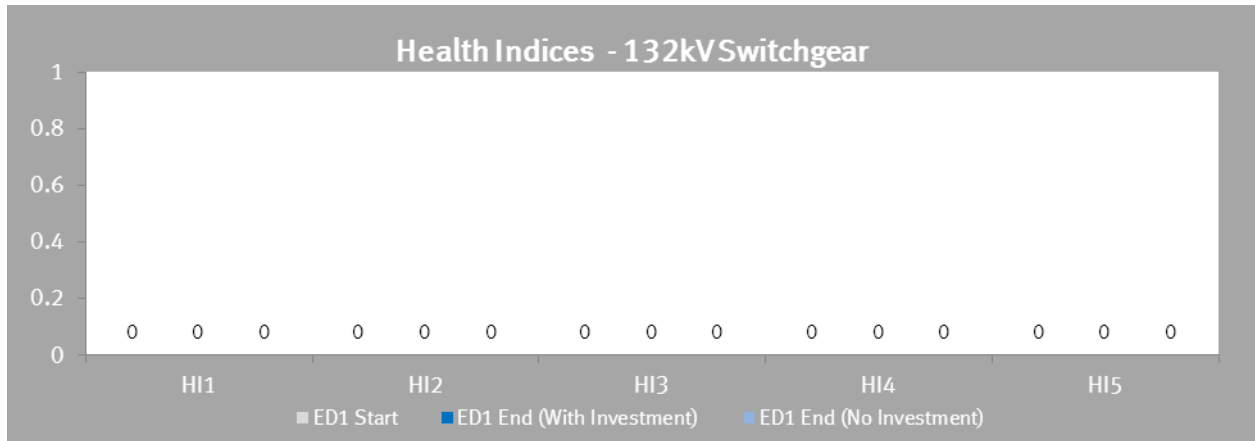


Figure 3.2022/23 Load Indices with and without interventions

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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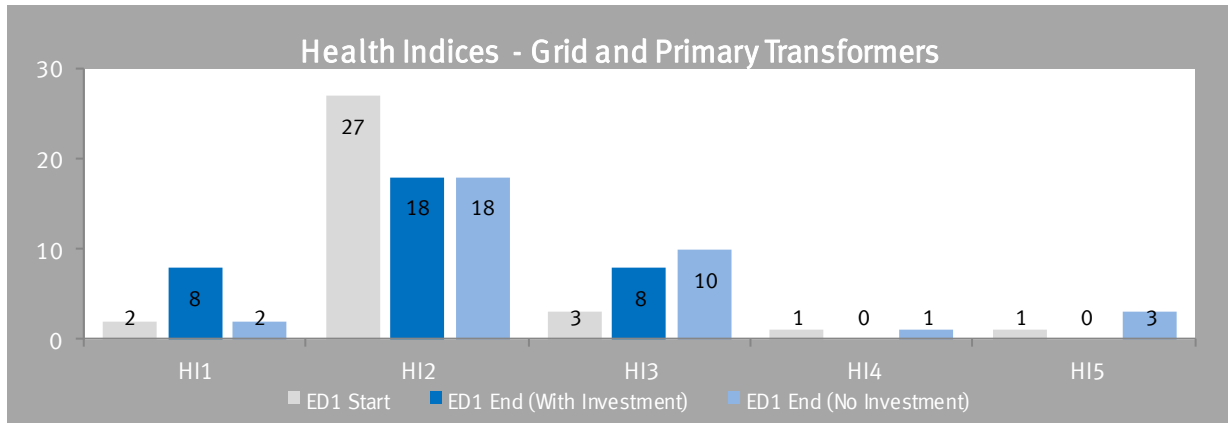


Figure 4. Health Indices by asset category

Scenarios Considered

Reinforce western fringe from Bury – to be a long-term solution an additional circuit needs to be laid from Bury Grid to a position close to the Lackford tee points for Kennett, where it would be able to support Kennett, Icklingham and Mildenhall. The load will continue to be supplied from Bury Grid and will not defer the need to reinforce the Bramford-Stowmarket overhead circuits.

Reinforce Bramford-Stowmarket circuits to 400ACSR when required. Although the towers are believed to be suitable for the larger conductor, ground clearances will probably not be adequate and tower replacements needed. The network would still be totally radial with no significant external interconnections.

RDP Dependencies and Interactions

The timing of most of these projects will be dictated by load growth and on-going 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.

Transfer of the western fringe load to Burwell will affect both Grid and Supergrid there. Firm capacity from Burwell is unlikely to be available before 2017, but the proposed interconnection would allow the fringe to be fed from either direction.

Interaction with Regional Development Plans of Twinstead GSP, Burwell GSP and Bramford GSP East.

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. For this study the requirements of the 132kV network as far as Bramford will be considered. The 33kV network fed from Bury and Thetford Grids only is within the scope of this document and that from Diss and Stowmarket is studied separately.

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On the 33kV network Bury and Thetford Grids run in parallel via Fornham and Drinkstone, and are loose coupled on the 11kV busbars at Mildenhall. There is also a loose coupled connection between Thetford and Diss/Stowmarket at Stanton and from Bury to Belchamp Grid via Boxted but the latter connection will not be part of this study.

Bury Grid has two new 90MVA transformers and is supported by British Sugar generating about 56MW. Thetford Grid also has two recently installed 90MVA transformers supported by Thetford Power Station at about 42MW.

2.2 Network changes in progress

The schemes below are either in progress or due to be completed prior to 2015.

Bramford GSP 132kV Exit Point – reinforce

The predicted load at Bramford Grid Supply Point will exceed the existing firm capacity, including the transfer capacity to Norwich and Rayleigh Grid Supply Points via the 132kV network. It is therefore proposed to augment the existing NG transformers with another unit. The existing switchgear is rated for this increased load but it is necessary to move existing circuit connections and replace current transformers.

(RDP - West Suffolk) Bury/Barrow 33kV cable - reinforcement (575A)

The predicted load on the Bury/Barrow circuit will exceed the existing rating. It is not possible to lower the load without compromising operational and planning requirements. Completion of this project will see a 2km underground replacement circuit.

Stowmarket – Bury 132kV tower line (PG) refurbishment

This is a 132 kV double circuit line which runs for 23.7km from Stowmarket to Bury. It consists of 82 towers built in 1957 to the PL16 design. It has Lynx phase conductors (175mm² ACSR) and Horse earth wire (70mm² ACSR), neither of which have any record of being reconducted. During a line patrol, it was recorded that the fittings and insulators were in poor condition on the entire route. The earthwire is being replaced with and so the earth fittings will also be replaced at this time. Therefore only the phase fittings needs replaced.

Drinkstone Primary – retrofit 11kV CBs

The 11kV switchboard at Drinkstone Primary is primarily made up of SWS type C8X/C4X. The highest health index at this site is HI4. As part of the asset replacement strategy it is proposed to retrofit eight circuit breakers.

3. Summary of Issues

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. Kimms Belt, Mildenhall, Fornham and Bury Grid 11 are more likely to see this effect.

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Generation

There are two major generators in this area which provide considerable support to the 33kV network.

Thetford Power Station	MPR 48.1MVA	MD 42.8MVA
British Sugar (Bury)	MPR 58MVA	MD 56MVA

Others with small capacity include 3 sites total MD ~1.5MVA into Fornham, 2 sites total MD ~2MVA into Feltwell and one site ~0.5MVA into Kennett. A list of recent generation enquiries is given in the Appendices.

Although these existing will reduce the visible load, they are each single machines with single points of connection run in association with a specific process. For these reasons their contribution cannot be considered ‘firm’ and due account should be made when determining the timing of network reinforcement. The recent rush of ‘solar farm’ enquiries has yet to translate into many actual installations.

Customer enquiries

Tentative enquiries are received for several specific parts of this area, but until the economic situation improves there will be few firm requests.

Overall developers are known for the Bury St. Edmunds housing areas, but they are in the very early stages of their own plans, as are those for the Thetford housing.

The employment enquiries mainly centre on the two existing industrial sites in Thetford, and two around Bury St. Edmunds, although hardly any actually go ahead at this time.

Council Development Plans

The major part of this area is covered by three District Councils.

- St. Edmundsbury covers the town of Bury St. Edmunds and immediate areas in all directions.
- Breckland covers Thetford and surroundings.
- Forest Heath covers the western fringe of the area from Brandon down to Kennett.

All have recently been through the process of new long-term plans for housing and employment requirements. The change of Government in 2010 has resulted in some modifications but in general the overall figures are unchanged apart from possible timing issues. The details of their proposals are given in 3.2.1 below

Housing

The effect on electricity demand of the new low/zero carbon Building Regulations will not be apparent for some time, but with a mix of housing sizes an ADMD of 1.5kVA per dwelling will be assumed.

Forest Heath

4000 new dwellings up to 2031, with associated jobs and other infrastructure. Housing areas of Mildenhall 1200, Brandon 700 (1200 if relief road available), Lakenheath 600, Red Lodge 1100, West Row+ Kentford+ Beck Row 600. The Forest Heath housing requirement is currently being reviewed due to a High Court ruling. Three scenarios are suggested ranging from ~4500 to ~8200 new dwellings in roughly the same proportions across the settlements)

Location	Number	Primary	New Load
Mildenhall	1200	Mildenhall	1.8MVA
Brandon	700 (1200*)	Brandon	1.1MVA (1.8MVA)
Lakenheath	600	Lakenheath	0.9MVA
Red Lodge	1100	Kennett	1.7MVA
Kentford	600	Kennett	0.9MVA
West Row, Beck Row		Mildenhall	

* Only if a new relief road is built

Breckland

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Thetford area ~5000 new dwellings, mostly greenfield to the north of the town

It is proposed that a new Primary “Thetford North” be constructed. This would cater for the new development (~7.5MVA plus associated community facilities and local employment) and take some existing load off Water Lane.

St. Edmundsbury

Bury St. Edmunds ~5900 new homes to 2031 in four main areas, with at least the same number of jobs.

Location	Number	Primary	New Load
Bury North-west	900 + Primary School	Fornham*	1.5MVA
Westley	500 + future hospital site	Playfields*	0.8MVA + 2MVA
Bury South-east	1250 + Primary School	Bury Grid 11	2MVA
Moreton Hall	500 + Secondary School	Bury Grid 11^	1MVA
Compiègne Way	1250 + Primary School	Bury Grid 11^	2MVA

* The combination of Bury North-west, Westley +hospital and the continuing growth of the industrial sites at Saxham and Risby makes a case for considering a new Primary at/near the Westley site. One new 630Al cable would be adequate for one side of the new site plus the existing line towards Barrow. The old Barrow cable would then be used for the other feed to the new site. (See also 4.2 item 5 below)

^See comment in Employment below

The balance of homes will be from smaller ‘brownfield’ sites which would normally be supplied from the existing 11kV/LV network without significant reinforcement. (Ref St. Edmundsbury B.C. Bury Vision 2031)

Employment

The ‘load per job’ is extremely variable, so no estimate has been made of the effect on the local network. Where appropriate, these areas are shown on the Housing maps in Appendix H.

Forest Heath

5000 jobs – mainly Mildenhall, Lakenheath, Brandon, and Red Lodge. Loads will fall on the Primary S/Stns mentioned in the Housing assessment above.

Breckland

Thetford area ~5000 new jobs by 2026. Expansion of the two existing industrial areas around Kimms Belt and to north of the town, plus additional smaller zones within the Thetford North development.

St. Edmundsbury

Bury St. Edmunds ~5000 jobs. These will be split between the main industrial estates –Mildenhall Road (Fornham), Suffolk Business Park-Rougham (Bury Grid 11), and Saxham/Risby (Fornham/Barrow) plus town centre general employment (Playfields).

The comment above regarding a possible new Primary at Westley is applicable here regarding Saxham/Risby. A similar situation exists with the Suffolk Business Park-Rougham area. It is currently fed from Bury 11, but recent load requests for >20MVA exceed the present summer spare capacity there. It is not possible to add further capacity at Bury 11kV, transfer to Playfields would require reinforcement there and would be limited by small cable size interconnections. A ‘Moreton Hall Primary’ (PIMS 6179) would secure the network in that part of the town for both domestic and employment load.

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).

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Stowmarket/Bury (PG) Refurbishment

The 132 kV double circuit line runs for 23.7km from Stowmarket to Bury. It consists of 82 towers built in 1957 to the PL16 design. It has Lynx phase conductors (175mm² ACSR) and Horse earth wire (70mm² ACSR), neither of which have any record of being reconducted.

During a line patrol, it was recorded that the fittings and insulators were in poor condition on the entire route. A scheme was raised to replace the fittings and insulators on the entire route. It was decided that instead of this, only 10% of the fittings and insulators would be replaced and these would be sent to EA Technology for testing.

The report has been returned from EA Technology and it shows that the insulators are near their end of life, and replacement should be considered in the near future.

The earthwire is being replaced with OPGW in 2012 and so the earth fittings will also be replaced at this time. Therefore only the phase fittings needs replaced.

The scope of the project is:

- Replace all phase fittings and insulators (47.4km)
- Rectify any other defects in Ellipse, or found while on site.

Thetford 132/33kV Grid Substation - Replace 33kV Switchgear

The condition assessment of the 1967/71 EEC OKM4 outdoor oil insulated switchgear installed at Thetford 132/33kV Grid Substation has shown that the probability of failure due to degradation will become unacceptable. Completion of the project will see 6 circuit breakers replaced with 6 new circuit breakers. 7 Circuit breakers are of a modern type, although some associated isolators are 1960 original. A civil assessment is recommended, specially the concrete structures.

Lakenheath 132/33kV Grid Substation - Replace 33kV Switchgear

The condition assessment of the 1971 EEC OKM4 outdoor oil insulated switchgear installed at Lakenheath 132/33kV Grid Substation has shown that the probability of failure due to degradation will become unacceptable. Completion of the project will see 2 circuit breakers replaced with 2 new circuit breakers. A civil assessment is recommended, specially the concrete structures.

Fornham 33/11kV Primary Substation - Replace 11kV Switchgear

The condition assessment of the 1968 AEI BVRP1 indoor oil insulated switchgear installed at Fornham 33/11kV Primary Substation has shown that the probability of failure due to degradation will become unacceptable. Completion of the project will see 9 circuit breakers replaced with 9 new circuit breakers. May need earlier replacement if extra feeder needed for Fornham housing. The bus section breaker does not have remote control.

Barrow 33/11kV Primary Substation - Replace 11kV Switchgear

The condition assessment of the 1967 SWS C4X & D8/12X indoor oil insulated switchgear installed at Barrow 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. The bus section breaker does not have remote control.

Icklingham 33/11kV Primary Substation - Replace 11kV Switchgear

The condition assessment of the 1962 SWS C4X & C8X indoor oil insulated switchgear installed at Icklingham 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. The bus section breaker does not have remote control.

Mildenhall 33/11kV Primary Substation - Replace 11kV Switchgear

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The condition assessment of the 1967 AEI BVRP1 indoor oil insulated switchgear installed at Mildenhall 33/11kV Primary Substation has shown that the probability of failure due to degradation will become unacceptable. Completion of the project will see 12 circuit breakers replaced with 12 new circuit breakers. 7x restricted VMX trucked CBs, remainder AEI BVRP1. Transformers to be replaced under reinforcement.

Barrow 33/11kV Primary Substation - Replace Primary Transformers (T1, T2)

The condition assessment of the 1962 WAT Primary Transformer installed at Barrow 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.

Honington 33/11kV Primary Substation - Refurbish Primary Transformers (T1, T2)

The condition assessment of the 1972 EEC Primary Transformer installed at Honington 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 refurbished.

3.3 Security of supply analysis

P2/6 Compliance table is available in the Appendices.

3.4 Operational and technical constraints

No significant operational and technical constraints have been identified in this network area.

Connection of Generation - Heat Map

It is generally possible to connect generation equipment to the electricity network at all voltages, but this capability can be restricted by a number of elements which may be:

- a) The amount of new generation that can be connected relative to the existing load/demand on the system;
- b) The proposed location and size of the generator;
- c) The nature of the existing equipment;
- d) The amount of generation connected or committed to connect

The heat map presented in the Appendices is indicative of the capability of the high voltage electrical network to accept connection of new generation equipment.

3.5 National Grid

Bramford 132kV GSP Reinforcement

This scheme is to replace the existing 132kV switchgear with plant with a higher fault rating. This will allow the five existing SGTs to be run in parallel, thus removing the problems associated with split running and complicated restoration using a 'hot standby' SGT. The timing will be dependent on the load increases on either bar.

4. Recommended strategy

The 33kV network fed from Thetford and Bury Grids relies significantly on the two major power stations – Thetford and British Sugar. While there are no known reasons why either should stop generation, the latter is tied to the continued sugar production at the site, and the former has had problems with fires in the incoming fuel storage areas. The 132kV supplies to the whole of west and central Suffolk are dependent on two dual-circuit tower lines which converge (but remain separate) at Stowmarket.

While covering the localised areas of reinforcement at the appropriate time, the long-term aim is to provide some supply from a different source and to allow better utilisation of the circuits between Bramford and

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Stowmarket. The two major schemes which give these results are Red Lodge 33kV Switching Station and associated circuits to Mildenhall and Kennet all fed from Burwell (4272), and a 132kV busbar at Stowmarket (3501) or additional cable circuits from Bramford to Stowmarket. This future 132kV requirement is examined in more detail in the RDP for Suffolk East network covering Stowmarket and Diss Grids.

Red Lodge 33kV Switching Station

An area to the north of Red Lodge village is included in the Forest Heath Council long-term plan for gradual housing and employment use. It is currently fed from Kennett Primary but that supply will not be adequate for any major loads despite the use of capacitors for n-1 voltage support (commissioned summer 2012). A new 33kV source in the Red Lodge area will give significantly better voltage at Kennett and Mildenhall and allow these two sites plus Icklingham to be transferred off the Bury Grid network. The interconnection will also provide capacity for further emergency transfers off Bury or Thetford. Red Lodge site will have space for future 33/11kV transformers and 11kV switchroom. Associated with this scheme is 4325 Eriswell 33kV Switching Station which provides a greatly improved switchable interconnection between Bury, Thetford and the new Red Lodge source. The acquisition of a suitable site for this switchboard has proved extremely difficult and an alternative scheme using separate pole-mounted equipment should be seriously considered. See Appendix D for localised SLD.

Stowmarket 132kV switchgear

With the continued expansion of Bury and Thetford (and to a lesser extent Stowmarket and Diss – see RDP for Suffolk East for more detailed discussion), the load on the pairs of 300mm² circuits from Bramford as far as Stowmarket will continue to grow. An option is to build a 132kV busbar at Stowmarket which will allow all four circuits to run firm 3-from-4.

4.1 Description

The table in the appendix G lists the substation LI category according to PLE figures which are based on an overall growth rate and do not make allowance for specific development areas. Both Bury and Thetford towns will be centres for expansion during the period and will alter the given PLE figures.

Thetford

The Breckland Council Development Plan for the period to 2031 sees the area on the northern edge of Thetford developed with ~5000 homes and associated community facilities plus some additional employment. Further employment will be provided by the expansion and redevelopment of the existing industrial areas on the north-western and western edges of the town. It is proposed to construct a new Primary substation 'Thetford North' at an early stage of house building. This will cater for the housing development, allow load to be transferred from Water Lane, and between them supply the north-western industrial load. Kimms Belt will supply the western area, requiring new switchgear and transformers as the load warrants. Map in Appendix H

Bury St. Edmunds

St. Edmundsbury Council Development Plan for the period to 2031 calls for housing expansion in four separate areas around the town, as well as the completion of a previously designated area and the provision of suitable community facilities and employment. A map is in Appendix H.

The completion of Moreton Hall to the east of the town is in progress and will add about 1MVA to Bury 11.

The next phases will be the two sites to the west – Bury NW and Westley (which will also be the future site for the relocated West Suffolk Hospital). There are nearby employment areas at Saxham and Risby with expansion potential, and the present industrial area near Fornham is underutilised. The suggested scheme for this area is to build a new Primary on the Westley site. This will supply Westley and the future hospital, allow transfer from Playfield to delay reinforcement there, and supply Saxham from Westley instead of Fornham.

Bury SE and Compiegne Way are the final areas in the present plan. The employment area at Suffolk Business Park will be expanded to join with a redeveloped Rougham industrial site along a new relief road. All are

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presently fed from Bury 11. The employment load and (increasingly) the effects of low-carbon rules will determine whether Bury 11 will have adequate capacity. It may therefore be necessary for a new Primary (Moreton Hall) to be built to the east. (1/11/12 – Load enquiry for 25MVA for development at Suffolk Business Park. This will exceed the summer rating of Bury 11 and trigger a new Primary)

Brandon 33/11kV Primary Substation - ITC (2x 11/18/24MVA) & 11kV Switchgear

The predicted load at Brandon Primary Substation will exceed the existing firm capacity, including the transfer capacity to Feltwell and Lakenheath Substations. It is therefore proposed to replace the existing transformers with 2 x 11/18/24MVA and a new switchboard comprising 10 circuit breakers.

Mildenhall 33/11kV Primary Substation - ITC (2 x 11/18/24MVA)

The predicted load at Mildenhall Primary Substation will exceed the existing firm capacity. It is therefore proposed to replace the existing transformers with 2x 11/18/24MVA units. The existing switchgear and circuits supplying the transformers are fully rated for the larger units.

Eriswell Proposed 33kV Switching Station

The predicted combined load at Bury St Edmunds and Thetford Grid Substations makes the operation of the network challenging without compromising operational and planning requirements. One proposal is to add a new switching installation called Eriswell. This proposed switching station will provide more flexible interconnection for the Mildenhall/Lakenheath/Kennett circuits. An alternative single switch option is shown on the proposed SLD in Appendix D and is the more likely to happen due to legal and Council Planning obstacles.

Thetford/Eriswell Junction 33kV OHL - 33kV OHL Reinforcement (770A)

The predicted load on the Thetford/Eriswell Junction circuit will exceed the existing rating under fault conditions. It is proposed to replace 13km of overhead line.

Bury/Thetford 33kV OHL Circuit - Reinforce 33kV Circuits (770A)

The predicted load on the Thetford Grid to Fornham Primary 33kV circuit will exceed the existing rating during abnormal running. It is proposed to replace 14km of overhead line.

4.2 Financial Appraisal and Benefits

- The financial expenditure is shown in Appendix D;
- Appendix F provides the Load Indices changes that would take place from the proposed projects.
- Appendix G provides the future Health Indices tables changes that would take place from the proposed projects;

5. Strategies Considered

5.1 Reinforce western fringe from Bury

To be a long-term solution an additional circuit needs to be laid from Bury Grid to a position close to the Lackford tee points for Kennett, where it would be able to support Kennett, Icklingham and Mildenhall. The load will continue to be supplied from Bury Grid and will not defer the need to reinforce the Bramford-Stowmarket overhead circuits.

5.2 Bramford-Stowmarket 132kV circuits

Reinforce Bramford-Stowmarket circuits to 400ACSR when required. Although the towers are believed to be suitable for the larger conductor, ground clearances will probably not be adequate and tower replacements needed. The network would still be totally radial with no significant external interconnections.

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 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 – Forest Heath, Breckland, St. Edmundsbury B.C. Bury Vision 2031

6.1 Appendices

Appendix	Description
Appendix A	Geographic 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	Area geographic plans
Appendix H	Generation Heat Map

6.2 Document history

Version	Date of Issue	Author	Details
1.0	22/05/2013	Ian Robertson	Updated PLE & associated figures
1.1	24/06/2013	Nuno da Fonseca	Final version
1.2	20/03/2014	D J Whiteley	Aligned for re-submission

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

Approval by:

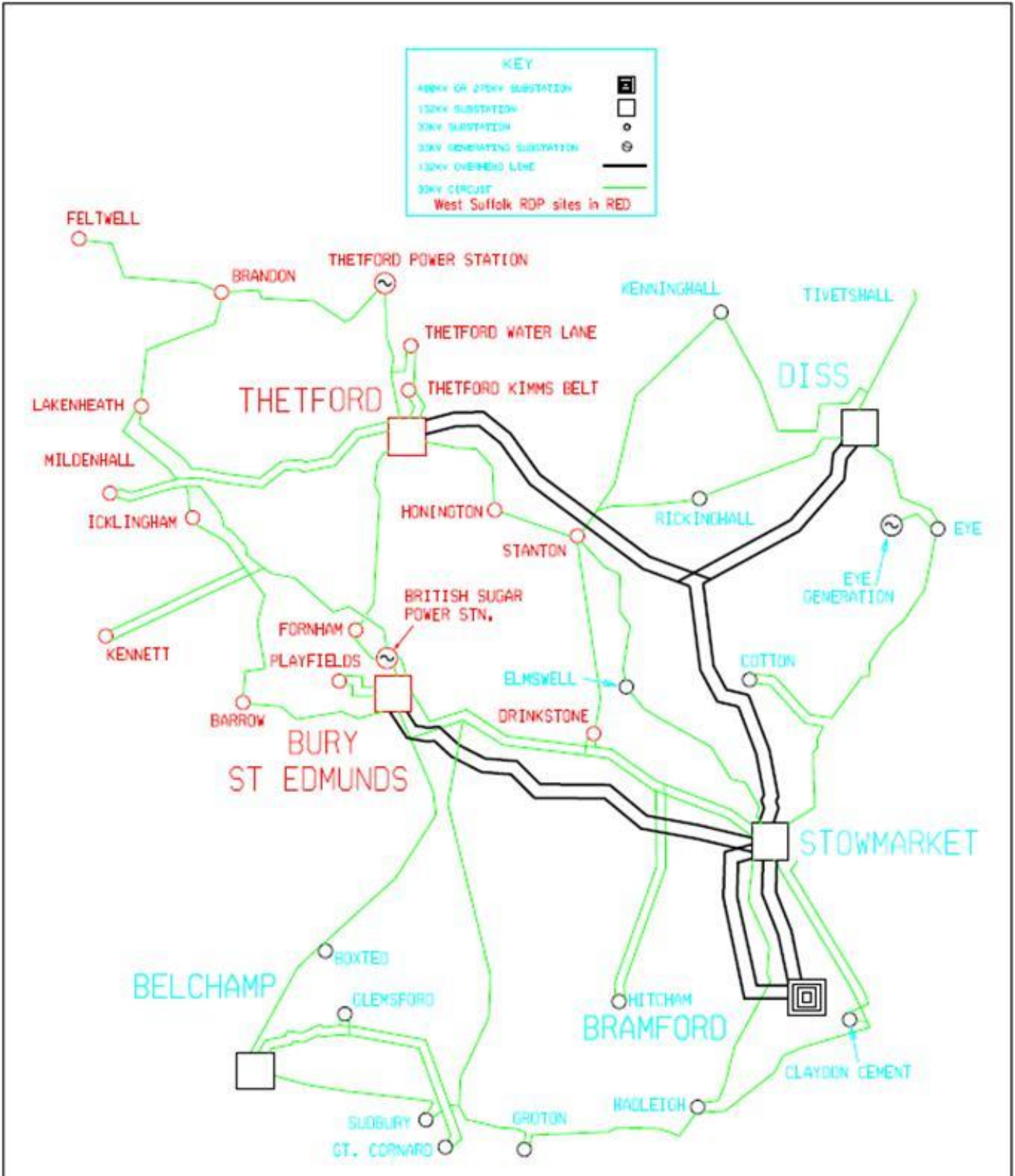
Name	Role	Signature	Date
Robert Kemp	Head of System Development		20/03/14
Barry Hatton	Director of Asset Management		

Bramford GSP – West Suffolk 33kV network (EPN)

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APPENDIX A: GEOGRAPHICAL DIAGRAM

This diagram shows the 132kV and 33kV West Suffolk network out of Bury and Thetford Grids fed from Bramford and includes for information the adjacent networks fed out of Stowmarket, Diss and Belchamp Grids.

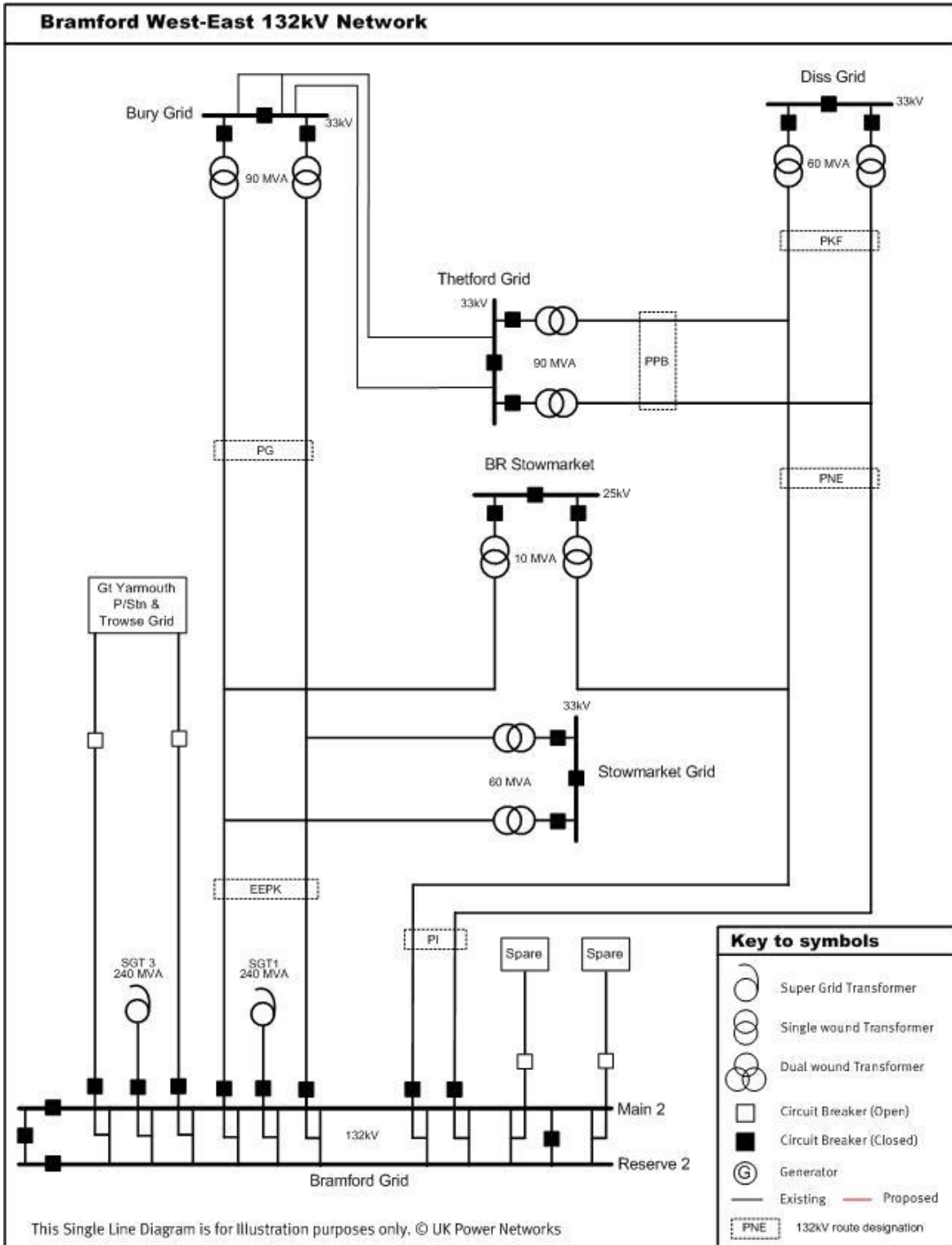


Bramford GSP – West Suffolk 33kV network (EPN)

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APPENDIX B: SINGLE LINE DIAGRAM – EXISTING NETWORK

This diagram shows the 132kV West Suffolk network to Bury and Thetford Grids fed from Bramford and includes for information the adjacent network to Stowmarket & Diss Grids.



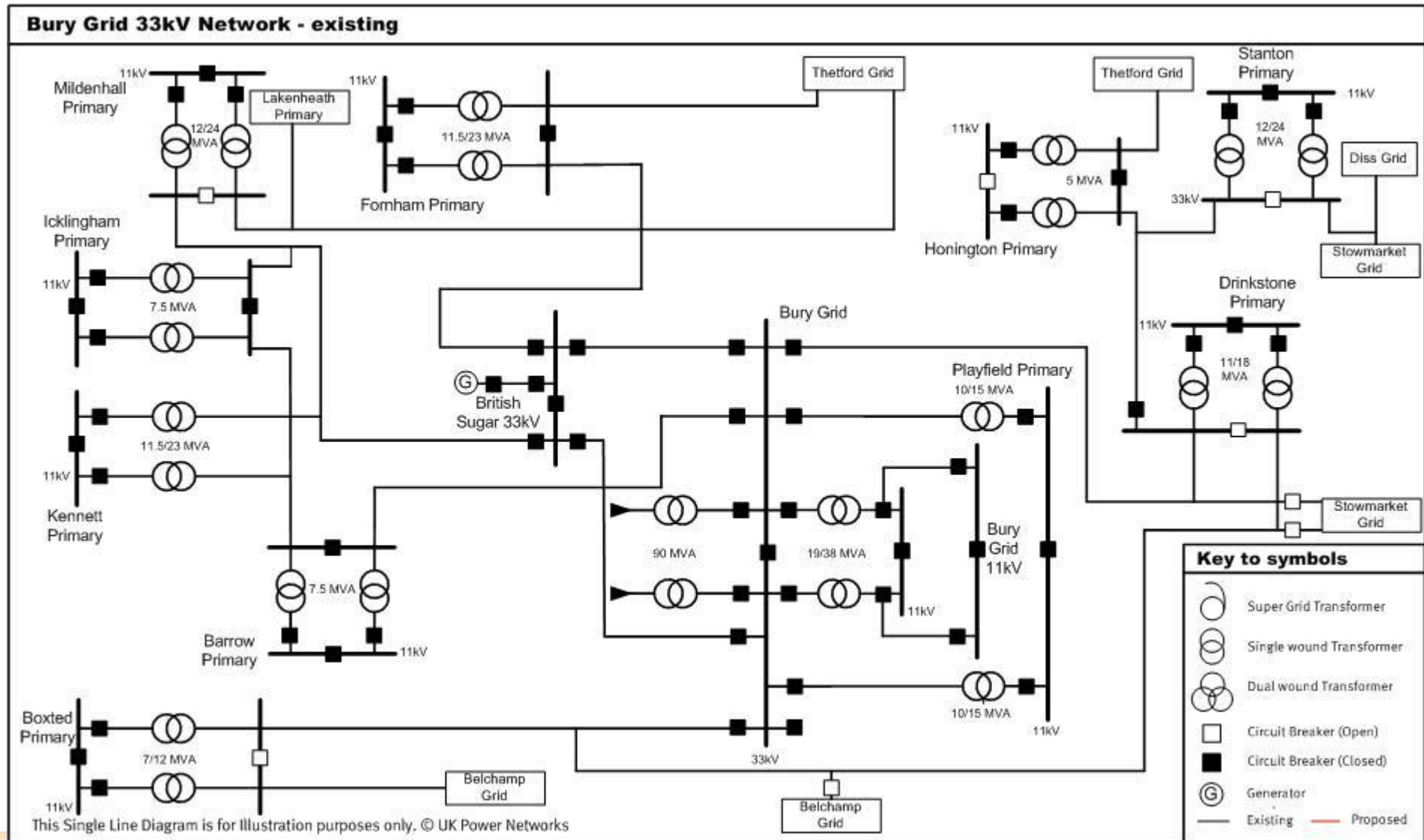
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Bramford GSP – West Suffolk 33kV network (EPN)

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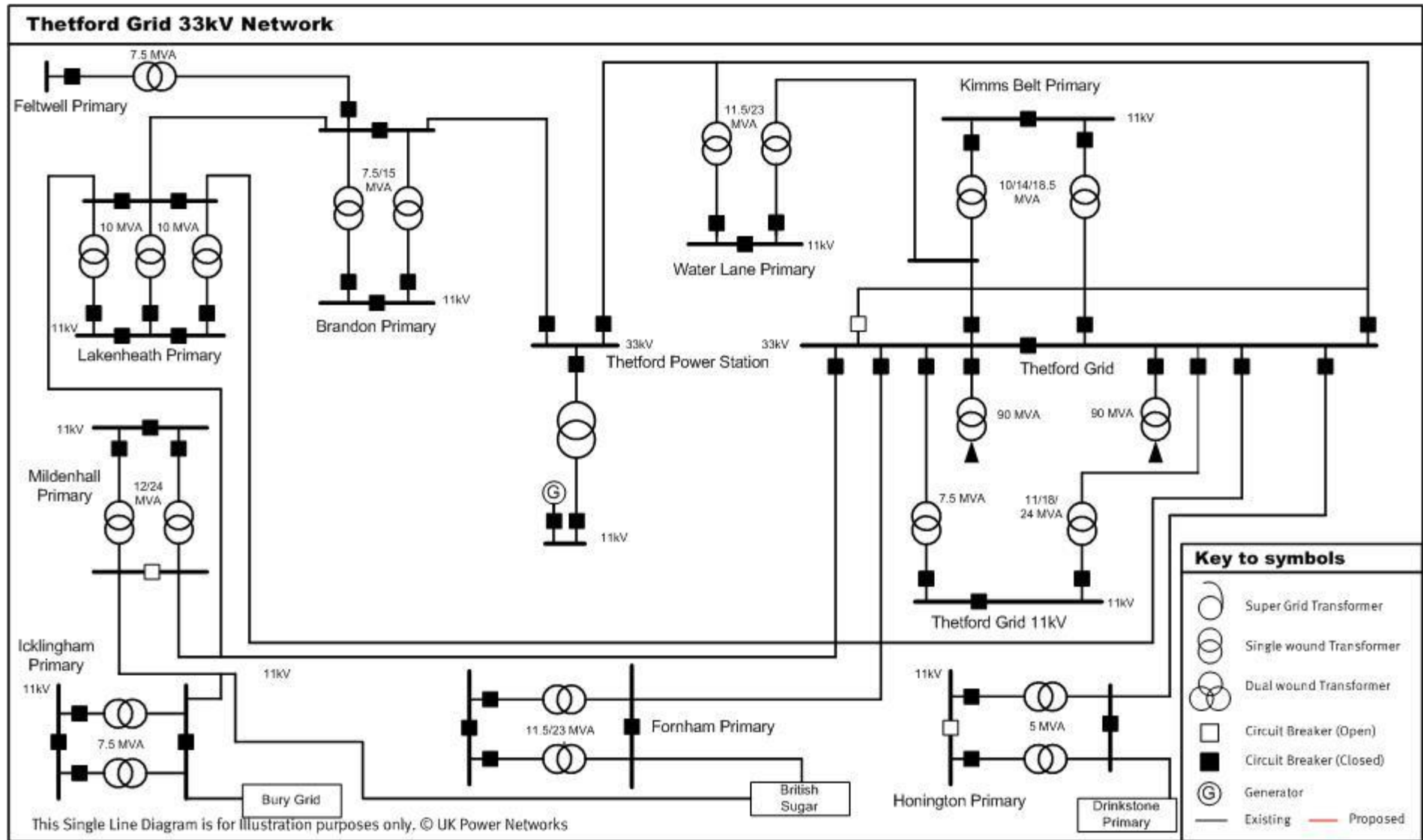
For simplicity the 33kV diagram is split into the networks fed from Bury Grid and Thetford Grid



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Bramford GSP – West Suffolk 33kV network (EPN)

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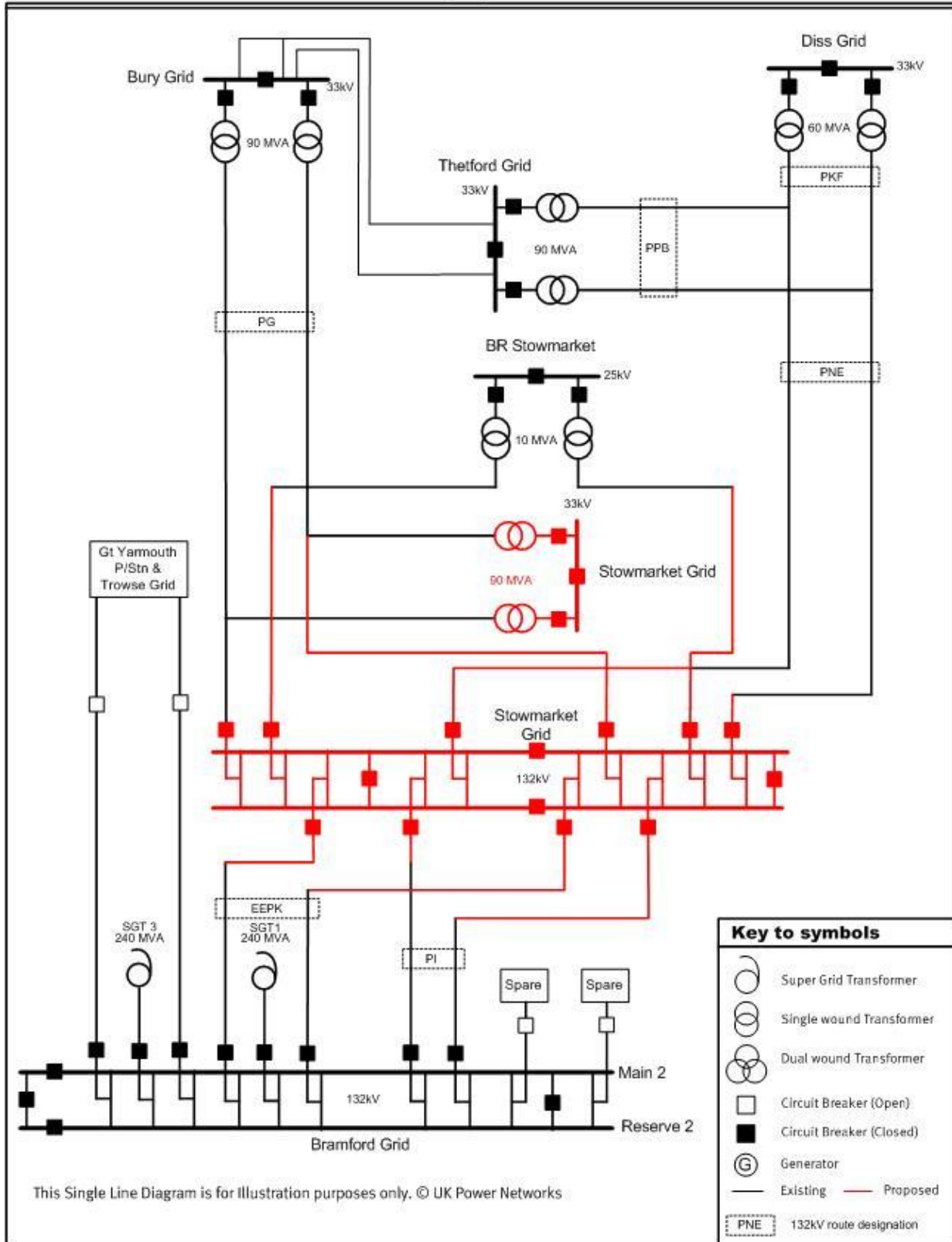


Bramford GSP – West Suffolk 33kV network (EPN)

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APPENDIX C: SINGLE LINE DIAGRAM – RECOMMENDED STRATEGY

Bramford West-East 132kV Network - proposed

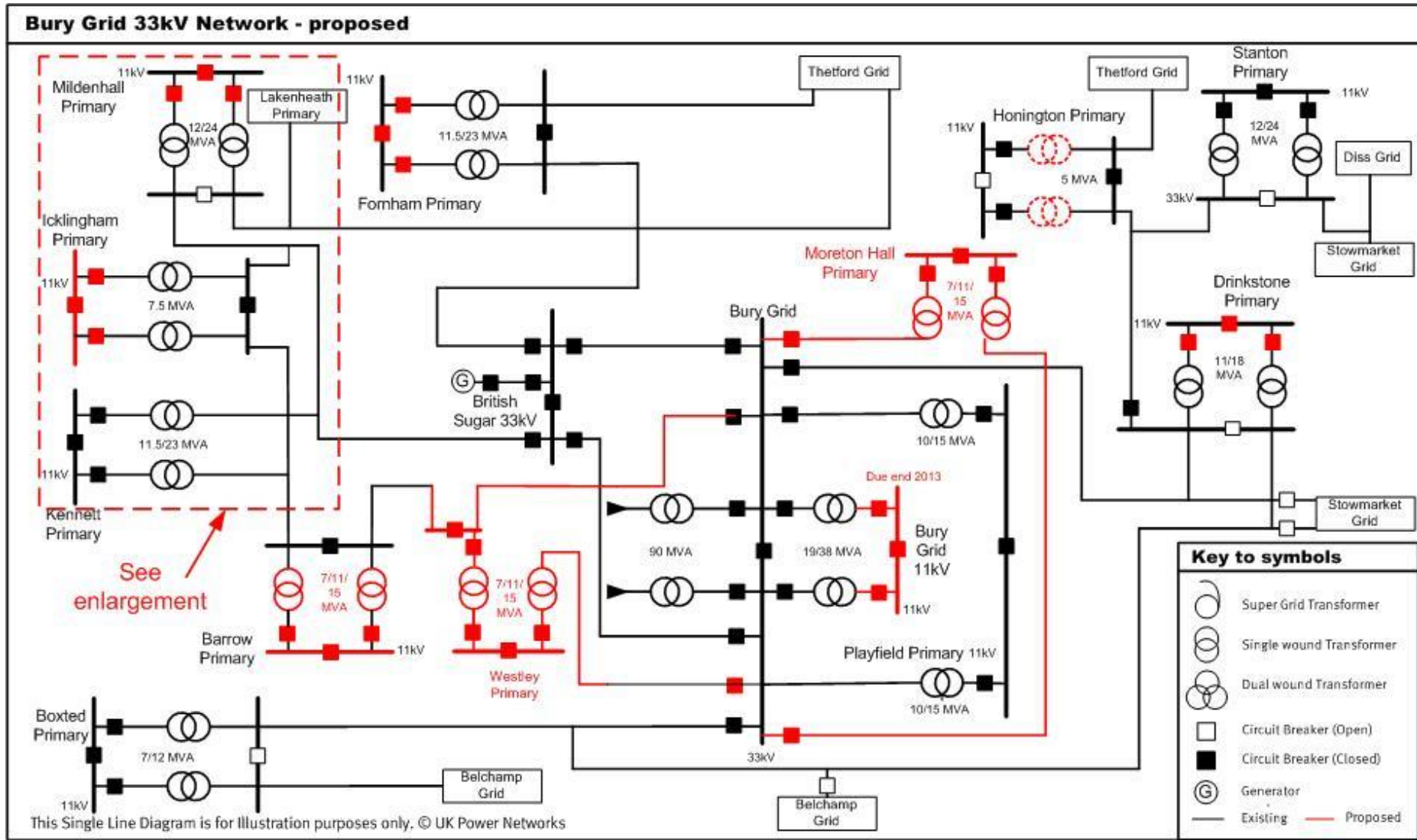


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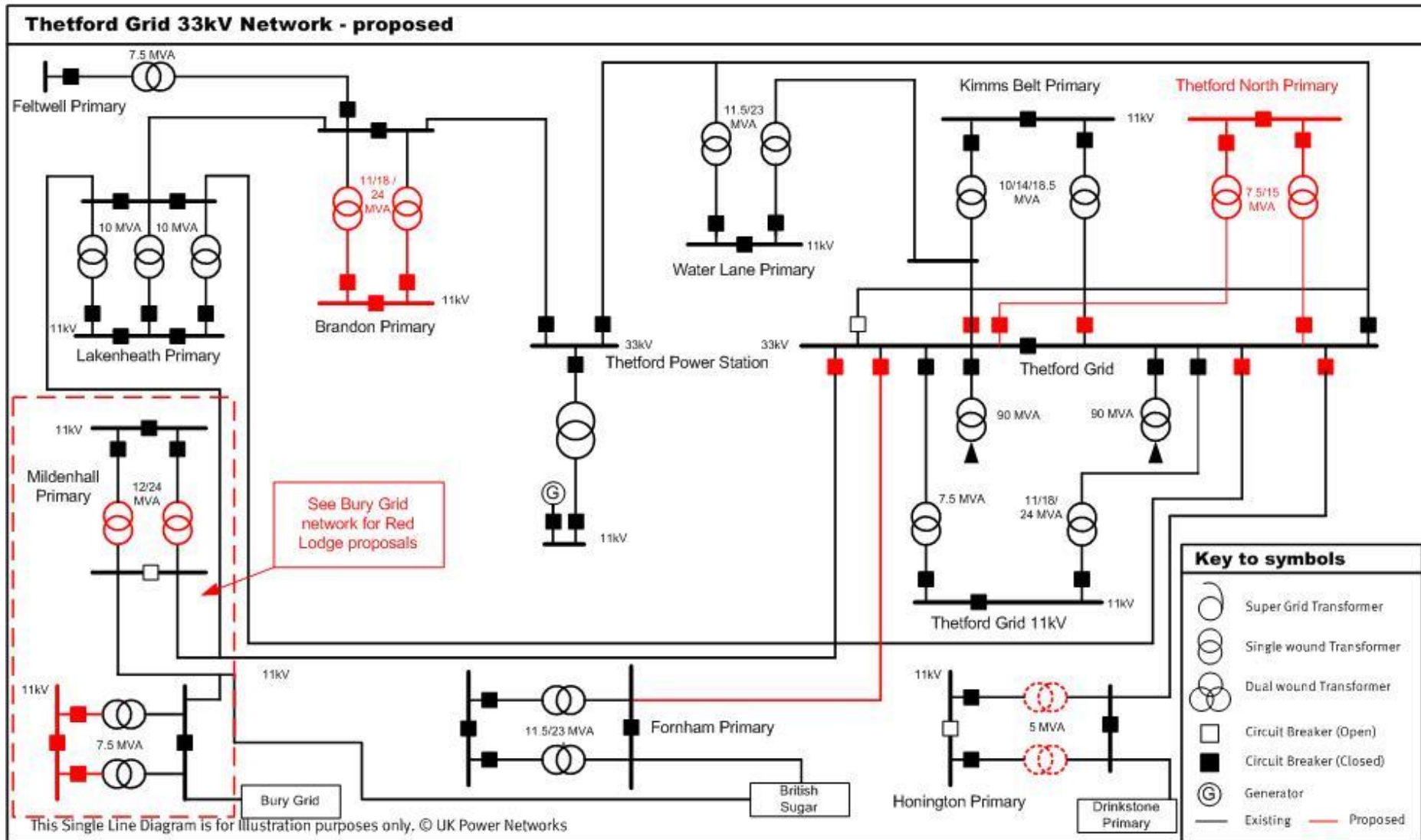


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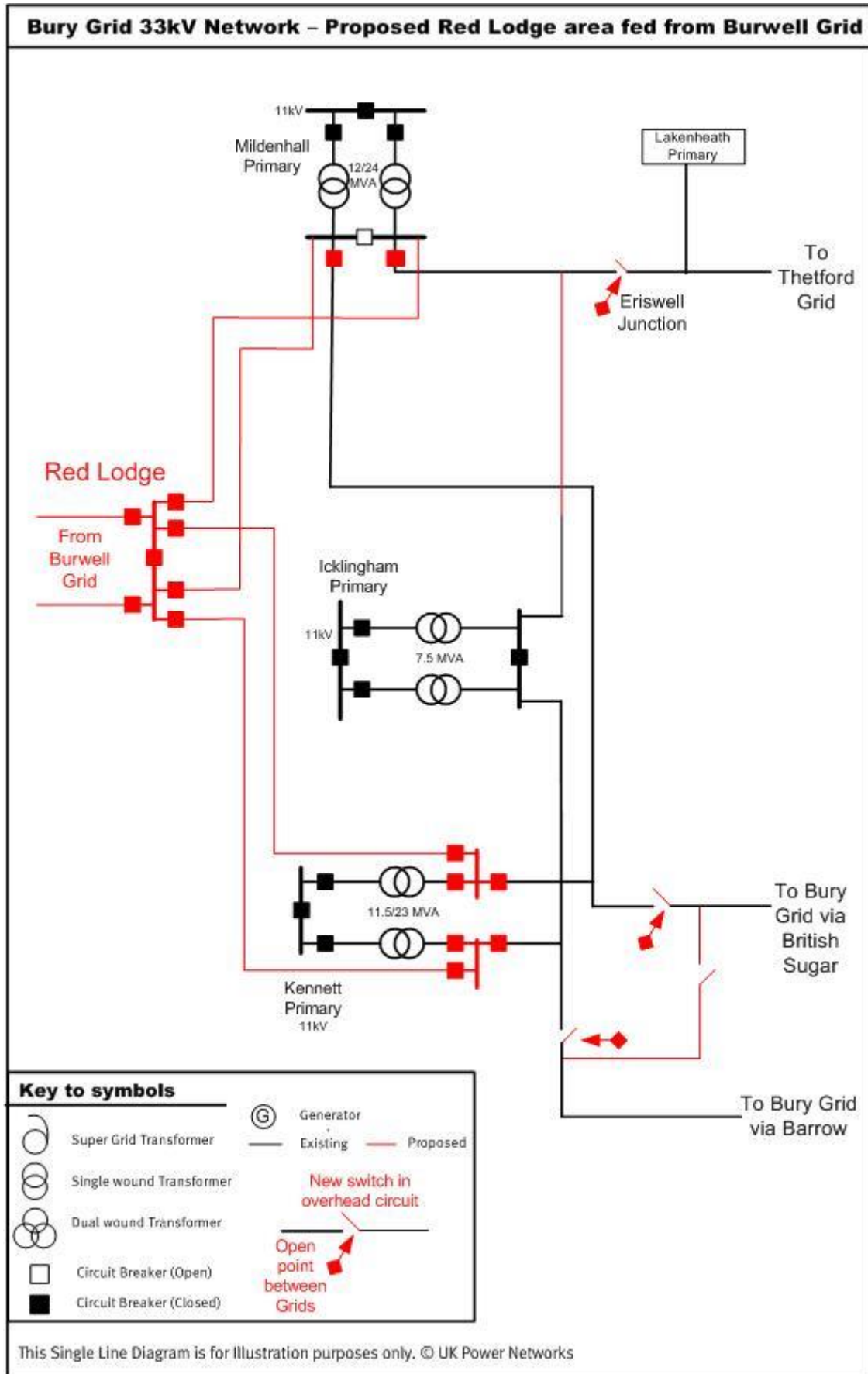
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Bramford GSP – West Suffolk 33kV network (EPN)

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APPENDIX D: DETAILED COSTS FOR RECOMMENDED STRATEGY

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

Cat	Ref	Description	2013 /2014	2014 /2015	2015 /2016	2016 /2017	2017 /2018	2018 /2019	2019 /2020	2020 /2021	2021 /2022	2022 /2023
A	1.02.90.5853	Stowmarket/Bury (PG) Refurbishment	279									
A	1.20.09.5887	Stowmarket 132/33kV Grid Substation - remove asbestos from bungalow/garage buildings and refurbish	4									
A	1.48.01.8506	Thaxted Grid 132kV Disconnecter Replacement (103 & 203)	46									
A	1.48.02.7603	Thetford 132/33kV Grid Substation - Replace 33kV Switchgear										246
A	1.48.02.7605	Lakenheath 132/33kV Grid Substation - Replace 33kV Switchgear									213	
A	1.50.01.5867	Drinkstone 33/11kV Primary Substation - Retrofit 11kV circuit breakers	132									
A	1.50.01.7642	Fornham 33/11kV Primary Substation - Replace 11kV Switchgear						49	1,039			
A	1.50.01.7670	Barrow 33/11kV Primary Substation - Replace 11kV Switchgear										265
A	1.50.01.7694	Icklingham 33/11kV Primary Substation - Replace 11kV Switchgear						265	579			
A	1.50.01.7699	Mildenhall 33/11kV Primary Substation - Replace 11kV Switchgear					316	819				
A	1.51.03.7744	Barrow 33/11kV Primary Substation - Replace Primary Transformers (T1, T2)									477	907
A	1.51.11.4056	Honington 33/11kV Primary Substation - Refurbish Primary Transformers (T1, T2)						51	250			
R	1.33.01.2128	Brandon 33/11kV Primary Substation - ITC (2x 11/18/24MVA) & 11kV Switchgear					413	1,046	316			
R	1.33.01.3934	Playfields 33/11kV Primary Substation - ITC (2 x 18/30/40MVA) & 11kV Switchgear										366
R	1.33.03.4401	Bury 132/33/11kV Grid Substation - switchboard A replacement (2000A)	382									
R	1.33.07.4272	Red Lodge Proposed 33/11kV S/S (RDP*) - (2 x 11/18/24MVA)									1,465	4,129
R	1.36.03.4325	Eriswell Proposed 33kV Switching Station.				209	837	637				

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Bramford GSP – West Suffolk 33kV network (EPN)

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

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

Cat	Ref	Description	2013 /2014	2014 /2015	2015 /2016	2016 /2017	2017 /2018	2018 /2019	2019 /2020	2020 /2021	2021 /2022	2022 /2023
R	1.37.07.2164	(RDP - West Suffolk) Bury/Barrow 33kV Circuit - reinforce cable (575A)	138	1,091								
R	1.37.07.4274	Red Lodge/Kennett Proposed 33kV Circuits										
R	1.37.07.4324	Red Lodge/Mildenhall Proposed 33kV interconnector										497

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Bramford GSP – West Suffolk 33kV network (EPN)

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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 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	Driver	2022 (S) 22/23 (W)	P2/6 Class	Comply
Barrow	W	Transformer	10.0	1.37.07.2164	10.0	4.9	5.1	LI1	LI1			LI1	B	Yes
Boxted Total	W	Transformer	12.0		12.0	3.8	3.9	LI1	LI1			LI1	B	Yes
Brandon	W	Transformer	15.0		15.0	12.2	13.2	LI2	LI2	1.33.01.2128	LRE	LI1	C	Yes
Bury Grid	S	Transformer	28.5	1.33.03.4401	28.5	22.2	23.5	LI1	LI2			LI2	C	Yes
Bury Grid 33	W	Switchgear	153.8		153.8	92.2	97.3	LI1	LI1			LI1	D	Yes
Drinkstone	W	Switchgear	15.2		15.2	10.8	11.4	LI1	LI1			LI1	B	Yes
Feltwell	W	Backfeed	4.7		4.7	3.4	3.3	LI1	LI1			LI1	B	Yes
Fornham	S	Transformer	17.3		17.3	12.6	13.4	LI1	LI1			LI1	C	Yes
Honington	W	Transformer	5.0		5.0	2.7	2.8	LI1	LI1			LI1	B	Yes
Icklingham	S	Transformer	7.5		7.5	4.0	4.4	LI1	LI1			LI1	B	Yes
Kennett	W	Transformer	23.0		23.0	7.4	8.1	LI1	LI1			LI1	B	Yes
Kimms Belt	W	Switchgear	15.2		15.2	11.1	11.6	LI1	LI1			LI1	B	Yes
Lakenheath	W	Transformer	26.0		26.0	18.6	19.3	LI1	LI1			LI1	C	Yes
Mildenhall Total	W	Voltage	19.8		19.8	17.9	19.0	LI2	LI3			LI3	C	Yes
Playfield	W	Transformer	19.5		19.5	16.2	17.0	LI2	LI2			LI2	C	Yes
Thetford Grid	W	Transformer	7.5		7.5	4.7	4.9	LI1	LI1			LI1	B	Yes

Regional Development Plan



Bramford GSP – West Suffolk 33kV network (EPN)

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

Substation	Season	First Limitation	FC NOW (MVA)	DPCR5 Intervention		RIIO-ED1 without intervention				RIIO-ED1 with Intervention			P2/6 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	Driver	2022 (S) 22/23 (W)	P2/6 Class	Comply
Thetford Grid 33	S	Transformer	123.4		123.4	64.5	67.8	LI1	LI1			LI1	D	Yes
Water Lane	S	Transformer	17.3		17.3	19.0	20.1	LI5	LI5			LI5	C	Yes

- Bury & Thetford Grids have direct support from significant generation. 'Real' loads are thus approximately 50MVA and 40MVA higher respectively
- Water Lane will be supported by transfer capacity from Kimms Belt until Thetford North is commissioned – estimated 2017/18 dependent on new housing development
- Feltwell MD seen will be affected by local generation contribution. It is a single transformer site reliant on 11kV backfeeds
- Mildenhall scheme is DSR only to provide the extra capacity – the original scheme was transformer change to correct tapping range

Bramford GSP – West Suffolk 33kV network (EPN)

APPENDIX F: OUTPUT MEASURES - HEALTH INDICES (HI)

Substation	132kV 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
BARROW PRIMARY															
DRINKSTONE PRIMARY															
FELTWELL PRIMARY															
FORNHAM PRIMARY															
HONINGTON PRIMARY															
ICKLINGHAM PRIMARY															
BOXTED PRIMARY															
KENNETT PRIMARY															
BRANDON PRIMARY															
KIMMS BELT PRIMARY															
LAKENHEATH PRIMARY															
MILDENHALL PRIMARY															
PLAYFIELD PRIMARY															
STANTON PRIMARY															
BURY GRID															
THETFORD GRID															
WATER LN PRIMARY															
TOTAL															

Bramford GSP – West Suffolk 33kV network (EPN)

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Substation	33kV 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
BARROW PRIMARY		1						1					1		
DRINKSTONE PRIMARY	1						1					1			
FORNHAM PRIMARY			1						1					1	
HONINGTON PRIMARY		1					1					1			
ICKLINGHAM PRIMARY		1					1					1			
BOXTED PRIMARY	1						1					1			
BRANDON PRIMARY			2							2					2
LAKENHEATH PRIMARY			1	1						2	2				
STANTON PRIMARY		1					1					1			
BURY GRID	1	12					13					13			
THETFORD GRID	4	3	2	1	3	3	4			6	3	4			6
Eriswell Switching Station											5				
TOTAL	7	19	6	2	3	3	22	1	1	10	10	22	1	1	8

Bramford GSP – West Suffolk 33kV network (EPN)

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

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
BARROW PRIMARY		4	3				1	5	1			1	5	1	
DRINKSTONE PRIMARY			8					8					8		
FELTWELL PRIMARY		4					4					4			
FORNHAM PRIMARY	1	5	4			1		5	4		10				
HONINGTON PRIMARY		1	2					3					3		
ICKLINGHAM PRIMARY			7					2	4	1	7				
BOXTED PRIMARY		1	6					6	1				6	1	
KENNETT PRIMARY		11						11					11		
BRANDON PRIMARY		10						10					10		
KIMMS BELT PRIMARY			10					10					10		
LAKENHEATH PRIMARY		7	4				4	7				4	7		
MILDENHALL PRIMARY			10		2			3	2	7	12				
PLAYFIELD PRIMARY		11						11			11				
STANTON PRIMARY		8						8					8		
BURY GRID		9						9					9		
THETFORD GRID		5	2				1	6				1	6		
WATER LN PRIMARY		9					2	7				2	7		
TOTAL	1	85	56		2	1	31	92	12	8	40	20	82	2	

Bramford GSP – West Suffolk 33kV network (EPN)

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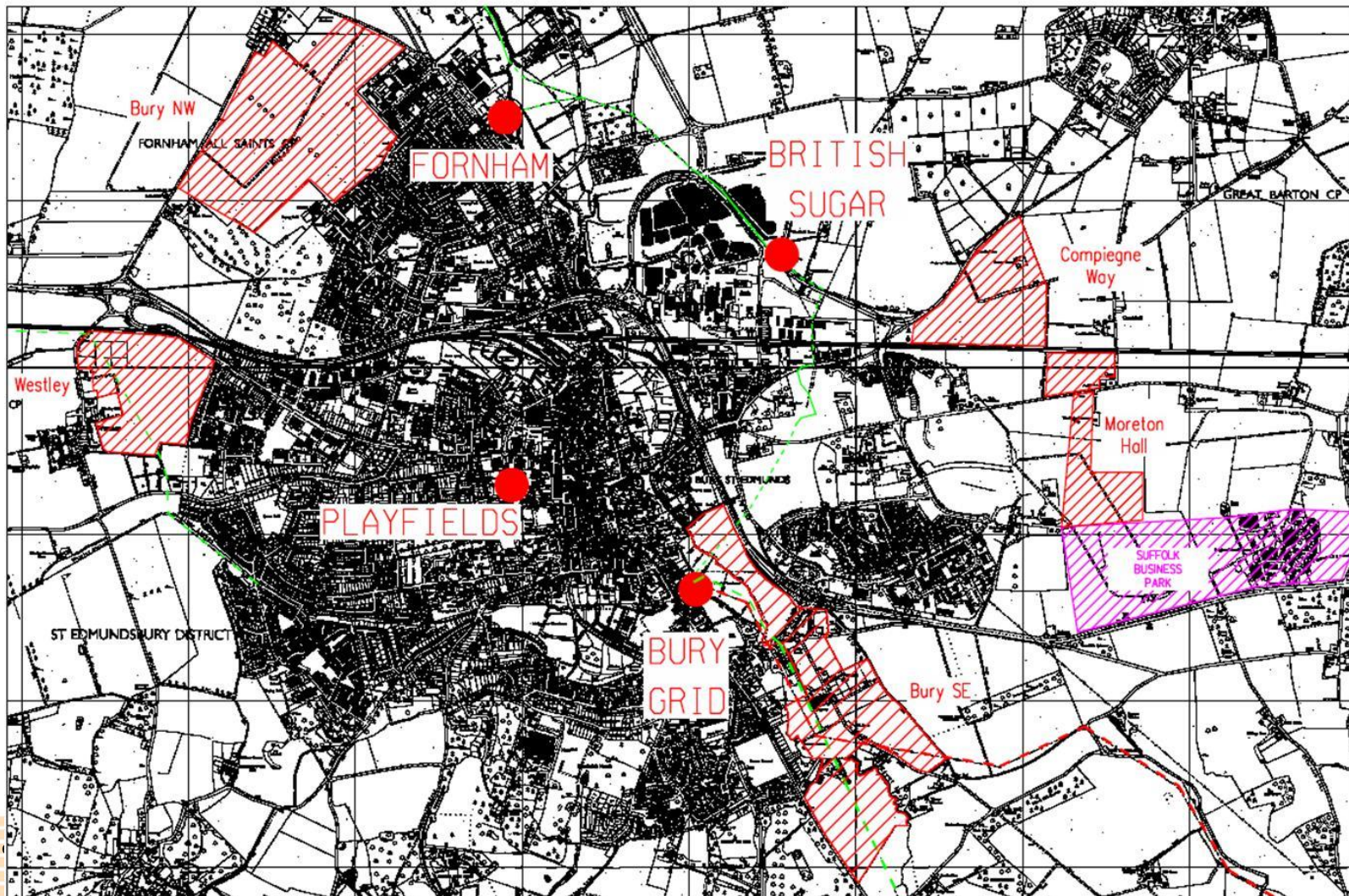
Substation	Grid and Primary Transformers														
	ED1 Start (2015)					End of ED1 (2023) No Investment					End of ED1 (2023) With Investment				
	HI1	HI2	HI3	HI4	HI5	HI1	HI2	HI3	HI4	HI5	HI1	HI2	HI3	HI4	HI5
BARROW PRIMARY			1		1				1	1	2				
DRINKSTONE PRIMARY		2					2					2			
FELTWELL PRIMARY		1					1					1			
FORNHAM PRIMARY		1	1				1	1				1	1		
HONINGTON PRIMARY			1	1						2			2		
ICKLINGHAM PRIMARY		2					2					2			
BOXTED PRIMARY		2					2					2			
KENNETT PRIMARY		2					2					2			
BRANDON PRIMARY		2						2			2				
KIMMS BELT PRIMARY		2					1	1				1	1		
LAKENHEATH PRIMARY		3						3					3		
MILDENHALL PRIMARY		2					2					2			
PLAYFIELD PRIMARY		2						2			2				
STANTON PRIMARY		1	1					1		1			1		1
BURY GRID	2	2				2	2				2	2			
THETFORD GRID		4					3	1				3	1		
WATER LN PRIMARY		2					2					2			
TOTAL	2	30	4	1	1	2	20	11	1	4	8	20	9	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

APPENDIX G: AREA GEOGRAPHIC PLANS

Bury St. Edmunds

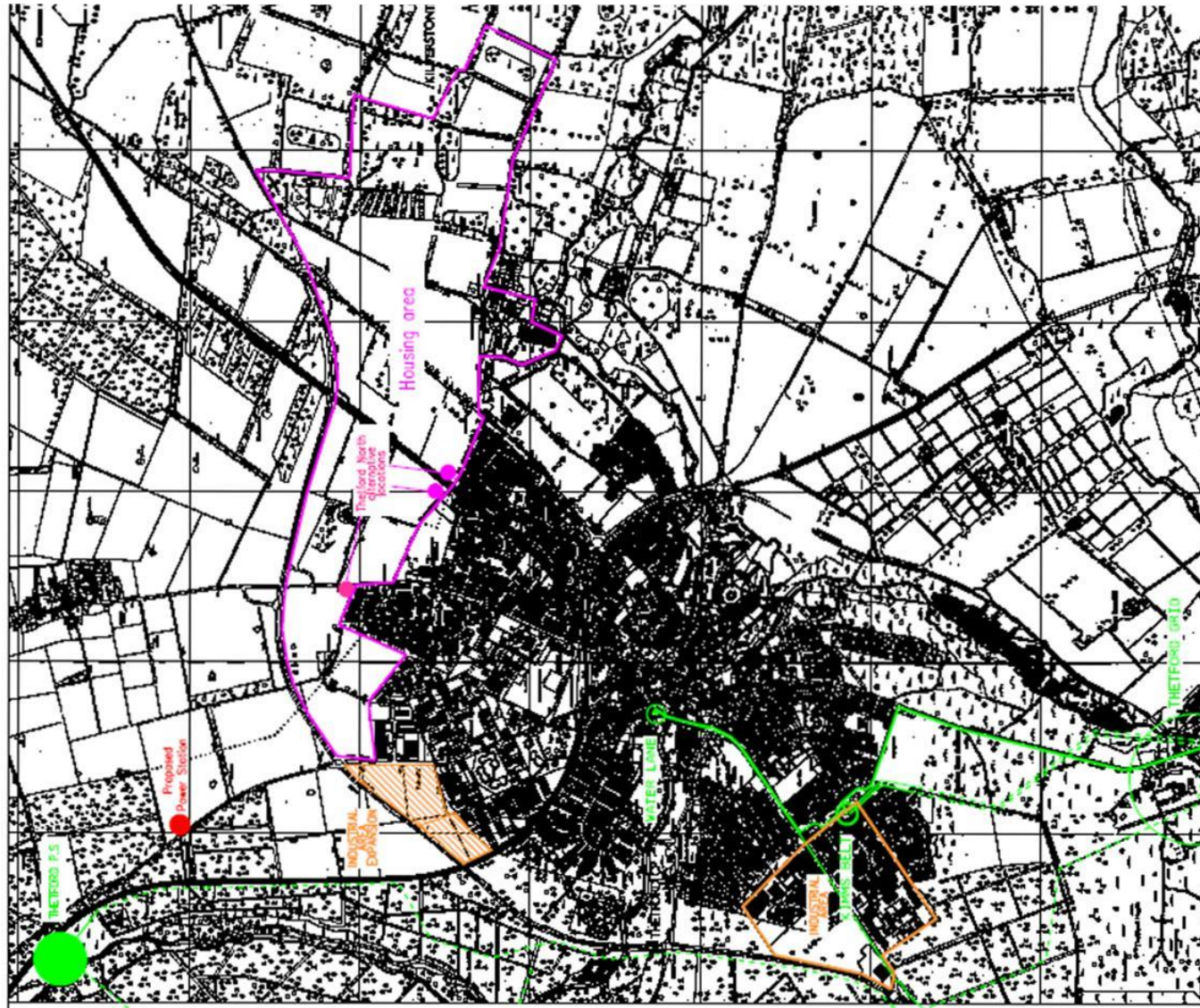
Bury area showing main substations and areas of future development



Thetford

Thetford – showing new housing area to the north of the town and the two main industrial areas.

Thetford Power Station is to the north-west. A second 45MW power station is proposed in the same area – not yet approved.



APPENDIX H: 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.

