



Regional Development Plan 11

Bramford GSP – Ipswich & Cliff Quay

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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 Ipswich and Cliff Quay Grids, supplied from Bramford Grid Supply Point (GSP). The two run in loose parallel via 11kV busbars at Turret Lane, Roundwood Road and Fore Hamlet Primary Substations. Direct connections are available by a 33kV bus section at Turret Lane and a normally open point at Cliff Quay. The Felixstowe area is currently fed on two 33kV double circuit overhead lines from Cliff Quay.

The area is characterized by three large peninsulas separated by the River Deben, Orwell and Stour. The towns of Ipswich and Felixstowe are on one peninsula with rural areas between them and the Shotley peninsula, together covering an area of circa 300km² with circa 150,000 people.

Key Infrastructure in the region is the container port at Felixstowe that handles 40% of all UK containerised imports. It is currently planning the long-term expansion plan. Ipswich also has a smaller port in adjoining the town centre. The London to Norwich East Anglian Main Line electrified main railway line passes through Ipswich with a mainly single-track spur line (not electrified) to Felixstowe. This spur line will be upgraded in the near future to become mainly two tracks with a better junction at Ipswich, enabling better utilisation of the route. The main BT research centre at Martlesham is also fed from this network.

The Bramford 132kV network to Ipswich and Cliff Quay Grids also supplies Lawford, Clacton and Colchester Grid substations in RDP 18 and provides vital interconnection to Rayleigh GSP with 132kV normal Open Points at Colchester.

There is at present no major generation connected to this network although there are LV generators at several separate locations.

1.1 Summary of issues addressed

The area covered in this document is Ipswich town and the Felixstowe and Shotley peninsulas. At present there are significant long-term predictions for both housing and associated employment growth, although the timing of any scheme will be determined by economic conditions and/or Government directives.

The expansion of Felixstowe Port may require the most substantial reinforcement with 132/33kV transformers established at the present Felixstowe Switching Station and a 132kV busbar at Cliff Quay Grid. Other developments will require reinforcement, the scope of which will depend on timing and surrounding loads.

The 33kV networks in this area and the neighbouring Lawford – Dovercourt (Harwich) network is largely 33kV dual circuit construction overhead lines. This type of construction requires dual circuit outages in order to replace the wood pole supports, these being taken under summer loading conditions. The growth in demand has taken the summer N-2 security beyond the 11kV alternative capacity able to support these networks. This RDP seeks to address this particular issue affecting Felixstowe, Shotley and Dovercourt radial 33kV circuits.

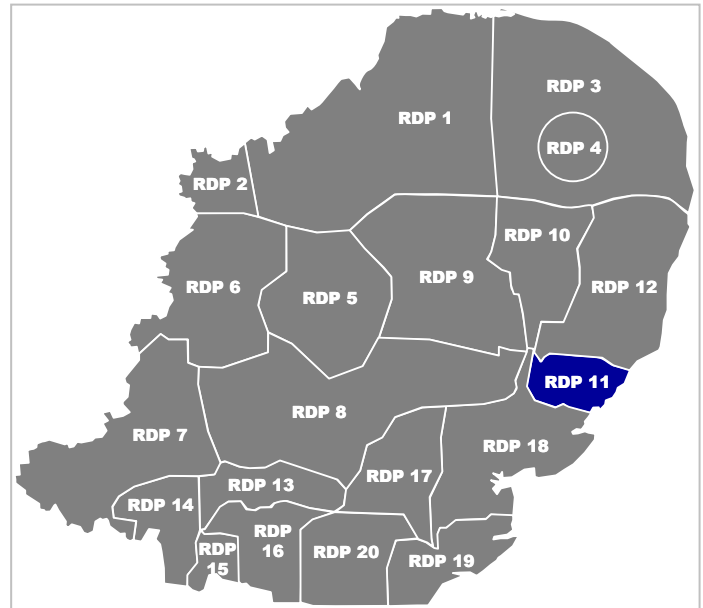


Figure 1 – Area covered by the RDP

Bramford GSP – Ipswich & Cliff Quay

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In addition to these specific areas general network issues are also reviewed:-

- 132/33kV Substation Reinforcement.
- Development of the 33kV interconnecting Networks.
- 132/33kV Substation Reinforcement.
- 33/11kV Substation Reinforcement.
- Major Plant Asset Replacement
- Address Fault Level issues.

1.2 Recommended strategy

The main proposal in this strategy is the establishment of Felixstowe Grid 132/33kV substation in order to provide an adequate supply to Felixstowe and the surrounding areas including the port when development takes place. This will release 33kV capacity at Cliff Quay Grid to cater for future load in the east of Ipswich and at Martlesham. To create a workable firm supply it will be necessary to establish 132kV connections at Cliff Quay and Ipswich Grid substations. Further increases when needed in the future can be accommodated by additional work on the circuits from Bramford to the Belsted tee point.

Plans for a large green-field housing site on the northern fringe of Ipswich (Westerfield) are beginning to be formalised. This will have ~3500 homes and associated community facilities by 2026. It is proposed to reinforce Highfield Primary substation and provide 11kV transfer capacity to Roundwood Road Primary.

Investment Profile

Figure 1 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 19-02-2014.

RDP	Type	DPCR5 2013-15	2015 /2016	2016 /2017	2017 /2018	2018 /2019	2019 /2020	2020 /2021	2021 /2022	2022 /2023	RIIO-ED1 Total
RDP11	LRE	£1.3m	£6.5m	£8.9m	£3.0m	£0.7m	£2.5m	£0.7m	£0.0m	£0.0m	£22.2m
	NLRE	£1.7m	£0.1m	£0.7m	£0.7m	£0.3m	£1.4m	£0.0m	£0.0m	£0.5m	£3.7m
	TOTAL	£3.0m	£6.6m	£9.6m	£3.6m	£0.9m	£3.9m	£0.7m	£0.0m	£0.5m	£25.8m

Table 1. LRE and NLRE expenditure profile

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 the figure below.

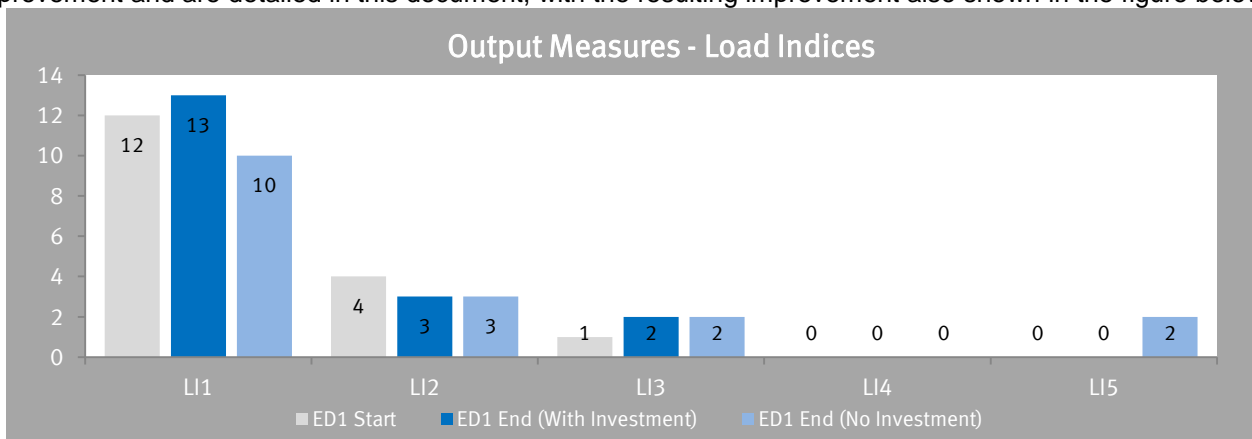
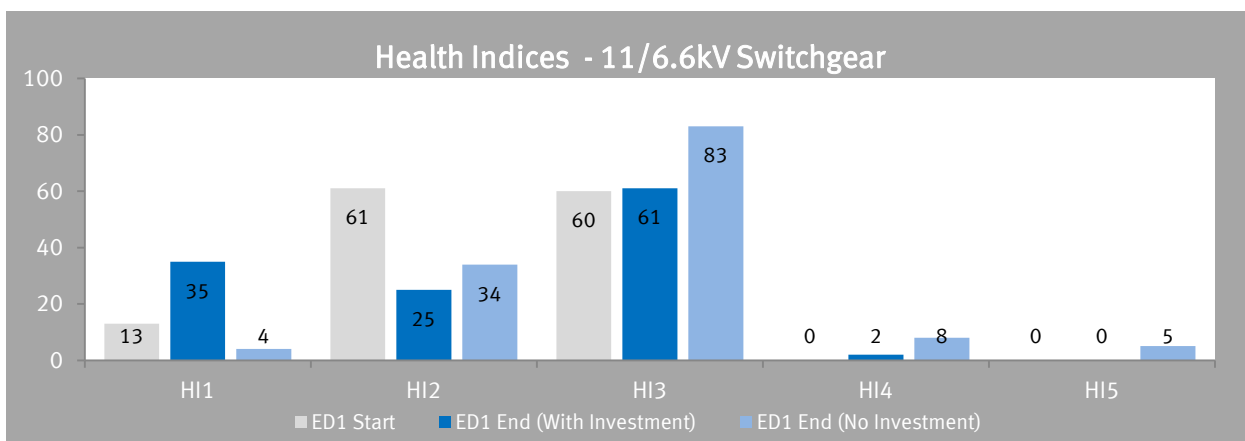
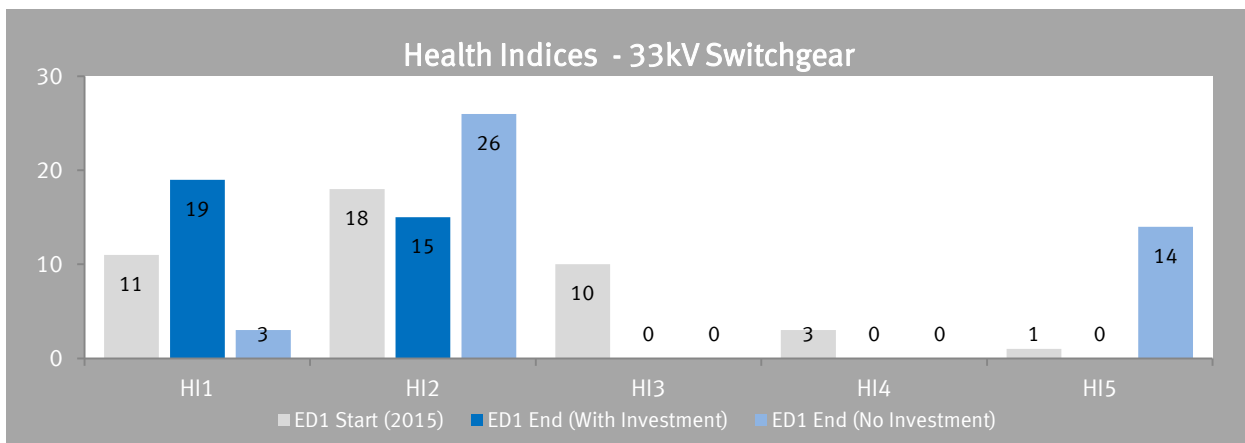
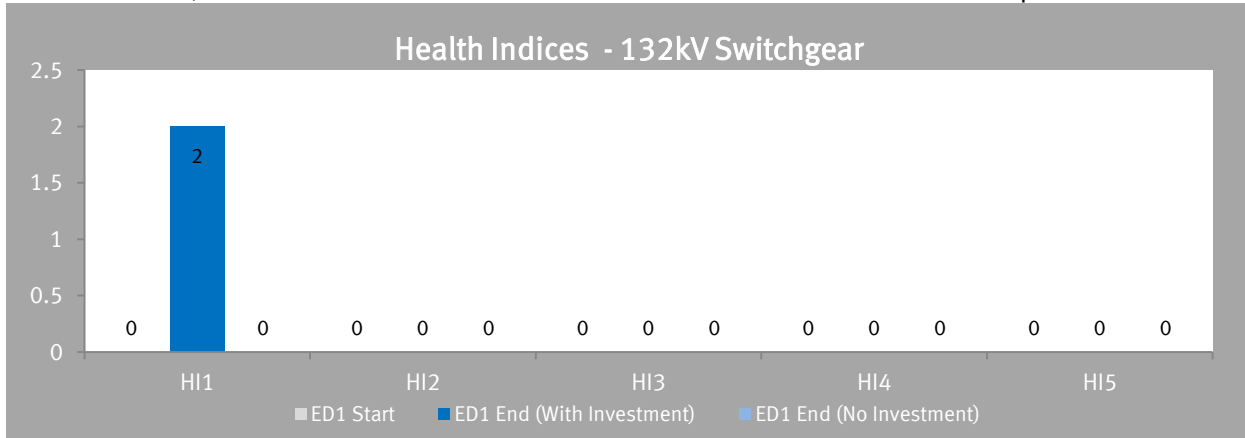


Figure 2. Load Indices (LI)

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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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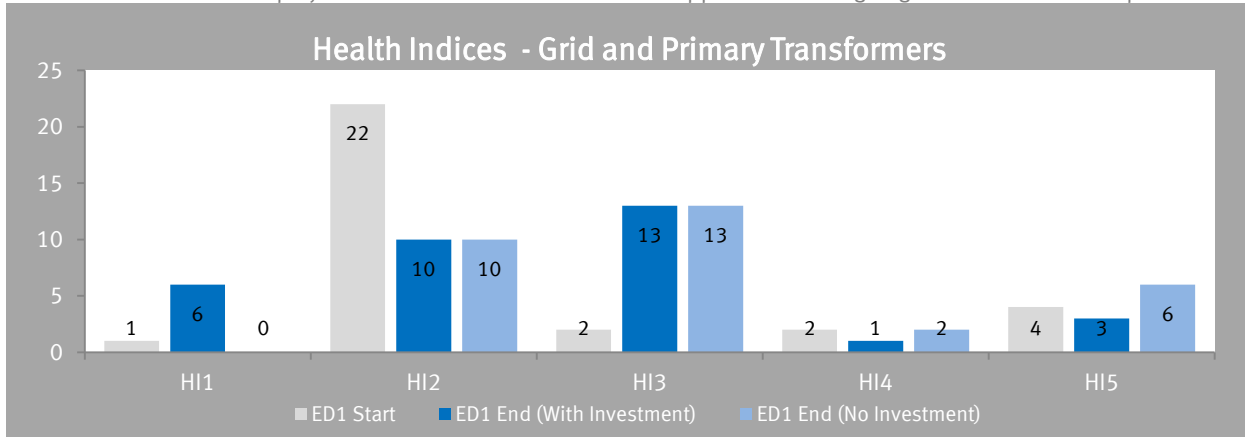


Figure 3. Health Indices by asset category

Scenarios Considered

- Demand growth from Planning Load Estimates (PLE’s) up to 2023.
- Major Generation sites disconnected
- Compliance with P2/6 Standard for Security of Supply and operational flexibility of the 132kV and 33kV networks.
- Imperial College model.

Rejected Strategy 1 - 132kV Tee off Cliff Quay

Tee Felixstowe circuits onto two Cliff Quay transformers. This arrangement would be particularly susceptible to a PTA double-circuit fault, when Cliff Quay and Felixstowe would be supplied at 33kV from the one remaining transformer at Cliff Quay. This would also prevent the uprating of the transformers at Cliff Quay as the route is only constructed with 300UPAS.

Rejected Strategy 2 - 33kV Reinforcement

Replace all transformers at Cliff Quay and Ipswich Grids with 90MVA units, replace 33kV switchgear at both sites, lay two 33kV circuits from Cliff Quay to FSS, lay one new 132kV cable from Bramford to Hadleigh Road, reconductor and split the PHB route to 300UPAS between Hadleigh Road and Belstead, reconfigure Belstead tee. This places continued reliance on the vulnerable 33kV overhead route into FSS. As in the previous solution, a double-circuit PTA fault will affect both Cliff Quay and FSS. The use of Cliff Quay 33kV capacity will reduce the future headroom for growth in Ipswich town and Martlesham. This approach also fails to address the 33kV dual circuit summer outage condition.

RDP Dependencies and Interactions

- Demand increase occurs at predicted rate.
- New Developments within reasonable demand parameters.
- Demand increase occurs at predicted rate.
- Completion of the Rayleigh Main 132kV works.

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.

Interaction with Regional Development Plans of Bramford East (RDP10) and Bramford – Rayleigh (RDP18)

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2. Network configuration

2.1 Existing Network

The network studied in this document is fed from Bramford National Grid exit point and falls into three separate sections. The first feeds most of Ipswich town and its immediate surroundings, the second feeds the Felixstowe peninsula including the important loads at BT Martlesham and Felixstowe port, and the third feeds the southernmost part of Ipswich plus rural areas and the Shotley peninsula. All network diagrams in Appendix B.

132kV Network

At present the circuits to both Ipswich and Cliff Quay are radial feeds from Bramford. One of the Ipswich circuits carries on to Lawford and one of the Cliff Quay circuits tees to Lawford at Belstead. These are two of the three circuits of the normal feed to Lawford. The direct Bramford – Lawford PJ route is the third. There is an authorised scheme to uprate this circuit to 300mm² subject to a satisfactory design being available. Lawford Grid can also be fed from the southerly direction at the extreme end of the two circuits from Rayleigh NG. There is therefore only limited alternative switching either within the Bramford network or from the weak interconnection from Rayleigh. The Gunfleet Sands windfarm (capacity 168MW) feeds into the Lawford network at Clacton Grid and thus masks the actual load on Lawford. Lawford itself is outside the scope of this document and is mentioned only to outline the complexity of the 132kV network. (See RDP18 Rayleigh-Bramford group).

Under summer outage conditions, bearing in mind the two NG exit points have 9 x 400kV supergrid transformers the two groups combine to a 300MW+ and become Class E for network security.

33kV Network

While Ipswich and Cliff Quay have relatively strong connections between them, there is only one dual-circuit connection to an outside network, via the normally open switches near Hadleigh towards Stowmarket Grid. This is a weak interconnection due to the length, other load and conductor size. The 33kV overhead lines to Tattingstone/Shotley, Felixstowe/Martlesham are dual circuit construction and as mentioned previously have summer outage limitations for wood pole replacements.

11kV Network

The town network has the normal multiple interconnections between Primary substations, although some are limited by small-section conductor. The two peninsulas at Felixstowe and Shotley are relatively isolated, but while there is only a small load left at Shotley, the town and docks at Felixstowe would be impossible to feed. There is no 11kV connection with the Lawford network due to the 'Essex' 11kV phase difference and the River Stour providing a barrier between the primary substations...

Ipswich town

The area is served from two Grid substations – Ipswich Grid (West End Road) has two 60MVA transformers and Cliff Quay Grid which sits within the boundary of land owned by the Port of Ipswich has three 60MVA transformers. The 132/33kV Ipswich Grid substation is undergoing asset replacement and reinforcement that will make it a 90MVA site by 2016/17.

Ipswich Grid is fed from Bramford on a dual circuit tower line which has recently been reconducted to 300mm² Al. A fibre optic link has been installed within the earth wire in readiness for future needs, although the two ends have not yet been taken into the substation buildings. Both circuits continue with fluid filled and polymeric cables underground through Ipswich town to Cliff Quay Grid. One circuit is in use at 33kV and provides the fourth circuit towards Felixstowe (see below), the other is alive at 132kV and runs on separate busbars through Cliff Quay to provide the third feed to Lawford Grid (not within the scope of this document, but see future requirements). These have both been recently diverted with polymeric cable in two adjacent locations due to redevelopment work, and a third diversion nearby is being planned (3.1 below 'Ipswich Wet Dock Diversion'). The 33kV switchgear is in poor condition and the configuration of the outdoor busbars prevents easy maintenance of the isolators. Load on the 132/33kV transformers has exceeded the nominal firm capacity and

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now relies on natural demand transfer and remote switch transfer to Cliff Quay. IDP Schemes are proposed for both switchgear and transformers.

Cliff Quay Grid is fed from Bramford on three circuits, two of which have tees to Lawford. The circuits are a mixture of 175 mm², 300mm² and 400 mm² overhead conductor plus some lengths of underground cable. They cross the River Orwell on two adjacent routes using very tall towers each carrying three circuits. The other circuits on the towers are the Ipswich Grid- Lawford 132kV circuit mentioned above and the two 33kV circuits from Cliff Quay towards Shotley (see below).

The town 33kV network comprises two single-customer 33/6.6kV sites and seven 33/11kV Primary sites. The two Grid sites run in loose parallel via three Primary 11kV busbars. Cliff Quay Grid also feeds the areas following.

Felixstowe Peninsula

This area is fed via two dual-circuit 33kV overhead lines out of Cliff Quay Grid. They run through and close to environmentally sensitive and exposed areas and were both significantly damaged during the 1987 hurricane. The two circuits are of different age but both have recently been refurbished. A significant length near Cliff Quay has been undergrounded, while at the Felixstowe end an enforced underground diversion has increased the circuit length. A new 33kV busbar has been created at Felixstowe Switching Station (FSS) in preparation for future reinforcement of Felixstowe. The four circuits now run in parallel thus providing a more robust network. Unit protection on these circuits is by rented pilots and may well be affected by 'BT21'. The installation of 132kV into FSS will allow UKPN pilots to be laid, leaving only Martlesham to be accommodated separately. In Felixstowe two Primary sites feed the normal town network and surroundings, while two are dedicated to the Felixstowe Port network with no 11kV interconnections to our network. A deliberate phase shift was introduced to help reduce any harmonic distortion from the Port crane operations. Almost half-way from Cliff Quay, the circuits to Martlesham tee off two of the overhead lines. Due to the total distance from Cliff Quay, under single transformer conditions any load at Martlesham above about 19MVA leads to voltage collapse there.

South Ipswich & Shotley peninsula

The area is fed from Cliff Quay Grid on a pair of 33kV overhead lines. These cross the River Orwell on the multi-circuit towers mentioned above and continue on their own 132kV-rated towers for 6 spans to Belstead Switching Station. Here the underground circuits to Gusford Hall Primary begin, while the main line continues on a dual-circuit wood pole line. At P39 both circuits tee towards the normally open interconnection point with the Stowmarket 33kV network near Hadleigh. At Tattingstone there is separate isolation for the local transformers and the continuing dual circuit to Shotley. The Orwell crossing is 400 mm² and the short section to Belstead has recently been reconducted to 300mm². There is a reserve site at the former Stoke Primary within the urban area but this has a somewhat restricted access and could be difficult to re-equip, as well as needing new incoming cables. At present there is adequate spare capacity at Gusford Hall although some 11kV reinforcement might be required to sensibly use that capacity.

There is currently no 33/11kV embedded generation within this region, although recent enquiries have been received for PV generation near Martlesham (7.5MW) and Tattingstone (20MW) – situation as at 18/12/12.

2.2 Network changes in progress

Warren Heath 33/11kV Primary S/S - T1 Refurbishment

The condition assessment of the 1971 HSP Primary Transformer installed at Warren Heath 33/11kV Primary Substation has shown that the probability of failure due to degradation will become unacceptable. Completion of the project will see one 33/11kV transformer refurbished.

Ipswich Grid – replace 33kV switchgear

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Gate B approved – Gate C in Q1 2013 for completion Q4 2014. An indoor board will replace the present outdoor compound.

Ipswich Grid - ITC Grid transformers to 90MVA

Gate B in Q1 2013 to allow this construction to follow the switchgear replacement.

3. Summary of Issues

3.1 Development areas

Maps where applicable are available in the Appendices.

This area falls within three Council districts:

- Babergh controls a small part of the western edge of Ipswich town, the southern boundary and the Shotley peninsula;
- Ipswich has the majority of the town including some presently greenfield area to the north;
- Suffolk Coastal adjoins Ipswich to the east and includes the Felixstowe peninsula.

As there is no experience with the electrical loads which might be needed due to the latest Building Regulations, and the impact of further 'green' technology such as electric cars, it is not sensible to predict a typical ADMD for new housing.

Felixstowe

Housing - The Council plan calls for ~1450 homes around the Felixstowe immediate area. Several locations have been included in their assessments but at present there is no decision to the first site to be developed. All are within reach from Langley Avenue and it is likely that the loads can be fed from there, if necessary after permanent transfers to Dock Road. A planning application has recently been submitted for c.200 homes and associated facilities on a plot adjacent to the A14 Dock Spur roundabout.

Port of Felixstowe - The Port (owned by Hutchison Ports) presently has dedicated supplies at 11kV from Fagbury Road and Oysterbed Road. These two sites deliberately have delta/star transformers to minimise distortion to the main public network. They therefore have no 11kV interconnection outside their own network, although there are also two separate supplies to Port-owned office-type buildings from our network. The Port has recently undertaken construction of the first part of a 'deep water' quay to allow docking of the latest generation of large container ships. This includes installation of some larger cranes. The daily peak demand fluctuates significantly but the peak (as at 14/11/11) was 12.8MVA, somewhat less than their own prediction but presumably due to the global economic situation. The current project is the construction of a third rail terminal which will cater for longer trains. The spur line back towards Ipswich is also being upgraded with a significant length of dual track and a 'chord' close to Ipswich station which will allow a direct connection towards the Midlands. Further minor increases in the Port demand will occur with additional reconfiguration of the land usage and it is expected that this can possibly be accommodated on the existing 33kV busbar arrangement at Felixstowe Switching station (FSS).

More major steps will take place if the 'green' ideas of electric straddle carriers and cold ironing are adopted. This will definitely require the provision of the 132kV supply into FSS.

Hutchison Ports also own Harwich on the south side of the estuary. A significant expansion (Bathside Bay) is proposed there which will require network reinforcement and extensions, although that is unlikely to take place until all the Felixstowe expansion has been completed. Harwich is presently fed from Lawford and the indicated 15MVA additional load would need a major reinforcement of the network on that peninsula. An alternative is to supply it at 33kV from Felixstowe (when a 132kV site) through directional drill routes via the Shotley peninsula.

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This would have the additional advantage of further interconnections to Shotley and the Lawford network. A preliminary survey of directional drill routes has been carried out with no adverse conditions found.

Associated employment - In addition to the Port expansion, it is expected that further jobs will be created in the immediate area on Port-related support activities. Some industrial-zoned land is still available and there have been several plans for warehousing/distribution depot plots, although none have yet appeared. There is space at Felixstowe Switching Station for local 33/11kV transformers if required. A possible site just west of Trimley beside the A14 may be too far from a sensible source if any significant load is requested. In this case a Primary on the site fed from the nearby 33kV circuits would be possible, but it may then need some 33kV reconfiguration at Felixstowe.

Broadmeadow

This site is on the eastern edge of Ipswich and was the former Sugar Factory. It is within the Babergh Council area and is zoned for employment use. One application for mainly housing with some employment was turned down and the site is presently derelict. The present small site supply is on the end of the network from Ipswich Grid 11 and there is no significant capacity available for new load, due to the distance from source and the existing loads on feeder and Primary. The alternative supply is from Highfield which is also constrained by existing loads, switchgear, transformers and 33kV capacity. Either supply would therefore need significant upstream reinforcement.

If a significant load was required, a new Primary may be the best solution. This would then be available to permanently take some of the Highfield and Ipswich 11 networks.

BT Martlesham

BT own a considerable area of land around their existing Martlesham research campus. Their long-term vision is to create a hi-tech research/light manufacturing employment park on the site with housing in an ecologically-friendly environment. Their present MD (@ 18/12/12) is around 11.2MVA. There is some semi-permanent generation on site. An initial enquiry was received for a total enlarged site load of 40MVA. This would have required a new Primary fed from Cliff Quay but their present plans are less certain both in load and timing. A first phase of housing is expected to begin in 2013 following the adoption of the Suffolk Coastal development plan which allocates a major part of the Council housing growth (~2000 dwellings) to the BT-owned land. The present Martlesham Primary site is restricted in space for replacement plant. Transformer replacement would either need an unacceptably long period of single-circuit risk or the temporary use of adjacent land if available. The incoming 33kV circuits will definitely need replacement with new direct underground circuits, so depending on the proposed final load it may be better to consider an additional site which would provide a much more resilient network for this important customer.

Nacton area

Nacton Primary was originally a 6.6kV site dedicated to the supply to the factories for Cranes and Ransomes. Cranes factory finally closed in May 2009 and the site is presently being redeveloped for retail and business units. A supply from the 11kV network will be provided.

Ransomes own factory area has considerably diminished from its original size, but a light industrial/retail/distribution complex has developed (Ransomes Europark), fed from our 11kV network. A large area is still to be built when economic conditions are more favourable. The Europark site straddles the boundary between Ipswich and Suffolk Coastal Council areas. Ransomes itself still has a small private 6.6kV network and is therefore the only customer fed from our original plant.

A new 11kV source was established in Nacton Primary in December 2006 with two 33/11kV transformers and an 11kV switchboard in a new building. This was to enable the expansion of the Europark and enable the transfer of load from Warren Heath which previously supplied the area. Warren Heath has 12/24MVA transformers but the incoming 33kV circuits limit the capacity to 18MVA. Nacton 11 will be able to supply any reasonable further load on Europark and will probably be required to receive more load from Warren Heath,

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requiring some 11kV reconfiguration. Discussions are ongoing with Ransomes to supply them at 11kV enabling the complete removal of our old 6.6kV apparatus at Nacton. It is anticipated that this will take place in summer 2013.

Ipswich North

This area (Westerfield) is the main zone for housing expansion in the Ipswich Council development plan which calls for 1500 dwellings up to 2022 and a further 2000 up to 2026. The area sits between and on the edge of the feeding zones for Highfield and Roundwood Road, both of which are predicted to require reinforcement in the medium term. If such reinforcement has taken place then it may be possible to supply the development by extending the existing 11kV network, otherwise a new Primary for the north of Ipswich would be more beneficial.

The relative costs of the possible schemes are:

Reinforcement at Highfield and Roundwood Road	£6.5m plus 11kV network reinforcement
New Primary at Westerfield	£5.9m

Ipswich Wet Dock cable diversion (map)

The Environment Agency is to construct a flood barrier for central Ipswich across the 'New Cut' adjacent to the Ipswich Port Wet Dock. Work for this and the associated raising of the adjacent river walls will affect a route containing two 132kV-rated cable circuits and to avoid conflict it will be necessary to divert these for a short distance. One circuit runs from Ipswich Grid through (but not connecting with) Cliff Quay to Lawford. The other is presently alive at 33kV and is part of one of the four circuits feeding Felixstowe. It will eventually be needed at 132kV for the long-term reinforcement of Cliff Quay.

At the point of work these circuits run close to the river bank on an area known as the 'Island' and cross outside the entrance of the Wet Dock with short lengths of submarine cable.

After considerable discussion and several rejected options it was agreed that a short tunnel under the Wet Dock lock would be the best long-term solution. The tunnel will also carry two Ipswich Port private cables, one 6.6kV and their internal pilot cable. The whole diversion and the increased maintenance costs of the tunnel are to be funded by EA, with UKPN contribution for betterment. (PIMS scheme 3433). It is anticipated that this scheme will be approved in early 2013 with the actual diversions in summer 2014.

Other developments

Ipswich town - The Council plan calls for 1700 dwellings in the 'IP-One' (central) area of town on brown-field land up to 2022. It is expected that many of these will be situated on or near the river frontage where many new developments have already appeared. This type of site has recently been stifled by the economic situation. An upturn will put pressure on the networks fed from Ipswich Grid 11, Turret Lane, Fore Hamlet and, to a lesser extent, Gusford Hall. Of these only Fore Hamlet has any significant capacity available, but it is limited by the small-size 11kV cables on its immediate network. Any 11kV overlay will cause considerable traffic congestion in the central part of town. A further 1500 dwellings are expected on smaller sites throughout the town. For the next period to 2026 an additional 2000 dwellings on smaller sites will be allowed. As these smaller sites are scattered over the whole town area, it is expected that they can be accommodated on the existing 11kV network without major reinforcement other than is predicted in the PLE tables.

Babergh - This Council controls the extreme western and southern fringes of Ipswich town. In addition to the Broadmeadow site mentioned above, a small area of 350 dwellings and employment is planned near the A12/A14 Copdock junction. This is presently on the edge of areas fed from Ipswich Grid 11 and Gusford Hall.

East Anglia Offshore Wind (EAOW) - This is a proposed 7200MW windfarm situated some 50km off the Suffolk coast. One of the connection points will be Bramford Grid (NG) at 400kV. The connecting circuits will be HVDC and (eventually) four converter stations will be needed. These are to be sited on the northern edge of Bramford NG land and with the DC cable route will not directly affect the Ipswich/Cliff Quay network.

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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).

Nacton 33/6.6kV Primary Substation - remove 6.6kV equipment

The condition assessment of the 6.6kV switchboard installed at Nacton Primary has shown that, following an incident, the probability of failure of this asset is become unacceptable. This project recommends the decommissioning of this equipment. Existing supplies will be maintained using the local 11kV network.

Turret Lane 33/11kV Primary Substation - Replace 33kV Switchgear

The condition assessment of the 1966 SCO RK30 outdoor oil insulated switchgear installed at Turret Lane 33/11kV Primary Substation has shown that the probability of failure due to degradation will become unacceptable. Completion of the project will see 5 circuit breakers replaced with 5 new circuit breakers.

Ipswich 132/33kV Grid Substation - replace 33kV switchboard (2000A)

Many of the existing circuit breakers were installed pre-1960. The 33kV switchgear at Ipswich Grid is constructed as an outdoor raft. The foundations of the raft have subsided and the outdoor busbars are being stressed by the movement of the concrete support structures. The foundations are sinking and braids have been installed on the bus bars to prevent strain. It is therefore proposed to replace 13-panel outdoor raft with a new indoor switchboard as part of the asset replacement strategy. Remedial measures are not viable and replacement of the whole board is considered to be the most cost effective option.

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

The condition assessment of the 1977 GEC BVAC indoor VAC switchgear installed at Tattingstone 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.

Dock Rd 33/11kV Primary Substation - Replace 11kV Switchgear

The condition assessment of the 1964/66 SWS C4X indoor oil insulated switchgear installed at Dock Rd 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.

Roundwood Rd 33/11kV Primary Substation - Replace 11kV Switchgear

The condition assessment of the 1960 SWS D8-12X indoor oil insulated switchgear installed at Roundwood Rd 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.

Cliff Quay 132/33kV Grid Substation - Refurbish Grid Transformers (GT2, GT3, GT4)

The condition assessment of the 1963/71 BLO Grid Transformer installed at Cliff Quay 132/33kV Grid Substation has shown that the probability of failure due to degradation will become unacceptable. Completion of the project will see 3 Grid Transformers refurbished.

Gusford Hall 33/11kV Primary Substation - Refurbish Primary Transformers (T1)

The condition assessment of the 1968 FUL Primary Transformer installed at Gusford Hall 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

This information can be found in the Appendices.

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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.

3.4 Operational and technical constraints

Pinch points

Orwell crossing – the river Orwell is crossed near Cliff Quay Grid by two sets of tall towers holding a total of four 132kV and two 33kV circuits (continuing on 132kV construction towers). These carry the three circuits feeding Cliff Quay Grid 132/33kV transformers, a circuit towards Lawford Grid and the two circuits which are the only 33kV interconnection to an external source. This must be seen as particularly vulnerable following the recent Apache helicopter incident on the Lawford circuits about five miles away that caused a dual circuit fault.



Figure 4. Orwell Crossing

3.5 National Grid

A fifth transformer is being installed at Bramford for P2/6 compliance. To avoid fault level problems the site will be run with split busbars (2+2), with the new transformer on hot standby, switchable to any bar for the loss of a single transformer. For n-2 the site would be run solid.

The proposed NG reinforcement which would provide Twinstead supergrid will not reduce our load on Bramford. Load increases will require our 132kV switchgear at Bramford to be replaced for increased fault capacity in order that parallel running can be re-introduced. The connection to NG network of East Anglia Offshore Wind (EAOW) mentioned in 3.1 above may also affect the timing of any switchgear replacement.

4. Recommended strategy

The main aspect of concern is the security to the radial fed 33kV overhead line networks to Felixstowe/Martlesham, Tattingstone/Shotley and the nearby Wix/Dovercourt. The expansion of Felixstowe Port and its associated facilities, the development of Adastral Park at Martlesham and the long-term housing/employment growth in Ipswich town also all require consideration. Felixstowe and Martlesham are linked due to their present 33kV feeding configuration from Cliff Quay. The growth in Ipswich can be accommodated by reinforcement of the existing 33kV and 11kV network and a new Primary if necessary. Any 132kV work for this would be incorporated in the work necessary for the suggested solution for Felixstowe/Martlesham.

4.1 Description

Felixstowe/Martlesham

The Felixstowe Switching Station (FSS) site has been laid out in preparation for 132/33kV transformers. This will be required to resolve the 33kV security of Felixstowe, Martlesham, Tattingstone, Shotley, Wix and Dovercourt during summer outages for essential work to their 33kV OHL circuits. There is also space for local

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33/11kV transformers and 11kV switchgear if needed in the future. A 132kV cable route has been identified and the final easement documents are now being prepared for signature (Dec 2013). Ducts have already been laid on large parts of the route back to Cliff Quay during recent 33kV undergrounding/diversions.

The installation of 132/33kV transformers at Felixstowe will ensure adequate capacity for all the foreseen port expansion, associated job creation and proposed housing on the peninsula. There is also the possibility of feeding the future Bathside Bay expansion of Harwich port via a directional drill route beneath the Rivers Orwell and Stour.

Feeding Martlesham Primary from a new Felixstowe Grid will slightly increase the available capacity before voltage collapse, but any major expansion towards the 40MVA previously suggested will need a new underground route direct from Cliff Quay, probably to a new site as the existing Primary is unsuitable for major redevelopment while still retaining an adequately firm supply for the BT campus.

Ipswich town

The major long-term development will be on the green-field area to the north of the town (Westerfield) presently fed on the edges of networks from Highfield and Roundwood Road, both of which are close to capacity. Various options are available for the Westerfield supply. The preferred solution is currently to reinforce Highfield Primary and supply the new demand as well as providing 11kV interconnection to Roundwood Primary, increasing resilience to both substations.

There is spare 11kV capacity at Fore Hamlet and efforts should be made to fully utilise it although this will require 11kV network reinforcement of small-section cables and/or additional outgoing circuits.

Turret Lane is approaching summer capacity. Reinforcement there would be quite difficult owing to its small town-centre location. A preferable solution might be to reconfigure some load towards Fore Hamlet and Ipswich 11. This site is within an area of town earmarked for possible future redevelopment. Ipswich Borough recognises that an alternative site would be an advantage to both parties so a dialogue should be maintained.

Ipswich Grid 11kV itself has limited spare capacity, but reinforcement would be a much less challenging task (and probably less expensive).

Warren Heath will require load transferred away to Nacton via 11kV network rearrangement and new cable connections. This will be cheaper than replacing the 33kV solid cables from Cliff Quay which are the limiting factor.

Felixstowe Grid 132/33kV substation – New substation (2 x 90MVA 132/33kV & 132kV circuits)

The 33kV summer firm capacity for the dual circuit overhead lines to Felixstowe switching substation and Wix/Dovercourt Primary's is being exceeded under N-2 conditions. This outage is a requirement for pole replacements on the 33kV OHL's supplying these substations.

The North Essex and South Suffolk coastal areas are typified by a series of peninsulas divided by the rivers Deben, Orwell, Stour and Colne. The area has a mixture of AONB (Area of Outstanding Natural Beauty), SPA (Special Protection Area), SSSI's (Sites of Special Scientific Interest) and Ramsar status. The three peninsulas accommodate the large conurbations of Felixstowe and Harwich with their major international port connections and are a major part of the Haven Gateway Sub-region. Felixstowe is known to be the largest container handling port in the UK and Harwich as a multi-purpose freight and international passenger port that is mainly used for passenger ferries and cruise embarkation.

Felixstowe Port and Trinity Distribution Park is of National importance as the UK's busiest and largest container port. It handles 40% of all UK imports and 60% of imports from China with approximately 4000 ships docking in a year and handling between 3.4 – 3.7 million TEU (twenty foot equivalent Units) containers per annum. The nearby Harwich International Port is also an important location for the embarkation of cruise liners and supports daily ferry services to mainland Europe as well as providing roll on and off facilities, petro-chemical and is a key provider of services to the off shore wind farms off the East Anglian coast.

The town and port of Felixstowe is located at the end of a peninsula between the rivers Orwell and Deben. The area is supplied by five 33/11kV primary substations, two of which are dedicated to the Port of Felixstowe, two to the local supplies in Felixstowe and the fifth supports the Martlesham area to the north of Ipswich that is also

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home to the BT research establishment (Aadastral Park). Felixstowe has approximately 14,000 customers with a maximum demand of 58MVA. It is provided via two dual circuit 33kV OHLs from Cliff Quay and Ipswich Grid substations approximately 15km & 20km away. The 33kV circuits provide a maximum winter N-1 capacity of 83MVA. However a dual circuit 33kV overhead line requires a dual circuit outage for routine pole replacements. Therefore the operational security at Felixstowe is under summer N-2 conditions with a capacity of 45MVA. The new 33kV switching station at Parkers Avenue acts as a hub for all the 33kV circuits to Felixstowe and has been built to allow development into a 132/33kV substation. (Felixstowe Port has a Maximum Power Required (MPR) capacity (14.7MVA) that is not always fully utilised and at peak typically uses 9.9MVA, but has to be kept available at all times under all n-1 operating conditions.)

Martlesham Primary is teed off two of the 33kV circuits to Felixstowe switching substation. The capacity available is limited to approximately 19MVA in winter and 18MVA in summer due to the poor voltage regulation, the 33/11kV transformers are 11/23MVA. The firm capacity is predicted to be exceeded in the ED1 period. The Primary supplies the BT Research Centre at Aadastral Park that has a MPR capacity (11.5MVA) that is not always fully utilised and at peak uses 10.3MVA (2012), but has to be kept available at all times and under all n-1 operating conditions.

Harwich lies across the estuary from Felixstowe and is between by the Rivers Stour and Colne. It is supplied via lengthy (17km) 33kV dual circuit OHL from Lawford Grid to Dovercourt Primary with Wix Primary substation midway between the two. These two primary's supply 13,300 customers with a combined demand of 22MVA. Again the Harwich Port has a MPR that is regularly reached and has to be kept available at all times

The Shotley peninsula sits between the rivers Orwell and Stour and lies opposite both the Harwich and Felixstowe peninsulas. Whilst the population is relatively sparse there are two primary substations, Tattlingstone and Shotley supply approximately 6000 customers with a maximum demand of 13MVA, again supported by dual circuit constructed overhead lines. Shotley was the location of HMS Ganges (the Royal Navy training establishment that closed in 1976) but continued to be used by other organisations up to year 2000 and is now a site now identified for redevelopment. There is insufficient 11kV interconnection to meet summer outage requirements.

The three peninsulas all share common construction/design of their 33kV overhead line networks, with dual circuit 33kV overhead lines. Between the 33kV OHLs across the three peninsulas there are nearly 100 D poles and 100+ S poles recorded in Ellipse needing attention. The poles have suffered from decay, third party damage, wood pecker damage and lightning strikes. The exposed nature of the area makes (flat exposed farmland) the latter a regular occurrence. The design and construction of dual circuit 33kV overhead lines does not allow for pole replacements with either circuit remaining live. Failure of a single structure is likely to cause faults in both circuits within the dual circuit with obvious consequences to the connected primary substations.

The summer outage scenario for a dual circuit 33kV wood pole replacement involves isolating both circuits (N-2). At Felixstowe this reduces the summer capacity to 45MVA. The summer load including the MPR's at Felixstowe Port and Martlesham Research Centre was 49.7MVA for 2013. At Dovercourt Primary and Wix Primary substations there is 17MVA of summer demand with approximately 6MVA of 11kV transfer capacity.

If winter conditions are used for a dual circuit outage (result of a fault trip affecting two circuits) the Felixstowe capacity is 50MVA and a potential demand of 64MVA (including MPR's).

There is no interconnection between the three peninsulas or to other 33kV networks making them all vulnerable to coincidental faults and outages.

Recent high wind storms have high-lighted the fragility of the 33kV network in this area with three of the four 33kV circuits to Felixstowe being lost simultaneously resulting in the fourth circuit reaching its maximum winter rating in October. The risk of multiple failures would be increased if the circuits were to experience ice and wind loading. The number of decayed poles could lead to failure of several pole structures due to shock loading of adjacent structures making the restoration lengthy and time consuming.

The 33kV circuits between Cliff Quay, Felixstowe and Martlesham are supported with rented BT pilot circuits that are due to be terminated and require replacement with dedicated protection circuits.

The port of Felixstowe is known to have plans to consider replacement of their stock of diesel powered electric cranes to a mains powered type. The Port's contribution to any Connections initiated reinforcement is likely to be in the region of 10%, if Parker Avenue was to be established as a Felixstowe Grid substation to support their

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growth. Their contribution would not include any 33kV interconnection works and would be limited to the total of 132kV reinforcement costs.

Highfield 33/11kV Primary Substation - ITC (2x18/30MVA) & 33kV circuits

The predicted load at Highfield Primary Substation will exceed the existing firm capacity, including the transfer capacity to Ipswich Grid and Roundwood Road Primary Substations. It is therefore proposed to replace the existing transformers with larger units. The existing switchgear is not fully rated for this increased load. The existing circuits supplying the transformers are not fully rated for the larger units. It is therefore proposed to replace one of these circuits and double up the existing circuits to provide the second fully rated circuit. The 11kV switchboard is part of ED1 asset replacement and reinforcement strategies. Completion of this project will see the 2 existing transformers replaced with 2 new transformers, the existing switchboard replaced with a new switchboard comprising 12 circuit breakers and a new 2.6km 33kV underground circuit.

Ipswich 132/33 Grid Substation - ITC (2 x 90MVA units)

The predicted load at Ipswich Grid Substation will exceed the existing firm capacity, including the transfer capacity to Cliff Quay Substation. It is therefore proposed to replace the existing transformers with larger units. The existing switchgear will be fully rated for the increased capacity following completion of its asset replacement. The existing circuits supplying the transformers are fully rated for the larger units. Completion of this project will see the 2 existing transformers replaced with 2 new transformers.

4.2 Financial Appraisal and Benefits

Financial expenditure can be found in the Appendices as well as LI and HI improvement.

5. Rejected Strategies

5.1 Rejected Strategy 1 – 132kV Tee off Cliff Quay

Tee Felixstowe circuits onto two Cliff Quay transformers. The two 'clean' transformer circuits are both on the PTA route from Hadleigh Road to Cliff Quay. This arrangement would be particularly susceptible to a PTA double-circuit fault, when Cliff Quay and Felixstowe would be supplied at 33kV from the one remaining transformer at Cliff Quay. This would also prevent the uprating of the transformers at Cliff Quay as the route is only constructed with 300UPAS. Rejected on operational limitations

5.2 Rejected Strategy 2 - Alternative 132kV configuration

This requires one new cable from Bramford to Hadleigh Road, work on PHB as above and two 132kV cables CQ-FSS. It would prevent uprating at Ipswich due to the capacity of the PLD lines and place both Felixstowe and Lawford at greater risk because of the shared circuit. Rejected on operational limitations

5.3 Rejected Strategy 3 - 33kV Reinforcement

Replace all transformers at Cliff Quay and Ipswich Grids with 90MVA units, replace 33kV switchgear at both sites, lay two 33kV circuits from Cliff Quay to FSS, lay one new 132kV cable from Bramford to Hadleigh Road, reconductor and split the PHB route to 300UPAS between Hadleigh Road and Belstead, reconfigure Belstead tee. This places continued reliance on the vulnerable 33kV overhead route into FSS. As in the previous solution, a double-circuit PTA fault will affect both Cliff Quay and FSS. The use of Cliff Quay 33kV capacity will reduce the future headroom for growth in Ipswich town and Martlesham.

The capacity of the 33kV CQ-FSS routes will quite quickly be reached, at which time a 132kV solution will be needed. The overall cost of such two-stage reinforcement is greater than the preferred single-stage 132kV option. The existing congested cable sections at each end of the underground route would mean that new routes will be needed for the 132kV circuits, and additional easements over the whole route renegotiated.

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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

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
Appendix H	Maps of development areas

6.2 Document history

Version	Date of Issue	Author	Details
1.0	31/01/2013	Ian Robertson	Transferred from previous template
1.1	15/03/2013	Ian Robertson	Updated SLDs
1.2	22/06/2013	Nuno da Fonseca Ian Robertson	Final version
1.4	20/3/14	Howard Green	Aligned with ED1
2.0	27/03/14	Regulation	Final Publication

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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
Howard Green	Infrastructure Planner		19/03/14
Nuno Da Fonseca	Infrastructure Planning Manager (EPN)		

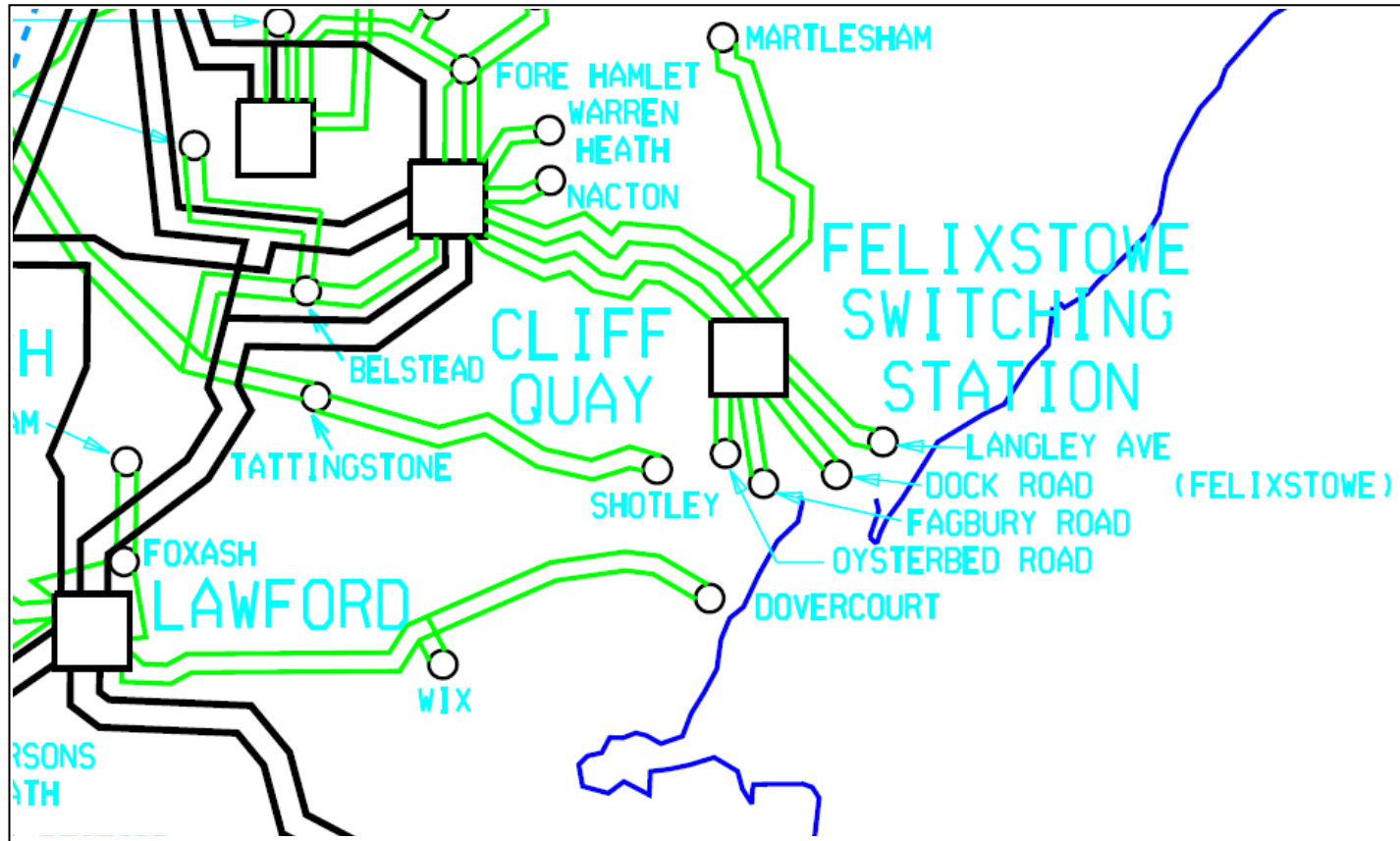
Approval by:

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

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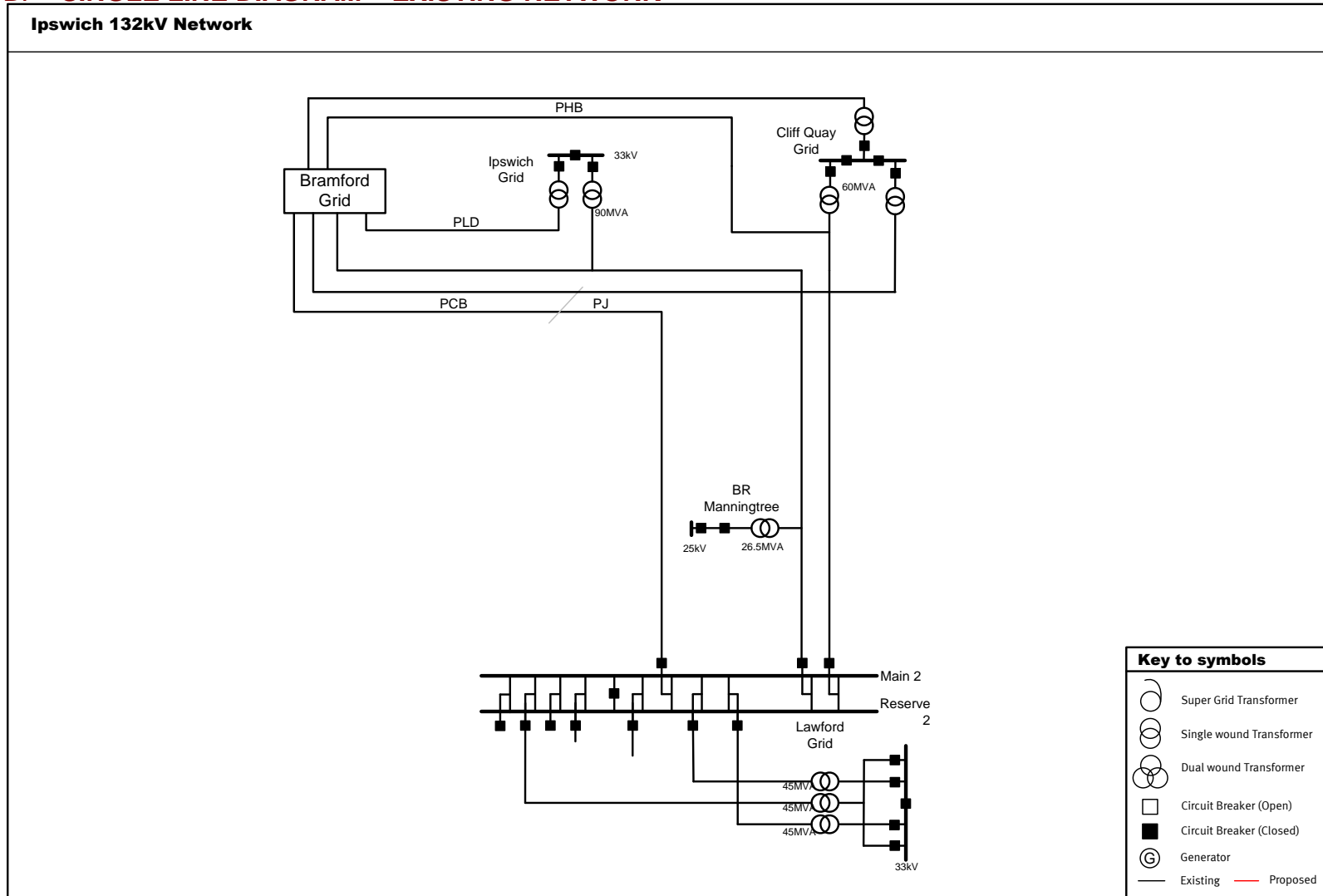
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APPENDIX A: NETWORK GEOGRAPHICAL DIAGRAM



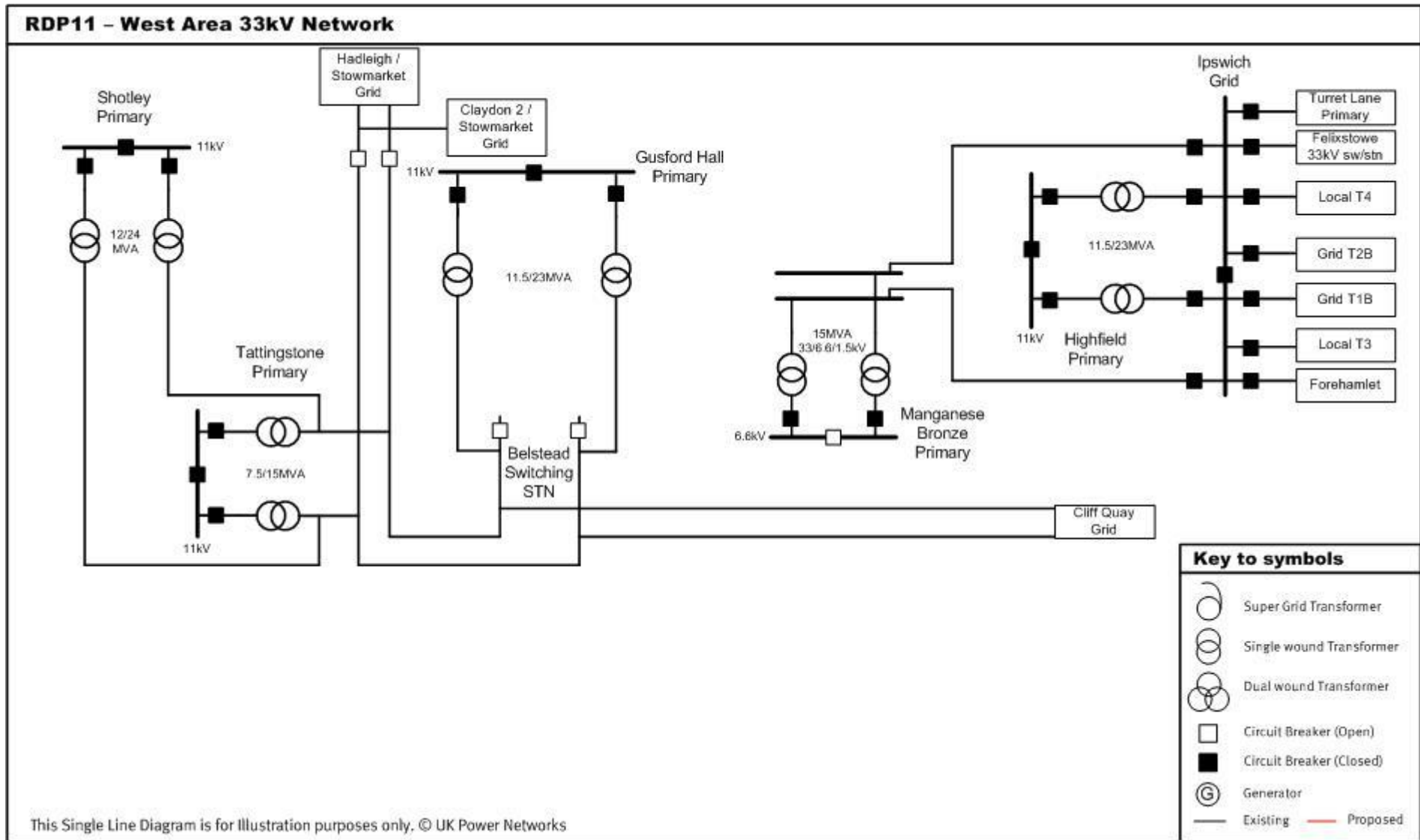
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APPENDIX B: SINGLE LINE DIAGRAM – EXISTING NETWORK



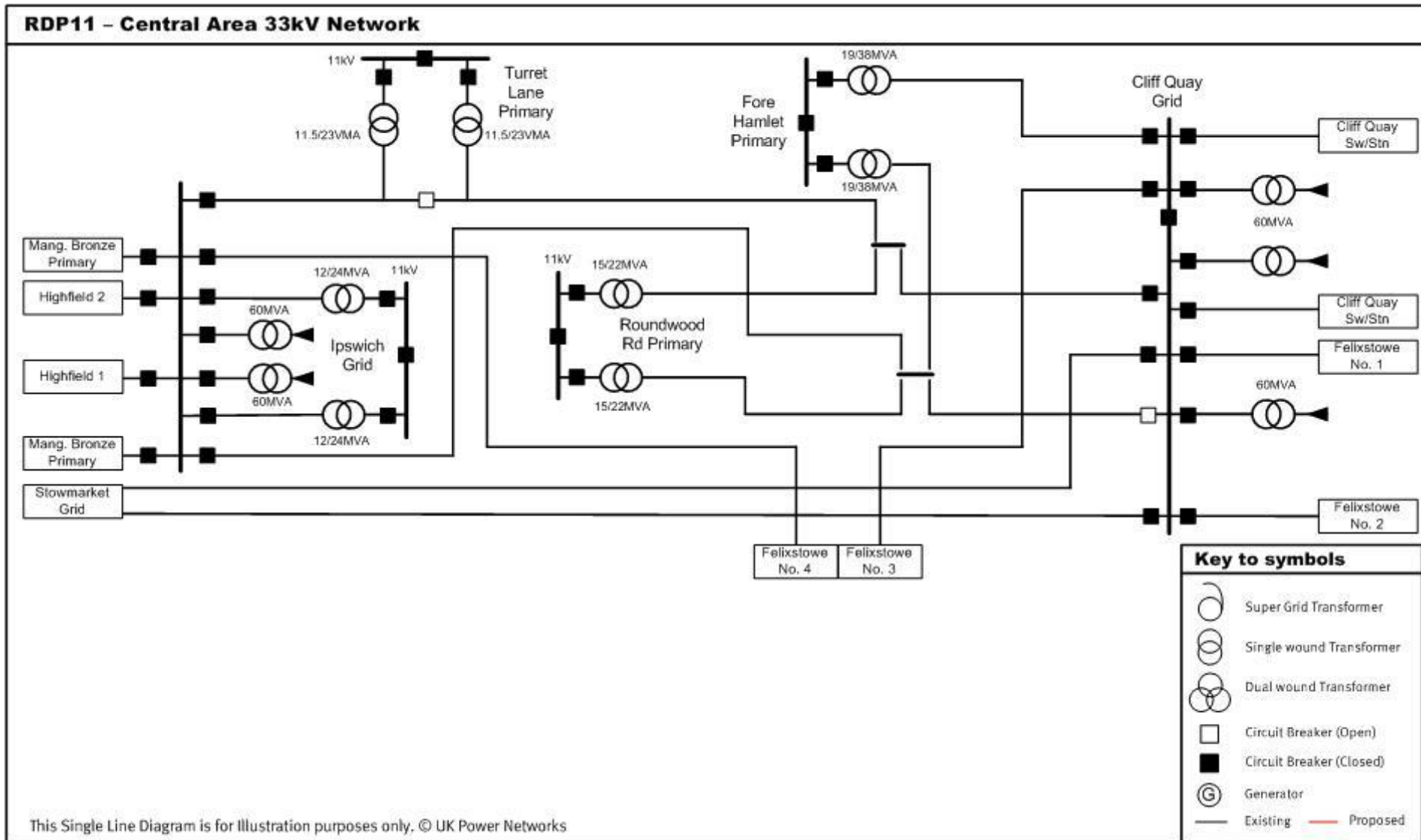
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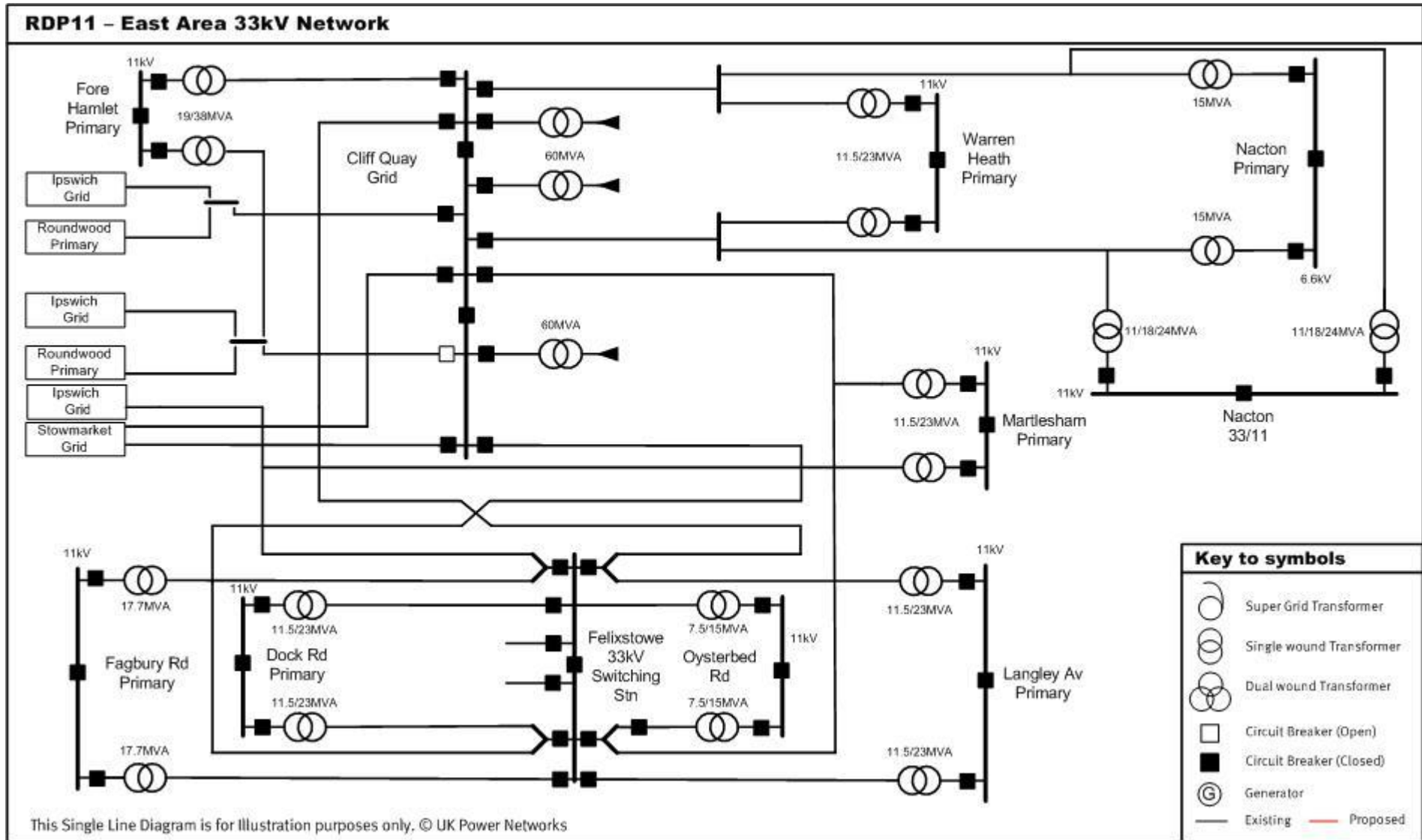


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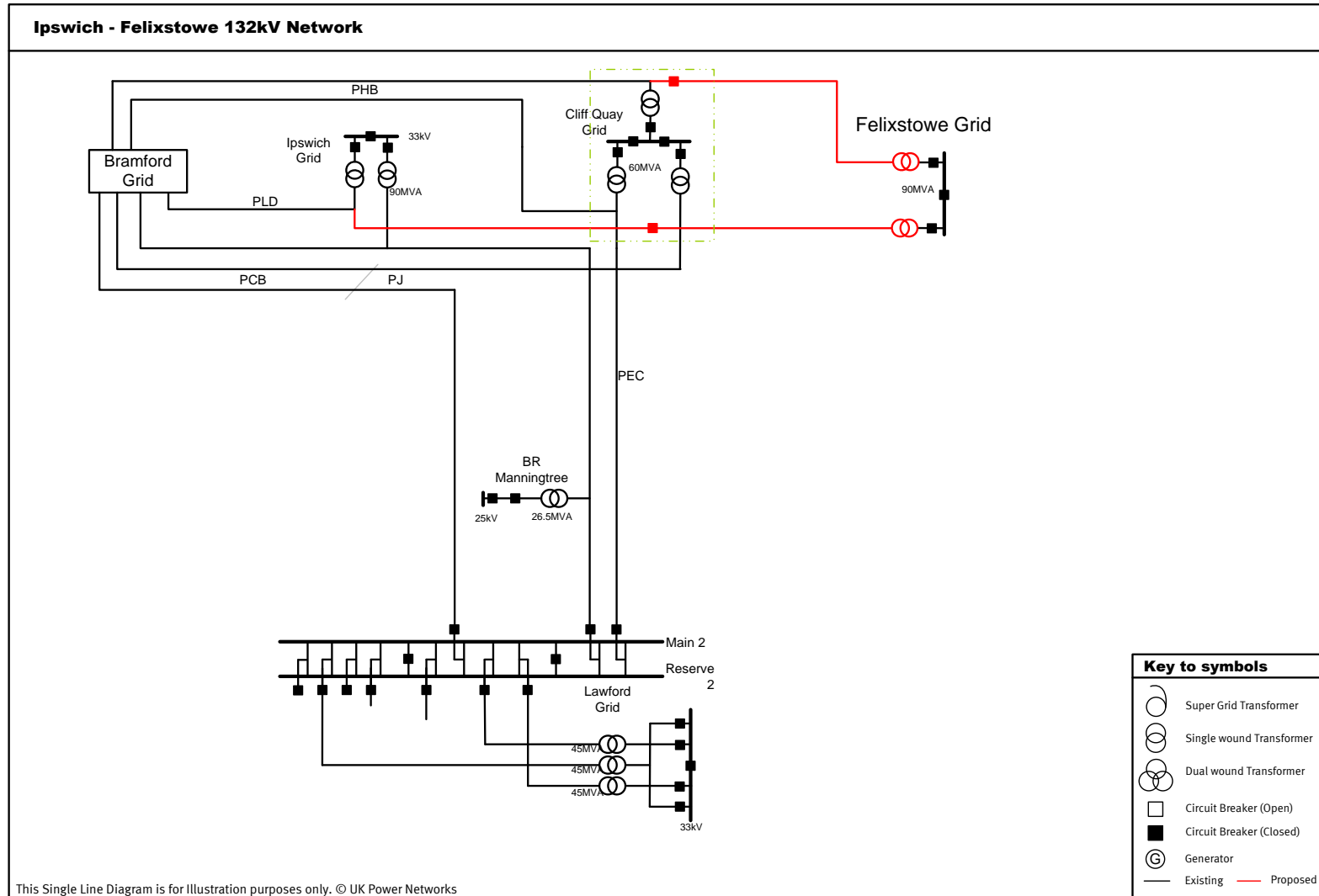


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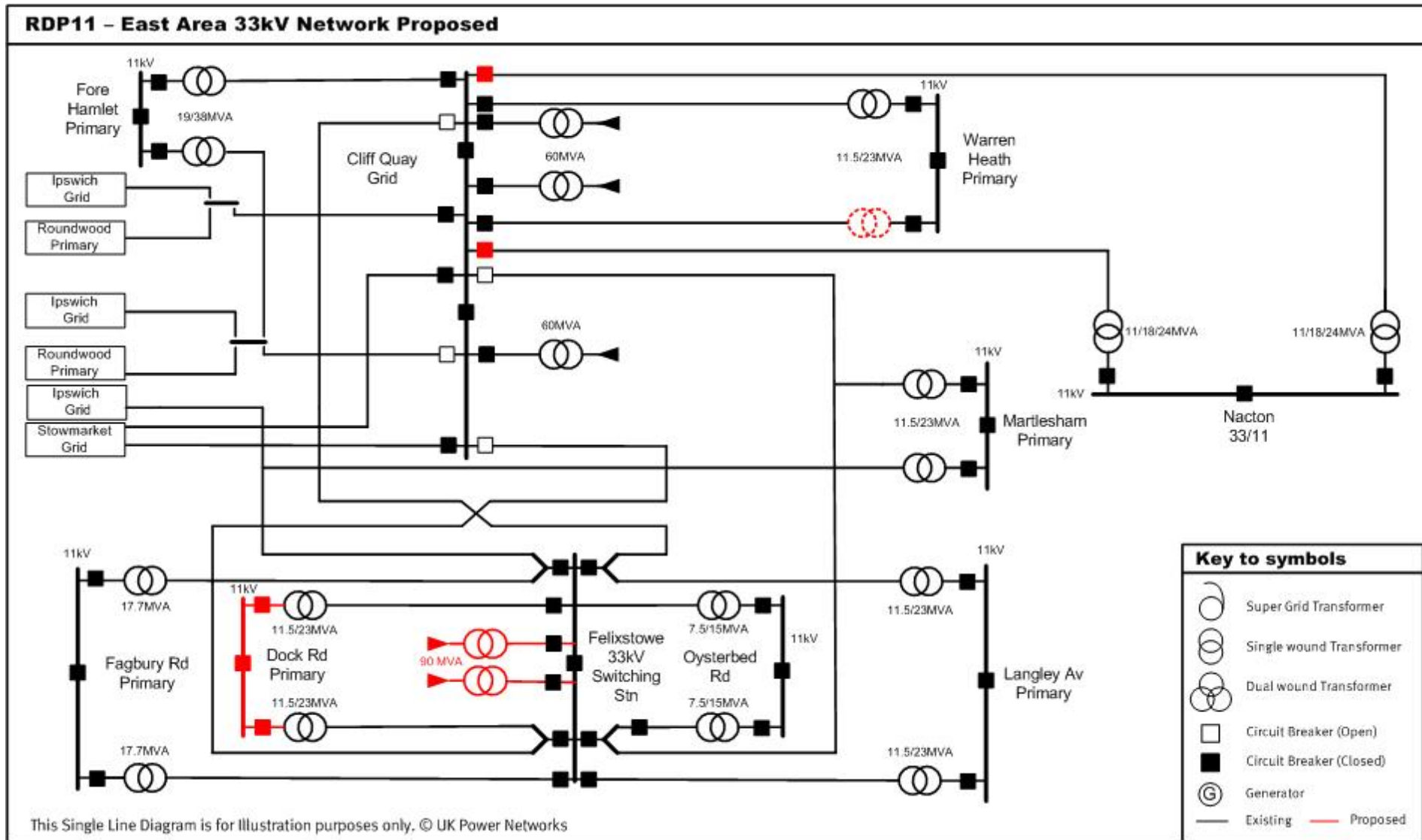
APPENDIX C: SINGLE LINE DIAGRAM – RECOMMENDED STRATEGY

Proposed Network –132kV



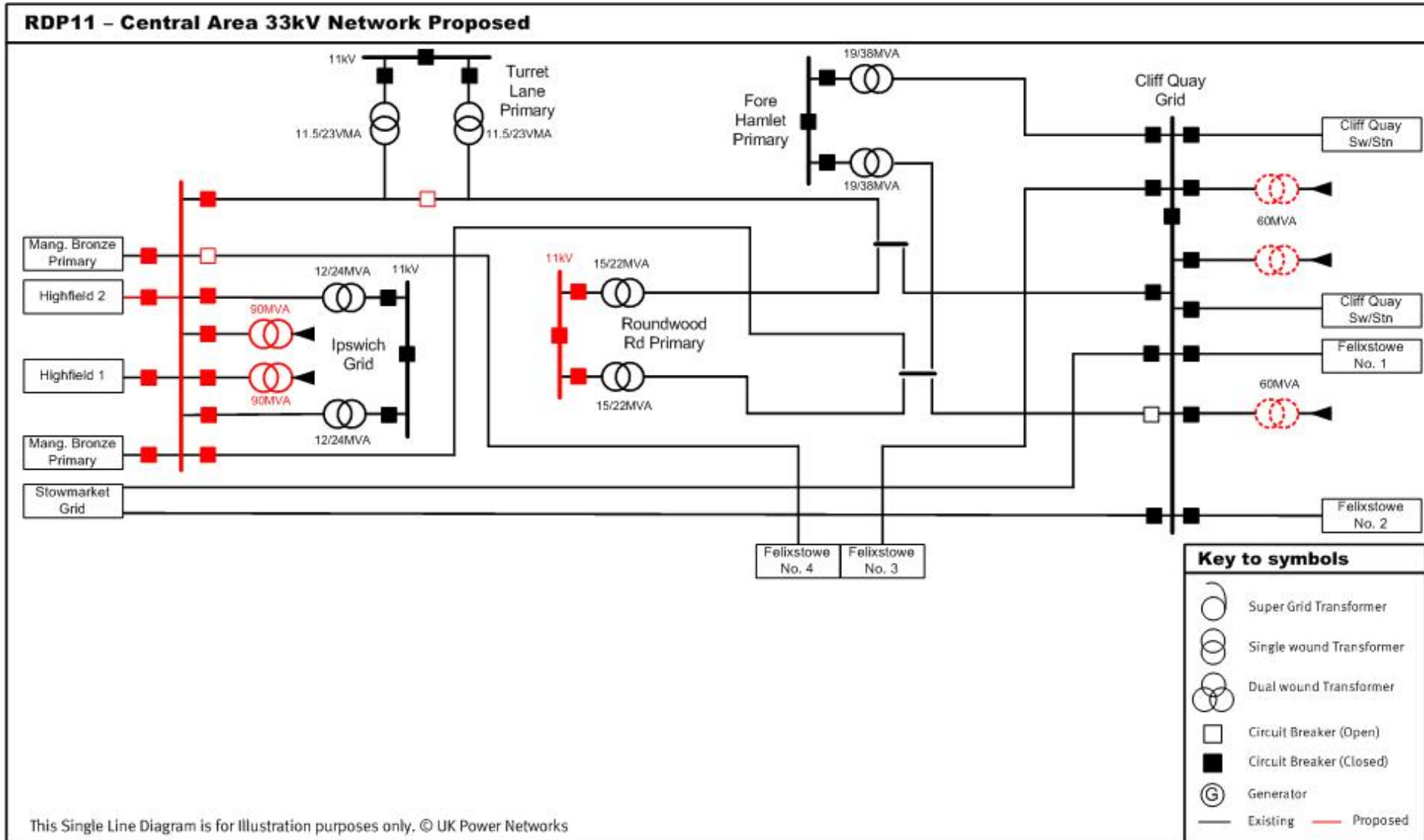
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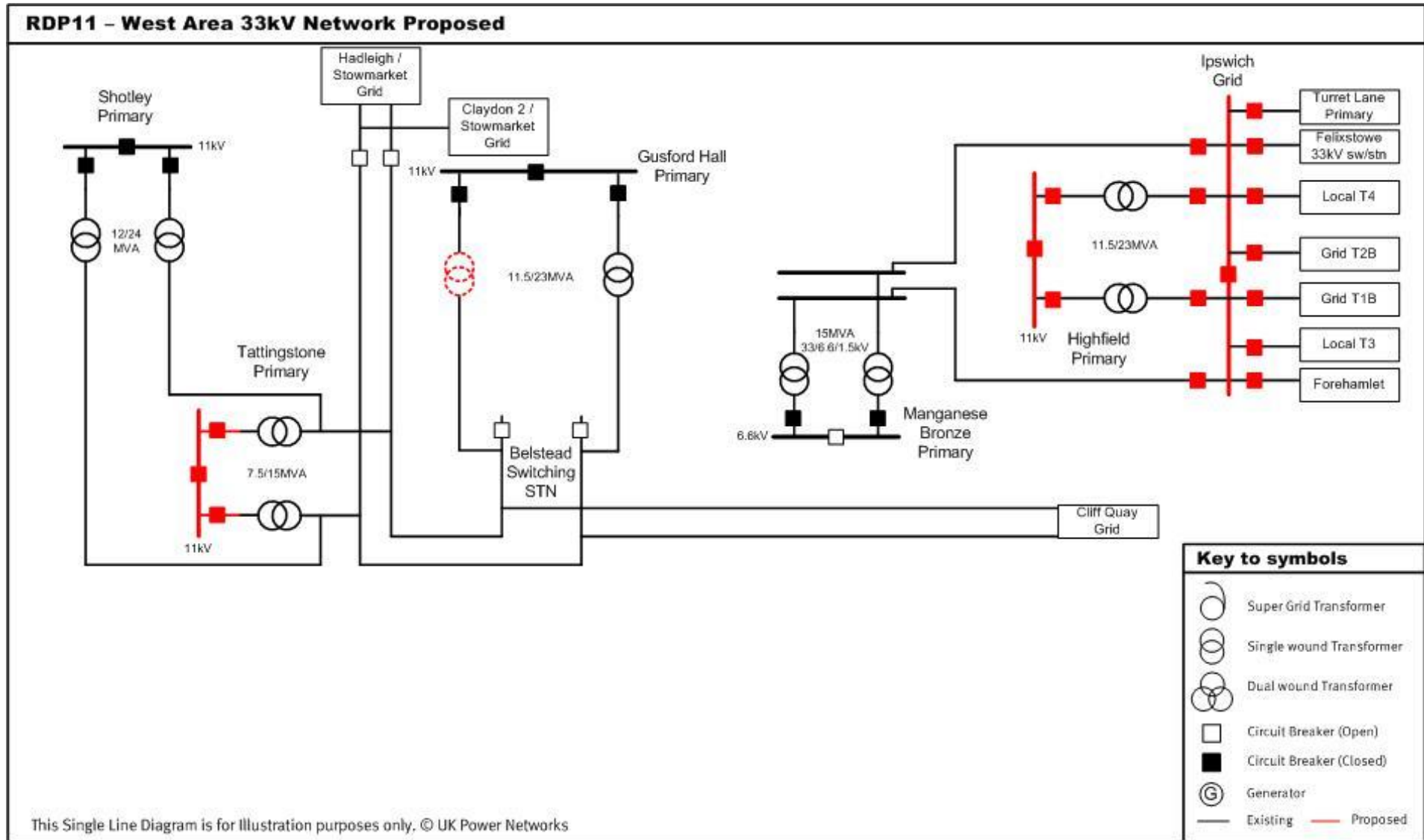


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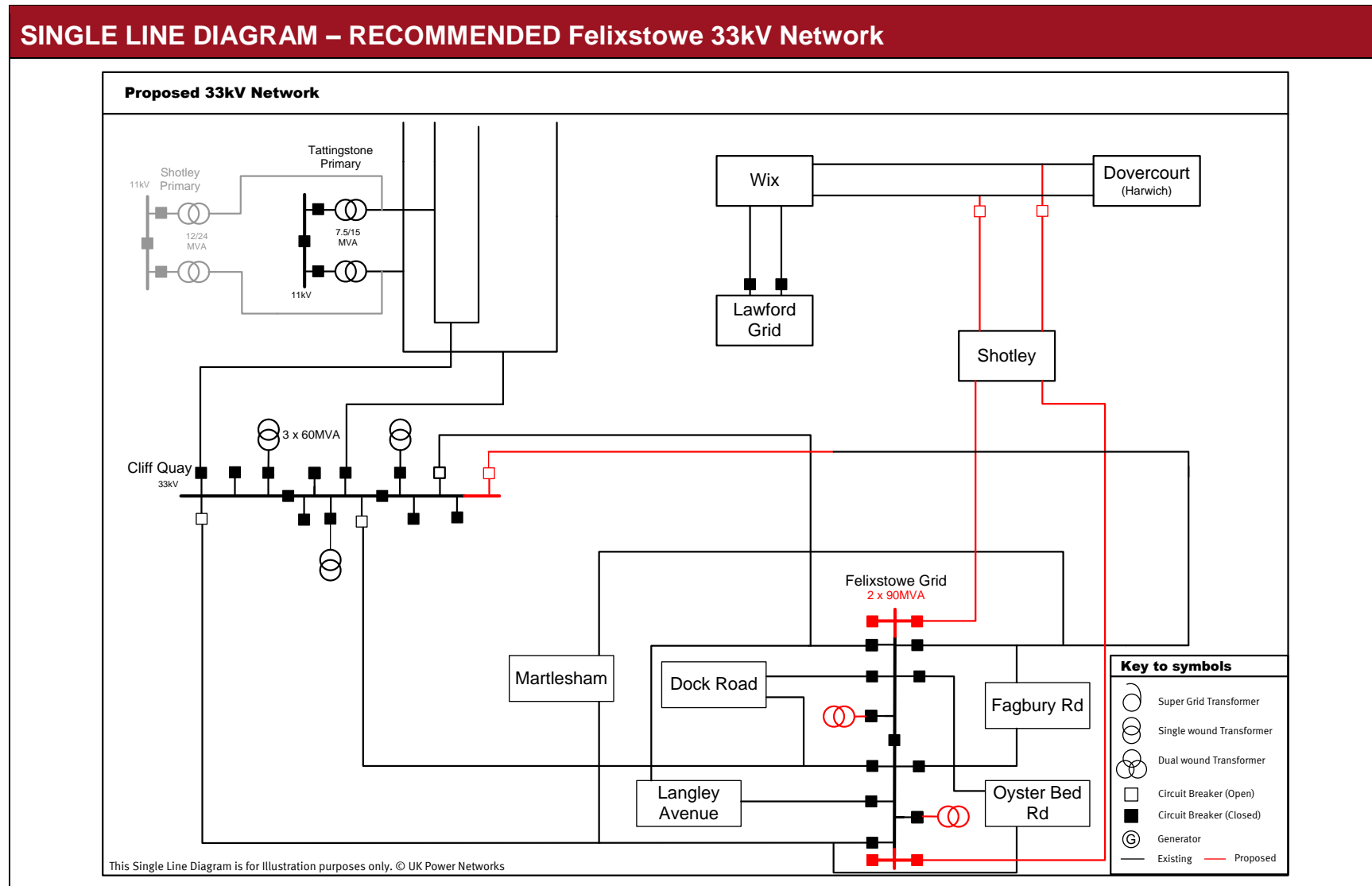
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SINGLE LINE DIAGRAM – RECOMMENDED Felixstowe 33kV Network



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APPENDIX D: DETAILED COSTS FOR RECOMMENDED STRATEGY

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

Cat	Namp Line	Project ID	Description	2013/ 2014	2014/ 2015	2015/ 2016	2016/ 2017	2017/ 2018	2018/ 2019	2019/ 2020	2020/ 2021	2021/ 2022	2022/ 2023
A	1.19.25	5522	Nacton 33/6.6kV Primary Substation - Remove 6.6kV Equipment	243,882									
A	1.48.02	2199	Turret Lane 33/11kV Primary Substation - Replace 33kV Switchgear										525,083
A	1.48.11	2198	Ipswich 132/33kV Grid Substation - Replace 33kV Switchboard (2000A)	934,482	519,315								
A	1.50.01	7665	Tattingstone 33/11kV Primary Substation - Replace 11kV Switchgear						234,836	555,099			
A	1.50.01	7680	Dock Rd 33/11kV Primary Substation - Replace 11kV Switchgear						39,111	823,146			
A	1.50.01	7704	Roundwood Rd 33/11kV Primary Substation - Replace 11kV Switchgear				252,267	653,264					
A	1.51.11	7710	Cliff Quay 132/33kV Grid Substation - Refurbish Grid Transformers (GT2, GT3, GT4)			102,040	350,711						
A	1.51.11	7730	Gusford Hall 33/11kV Primary Substation - Refurbish Primary Transformers (T1)			25,510	125,407						
R	1.11.90	2988	Divert 132kV Cables - Ipswich Wet Dock			1,020,400							
R	1.33.01	5397	Highfield 33/11kV Primary Substation - ITC (2x18/30/40MVA), 11kV Switchgear and 33kV Circuits						668,971	2,484,750	655,401		
R	1.35.01	3873	Ipswich 132/33 Grid Substation - ITC (2 x 90MVA units)	68,213	1,110,892	1,481,190	403,145						
R	1.37.06	2716	Parker Avenue 132/33kV Grid Substation - Install Grid Transformers (2 x 90MVA) and 132kV Circuits		79,131	4,010,352	8,475,886	2,956,329					
R	1.37.06	5772	Cliff Quay - Felixstowe 132kV Cable Route - Acquisition of Remaining Easements	30,000									

Regional Development Plan



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APPENDIX E: OUTPUT MEASURES – LOAD INDICIES (LI)

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

Substation	Season	First Limitation	DPCR5 Intervention		RIIO-ED1 without intervention			RIIO-ED1 with Intervention			P2/6 at End of ED1		Comply	
			FC NOW (MVA)	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
Cliff Quay Grid 33	W	Transformer	156.0		156.0	117.5	125.4	LI1	LI2		156.0	LI2	D	Yes
Dock Road	S	Transformer	17.3		17.3	8.5	8.8	LI1	LI1		17.3	LI1	B	Yes
Fore Hamlet	S	Transformer	28.5		28.5	14.2	15.3	LI1	LI1		28.5	LI1	C	Yes
Gusford Hall	W	Transformer	23.0		23.0	14.4	15.6	LI1	LI1		23.0	LI1	C	Yes
Highfield	W	Switchgear	22.8		22.8	20.6	25.5	LI2	LI5	5397	38.1	LI1	C	Yes
Ipswich Grid	S	Transformer	18.0		18.0	14.1	15.0	LI1	LI2		18.0	LI2	C	Yes
Ipswich Grid 33	W	Switchgear	68.5	2198	78.0	75.8	81.2	LI3	LI5	3873	114.3	LI1	D	Yes
Langley Avenue	W	Transformer	23.0		23.0	16.2	17.8	LI1	LI1		23.0	LI1	C	Yes
Martlesham	S	Transformer	17.3		17.3	15.9	16.6	LI2	LI3		17.3	LI3	C	Yes
Nacton 11	S	Transformer	18.0		18.0	8.1	8.6	LI1	LI1		18.0	LI1	B	Yes
Roundwood Road	W	Transformer	22.0		22.0	19.0	20.8	LI2	LI2		22.0	LI2	C	Yes
Shotley	W	Circuit Rating	21.7		21.8	4.4	4.8	LI1	LI1		21.8	LI1	B	Yes
Tattingstone	W	Transformer	15.0		15.0	7.7	8.6	LI1	LI1		15.0	LI1	B	Yes
Turret Lane	S	Transformer	17.3		17.3	12.8	13.8	LI1	LI1		17.3	LI1	C	Yes
Warren Heath	W	Circuit Rating	18.5		18.5	16.4	17.8	LI2	LI3		18.5	LI3	C	Yes
Felixstowe Grid (New)	S	Transformer	-		0.0	0.0	0.0	-	-		90.0	LI1	C	Yes
Fagbury Road	W	Transformer	21.2		21.2	5.7	5.7	LI1	LI1		21.2	LI1	B	Yes
Oysterbed Road	S	Transformer	11.5		11.5	5.5	5.5	LI1	LI1		11.5	LI1	B	Yes

Bramford GSP – Ipswich & Cliff Quay

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
CLIFF QUAY GRID											2				

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
CLIFF QUAY GRID		15					15					15			
FELIXSTOWE 33KV SW/STN	11					3	8								
IPSWICH GRID		3	9				3			9	12				
MARTLESHAM PRIMARY											2				
TURRET LN PRIMARY			1	3	1					5	5				
TOTAL	11	18	10	3	1	3	26			14	19	15			

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
DOCK RD PRIMARY		2	8					3	4	3	10				
FAGBURY RD PRIMARY		3					3				3				
FORE HAMLET PRIMARY		13					13				13				
GUSFORD HALL PRIMARY	1	3	6			1		9			1		9		
HIGHFIELD PRIMARY		7	5					8	2	2	12				
IPSWICH GRID		2	13					15					15		
MARTLESHAM PRIMARY		11					6	5			6	5			
NACTON 33/11	11					3	8								
NACTON PRIMARY			9					7	2				7	2	
OYSTERBED RD		3					3				3				
ROUNDWOOD RD PRIMARY	1	4	7			1	11				12				
TURRET LN PRIMARY		10	4					14					14		
WARREN HEATH		3	8					11					11		
TOTAL	13	61	60			4	34	83	8	5	35	25	61	2	

Bramford GSP – Ipswich & Cliff Quay

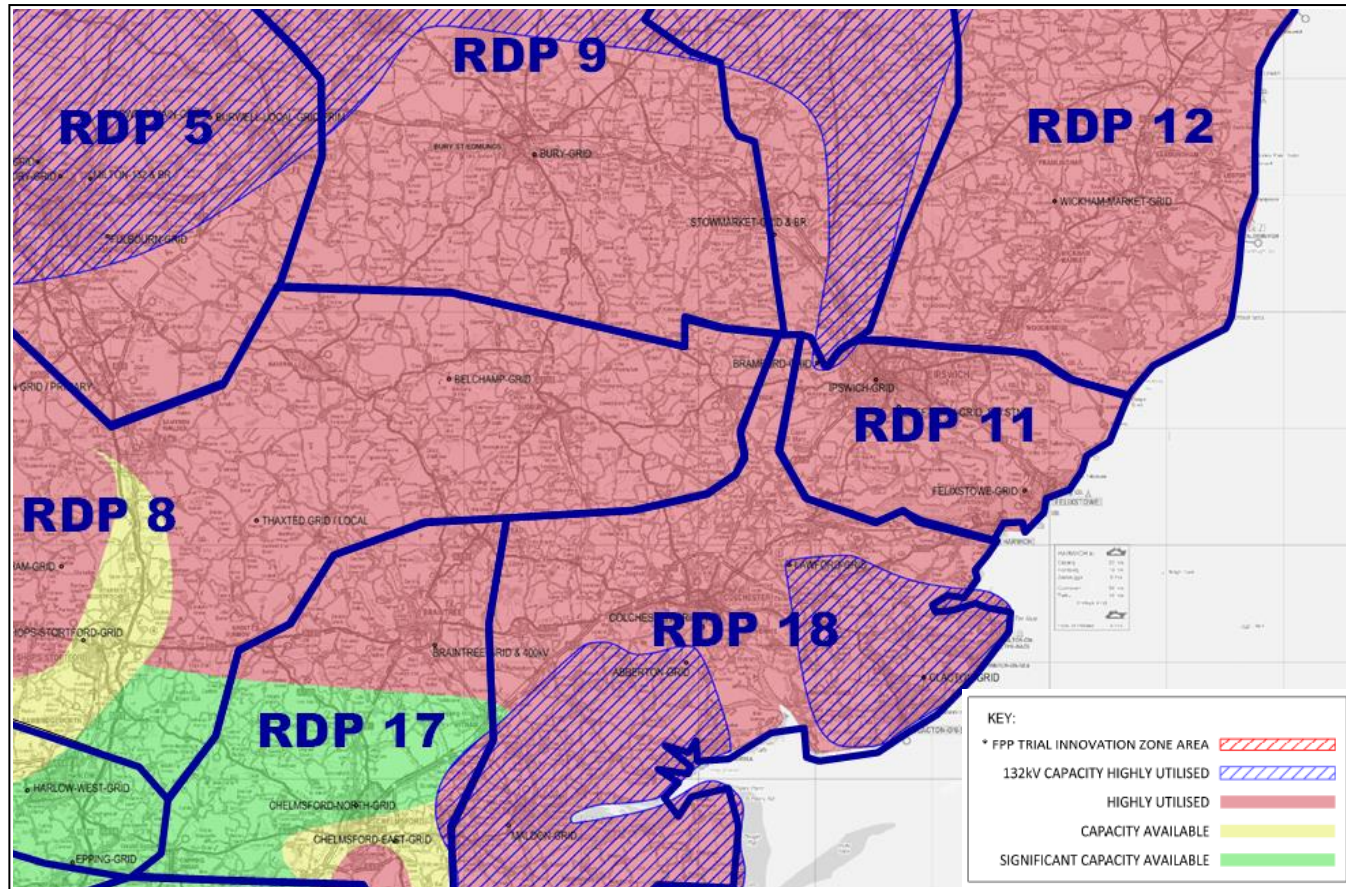
Substation	Grid and Primary Transformers														
	ED1 Start (2015)					End of ED1 (2023) No Investment					End of ED1 (2023) With Investment				
	HI1	HI2	HI3	HI4	HI5	HI1	HI2	HI3	HI4	HI5	HI1	HI2	HI3	HI4	HI5
CLIFF QUAY GRID			1		2				1	2				3	
DOCK RD PRIMARY		2						2					2		
FAGBURY RD PRIMARY		2						2					2		
FELIXSTOWE 33KV SW/STN												2			
FORE HAMLET PRIMARY		2					2					2			
GUSFORD HALL PRIMARY		1			1	1				1		1	1		
HIGHFIELD PRIMARY		2						2				2			
IPSWICH GRID		4					2	2			2	2			
MARTLESHAM PRIMARY		2						2					2		
NACTON 33/11	1	1					2					2			
NACTON PRIMARY				2						2					2
OYSTERBED RD		2					1	1				1	1		
ROUNDWOOD RD PRIMARY		2						2					2		
TURRET LN PRIMARY		1	1				1		1			1		1	
WARREN HEATH		1			1		1			1		1			1
TOTAL	1	22	2	2	4	10	13	2	6	6	10	13	1	3	

Regional Development Plan

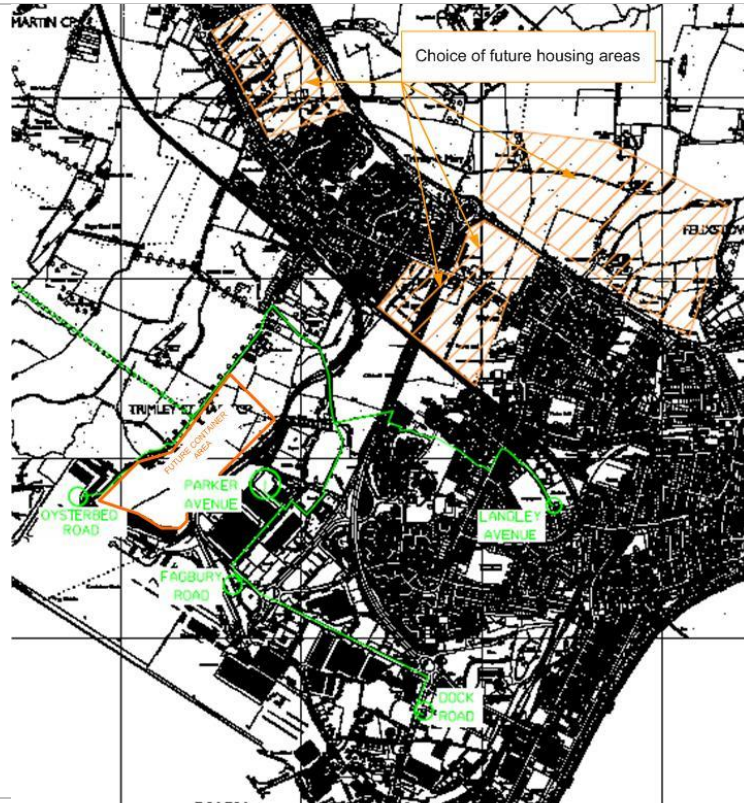
Bramford GSP – Ipswich & Cliff Quay

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.

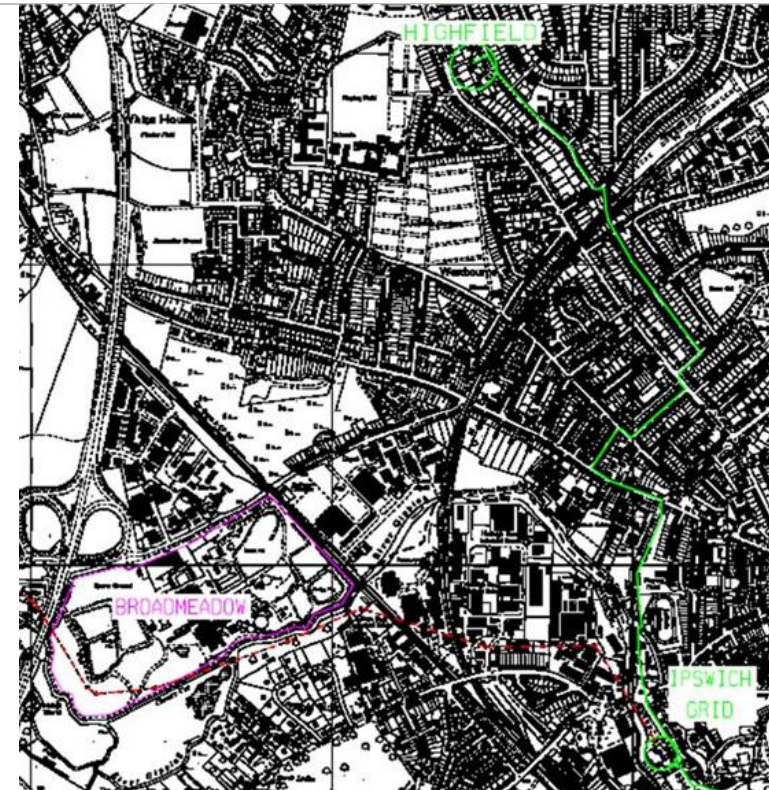


Felixstowe 33kV Network and future housing areas



Fagbury Road and Oysterbed Road are the two Port of Felixstowe dedicated sites. Dock Road and Langley Avenue feed the UKPN network. Parker Avenue is now known as Felixstowe 33kV switching station and will become the Grid site. The incoming 33kV circuits from Cliff Quay were recently diverted to avoid an area set aside for a future container storage park. From the northernmost point of the diversion spare ducts were laid into Parker Avenue for the future 132kV circuits. Not all of the proposed housing areas will be developed in the foreseeable future.

Broadmeadow, Ipswich

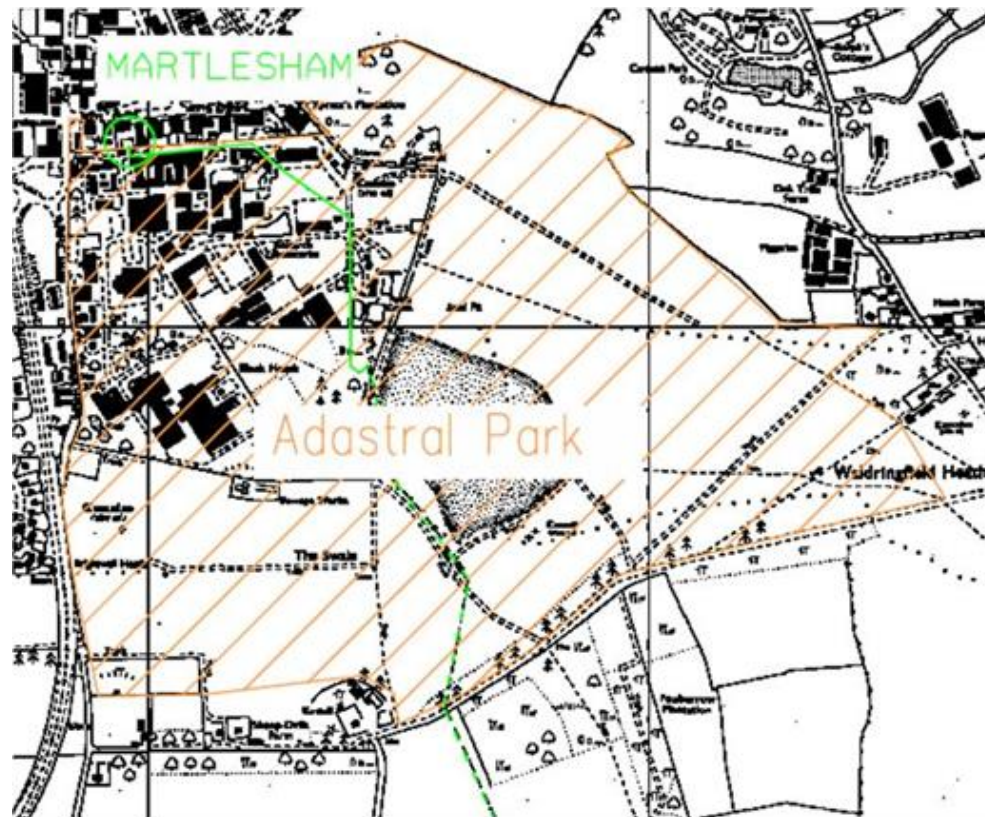


Broadmeadow is the site of the former Ipswich Sugar Factory. Although it appears to be in Ipswich town, it is actually just within Babergh District Council area.

An application for mainly housing on the site was rejected as it is zoned for employment and the site is presently derelict (Nov. 2011). The 132kV route PLD Bramford – Ipswich crosses the southern and western parts of the site.

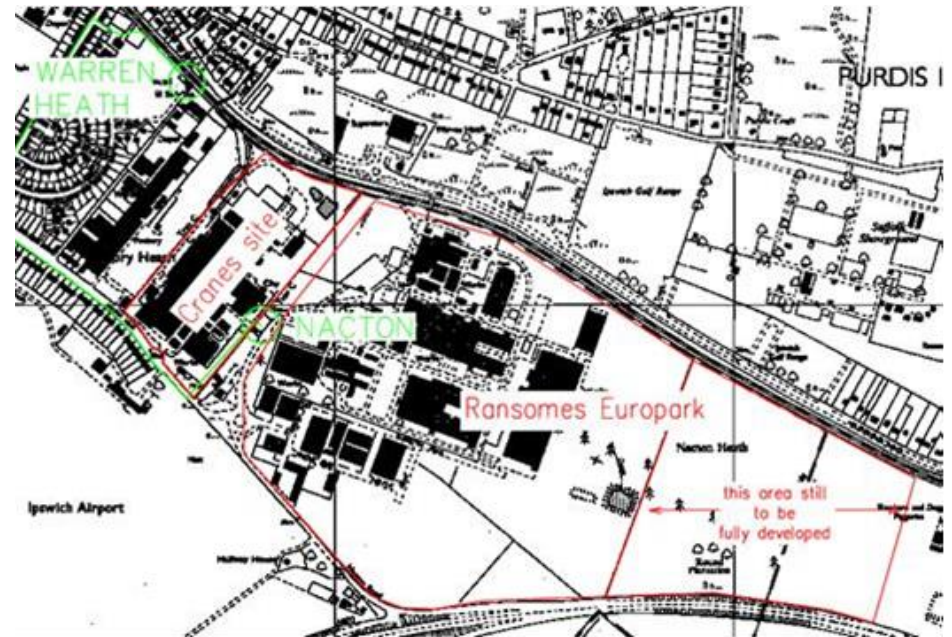
Bramford GSP – Ipswich & Cliff Quay

BT Martlesham



BT own a considerable area of land outside their existing research campus at Martlesham. Their long-term plan is to develop that land into a larger campus of associated hi-tech units and housing. (www.adastralvision.com). Part of the land is presently used for gravel extraction and this will continue until the allowable material has been recovered. The first housing is expected to begin in the south-west corner during 2013.

Nacton area, Ipswich



Nacton Primary has recently had 33/11kV transformers and 11kV switchboard installed to provide reinforcement for the expansion of Ransomes Europark employment area. The adjacent Cranes site is now demolished and enquiries have been received for redevelopment.

The old 33/6.6kV transformers at Nacton now only feed Ransomes factory (<2MVA MD) and it is hoped that agreement can be reached to uprate them to 11kV.

Bramford GSP – Ipswich & Cliff Quay

Ipswich – Westerfield area



The main housing expansion in Ipswich will be the development in three phases of the green-field Westerfield area. It will be the existing urban area and will initially be bounded by the Ipswich to Lowestoft/Felixstowe railway, although the final phase will extend northward beyond the railway to the borough boundary.

Wet Dock 132kV diversion



The old disconnected cable lengths will be drained, capped and abandoned.