



Regional Development Plan

RDP16 Brimsdown and Tottenham GSP (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.

Document History

Version	Date	Revision Class	Originator	Section Update	Details
1.5	12/03/2014	Major	Paul Ramsbotham	1.2, Appendix D	Expenditure aligned to the 19th February 2014 NAMP version J less indirect costs.
1.5	12/03/2014	Major	Paul Ramsbotham	1,2,3,4,5	RDP narrative updated to reflect latest position
1.5	12/03/2014	Major	Paul Ramsbotham	1.2, Appendix E, Appendix F	LI and HI output measures updated in line with current NAMP plan and RIG tables
1.5	12/03/2014	Minor	Paul Ramsbotham	2.2	Network changes in progress updated to reflect interventions to date
1.5	12/03/2014	Major	Paul Ramsbotham	4	Recommended strategy reflects latest position
1.5	12/03/2014	Major	Paul Ramsbotham	Appendix G	Generation activity reflects latest position
1.5	29/03/2014	Minor	Steve Mould	All sections	All sections checked for consistent section numbering, content etc.

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1 Executive Summary

This Regional Development Plan (RDP) reviews sections of UK Power Networks (UKPN) EPN HV and EHV network supplied from Tottenham 132 and Brimsdown 132 Grid Supply Points (GSP) covering the geographic areas associated with Haringey, Enfield, Waltham Forest and Barnet Councils. Tottenham 132 supplies 33kV and 11kV sites at Tottenham Grid, Hornsey Grid and Palmers Green Grid as well as three over-ground and one underground rail traction supplies. Brimsdown 132 supplies Barnet Grid, Brimsdown North and South Grid sites and Waltham Park Grid.

Being located to the north of London, and bounded by the M1, M11 and M25, the area is almost entirely urban and comprises a number of large commercial and industrial areas. There are also a number of large residential areas surrounding the many towns throughout this area. A number of railways cross the area to enter London and there are four rail traction substations; BR Ferme Park, BR Woodgreen, RT Manor House and RT Northumberland Park.

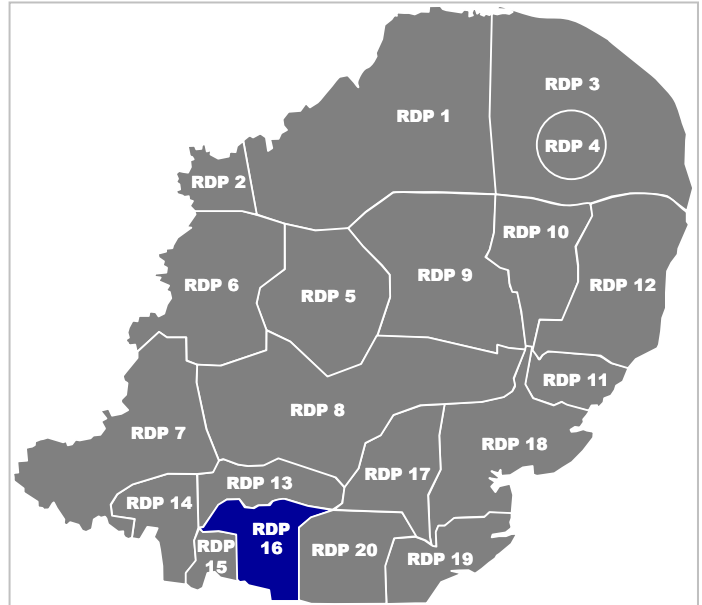


Figure 1 – Area covered by the RDP

1.1 Summary of issues addressed

Detailed within this RDP are the proposed works within the Tottenham 132 and Brimsdown 132 areas which comprise both asset replacement and reinforcement works. The reinforcement programme of works has been produced based on predicted load growth expected in the area with the aim of managing Load Indices (LI) across the region. The asset replacement works, provided by Asset Strategy and Performance (ASAP), are based on Health Index (HI) information taken from current asset data.

The main focus of the RDP is to:

- Replace deteriorating assets and create additional capacity at Hornsey 132/11kV substation by establishing an ITC and corresponding switchgear change.
- Replace deteriorating assets and create additional capacity at Central Tottenham Primary by establishing an ITC and corresponding switchgear change.
- Manage load at Brimsdown North Grid by transferring South Chingford Primary on to Tottenham Grid.
- Complete an ITC at South Chingford as the site is approaching its firm rating and transfer load from North Chingford in order to maintain North Chingford within its firm rating.
- Complete 12 asset replacement schemes within the Tottenham 132 area
- Reinforcement of Cockfosters and Ladysmith Rd Primaries through conventional ITC and switchgear changes. Enhancing 11kV interconnection was considered as an alternative option but was rejected.
- Complete 9 asset replacement schemes within the Brimsdown 132 area

Generation

Brimsdown and Tottenham GSP

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Embedded generation is not too widespread through the area covered by this RDP and the number of generation enquiries received is well below the average for the wider EPN area. However, there is a 50MW generator, with potential to increase to 60MW, connected at Deephams Primary feeding in to Tottenham Grid.

1.2 Investment profile

The Figure below provides the projected expenditure profile for reinforcement and asset replacement projects (LRE and NLRE) in this RDP for both DPCR5 and ED1. This information is taken from the NAMP version 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
RDP16	LRE	£3.6m	£0.4m	£1.5m	£1.1m	£0.0m	£0.0m	£0.0m	£0.8m	£2.2m	£6.0m
	NLRE	£1.5m	£1.1m	£4.8m	£5.4m	£5.7m	£8.3m	£5.9m	£1.3m	£0.1m	£32.6m
	TOTAL	£5.2m	£1.5m	£6.3m	£6.5m	£5.7m	£8.3m	£6.0m	£2.1m	£2.3m	£38.6m

Table 1. LRE and NLRE expenditure profile

Output Measures

The figures below provide the expected Load Indices (LI) for all substations covered in this RDP at the end of the 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.

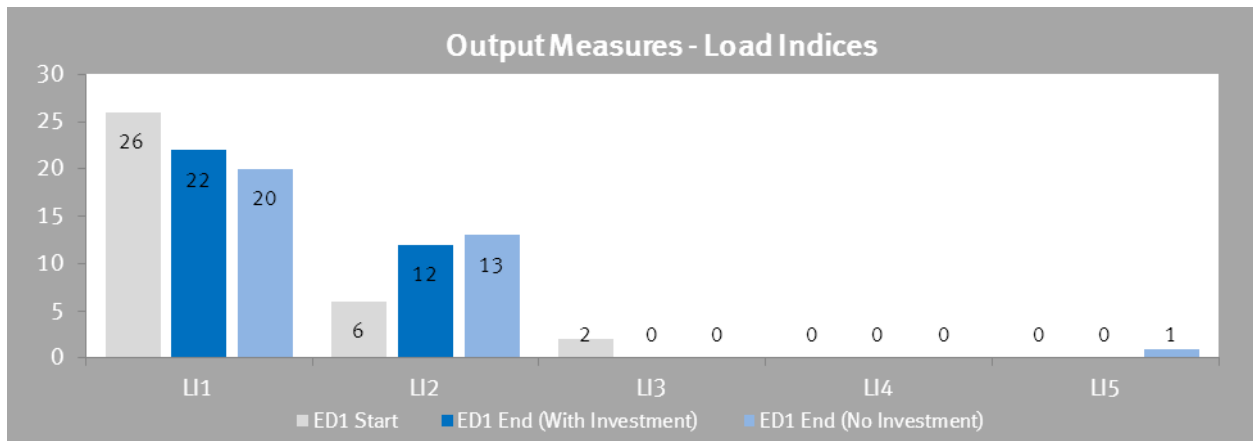


Figure 2. Load Indices (LI)

The figure 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



fects.

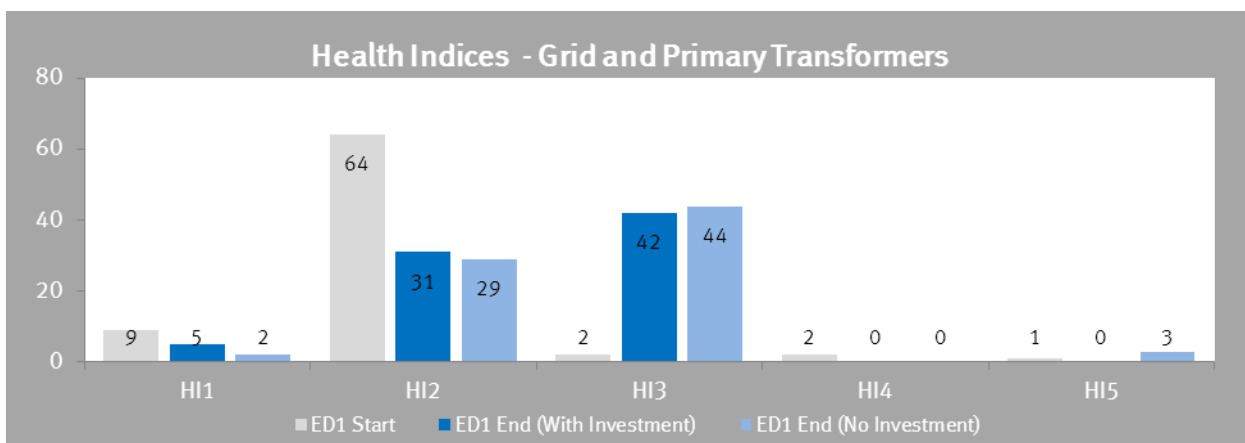
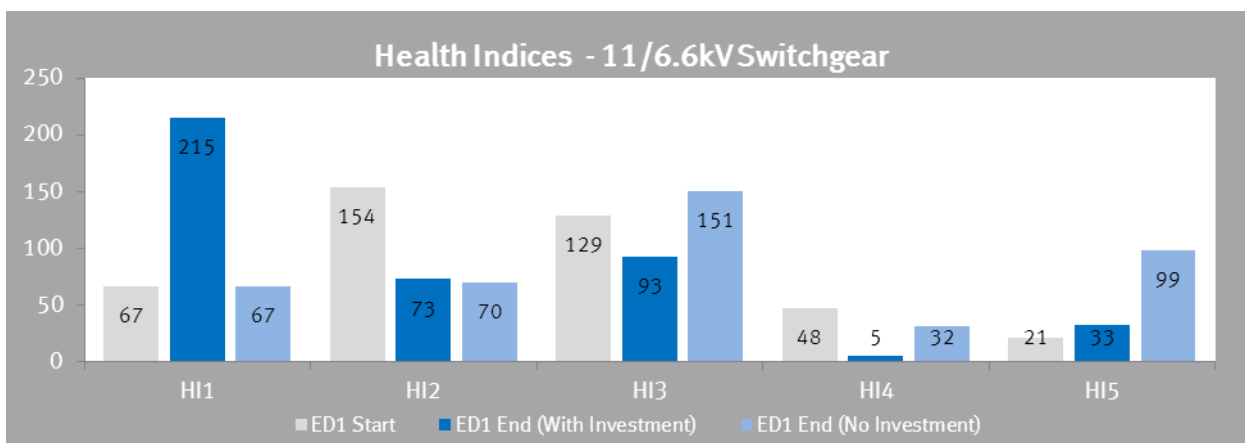
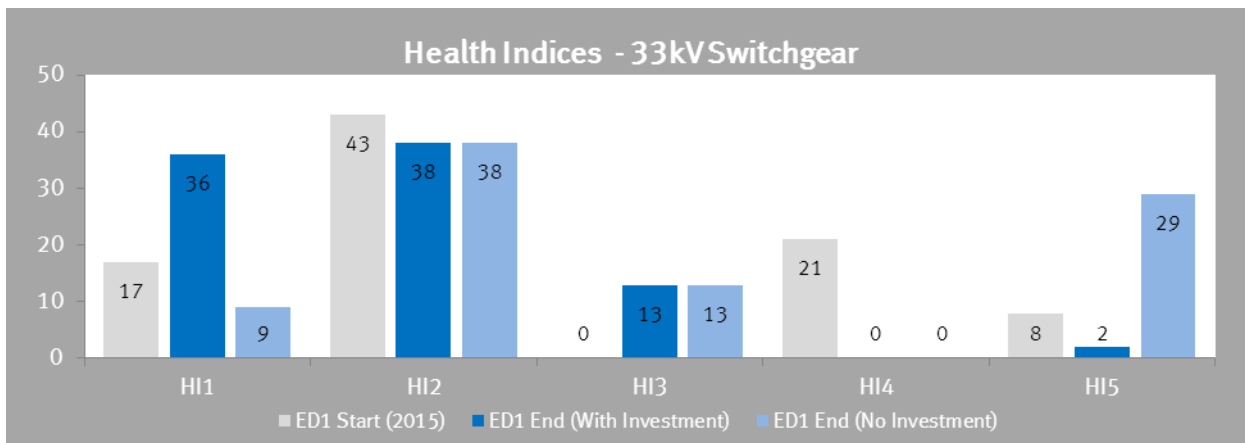
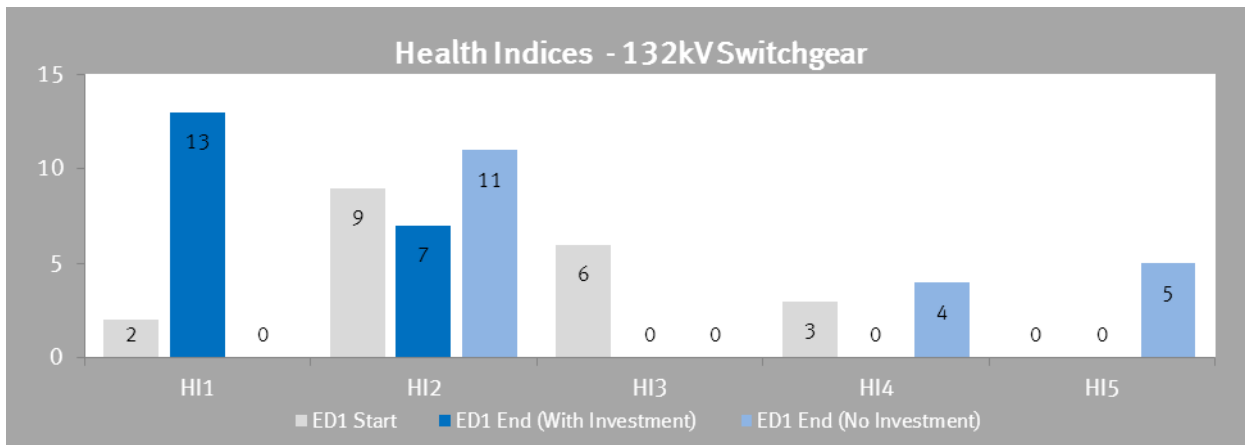


Figure 3. Health Indices by asset category

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Scenarios considered

The majority of costs contained within the RDP focus on replacing existing assets due to their Health Indices. The opportunity to combine reinforcement with these asset replacements has been taken where possible resulting in a cost effective strategy that aims to maximise gains in terms of HI and LI improvements throughout the region. The reinforcement of Hornsey 132/11kV substation in particular creates a large increase in 11kV capacity whilst also removing assets from the network that date back to the 1960s. The strategy also improves utilisation of existing assets rather than reinforcing where possible, in particular, rather than reinforcing Brimsdown North Grid the opportunity has been taken to transfer South Chingford Primary on to Tottenham Grid to utilise spare capacity at that site. This manages loads on both Grid sites more effectively whilst also allowing a more cost efficient ITC to be completed at South Chingford as less 33kV cable is required to supply it from Tottenham Grid than would have been required from Brimsdown North.

The rejected strategy for the Brimsdown 132 area considers increased 11kV interconnection between Primary sites rather than the utilisation of ITCs. Whilst this is a lower cost approach, and one that can enhance utilisation of existing assets, it wasn't possible in this case as it doesn't create sufficient capacity to meet the rising demands of the area. It also considers conventional reinforcement of Brimsdown North Grid and a subsequent ITC at South Chingford.

The rejected strategy for the Tottenham 132 establishes a new Primary site at Hornsey Grid, rather than the proposed direct transformation ITC but was rejected due to lack of space available at the site. It also considers a cheaper solution to the replacement of Tottenham 132 switchgear by utilising the existing bays but is dismissed due to a lack of available space. Again, 11kV interconnection is considered between existing sites rather than an ITC at Central Tottenham but is rejected as it impacts too greatly on the other Primary sites that it interconnects with.

RDP Dependencies and Interactions

The area contained within this RDP is largely independent of other networks and dependencies and therefore this RDP is considered in isolation of other documents.

Brimsdown 132 is considered independently of Elstree 132 as the 132kV network is now run open.

A scheme is currently underway to complete an ITC at Elstree Primary (1.33.01.2272), a site which interconnects with Hatfield Grid. As the site is also supplied from Barnet Grid, and therefore crosses Super Grid groups, it is also referenced in RDP13 (Elstree and Rye House).

2 Network configuration

2.1 Existing network

This RDP considers a total of nine Grid substations supplied from both Brimsdown 132 and Tottenham 132.

The 132kV bars at Tottenham 132 are owned by UKPN and fed from 4 x 275/132kV transformers (3 x 240MVA, 1 x 180MVA) owned by National Grid. Tottenham does not have any 132kV interconnection to any other substation groups. The 132kV switchgear is due to be replaced within the ED1 period.

Tottenham 132 feeds 6 UKPN substations, 1 London Underground substation and 3 National Rail substations at 132kV. The Hornsey, Palmers Green and Tottenham areas are each fed from both 132/33kV and 132/11kV substations. The 132/33kV substations then supply 33/11kV substations

The 132kV bars at Brimsdown 132 are owned by National Grid and fed from 4 x 275/132kV transformers (4 x 240MVA). Also connected to the National Grid bars are 2 x 132kV supplies to Buckhurst Hill for LPN and the Enfield Energy generator.

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Brimsdown 132 has 132kV interconnection capacity to Elstree 132 via a 175mm dual circuit tower line. The interconnecting circuits are run open at Elstree 132.

Brimsdown 132 feeds 4 UKPN substations at 132kV, 2 x 132/33kV substations (Barnet Grid and Brimsdown North Grid) and 2 x 132/11kV substations (Brimsdown South Grid and Waltham Park Grid).

Tottenham Grid

The Tottenham area is fed via 2 x 132kV 0.1km fluid filled cables rated at 193MVA winter, 176MVA summer, connected to a 132/33kV substation and a 132/11kV substation at Tottenham Grid. Tottenham Grid 132/33kV in turn feeds 3 x 33/11kV Primary substations and a dedicated customer 33/11kV substation owned by London Waste.

Tottenham Grid is equipped with two 90MVA, 132/33kV transformers. The site comprises indoor 33kV switchgear dating back to 2001. Tottenham Grid supplies a total of four Primary sites: Central Tottenham, Bruce Grove, Ponders End and Deephams (customer's site).

11kV switchgear replacements is planned Bruce Grove.

The 132kV fluid filled cable supplying Tottenham Grid is included for replacement within ED1.

Tottenham Grid also comprises two 30MVA, 132/11kV Grid transformers connected to a single bus 11kV switchboard dating back to 2002. The switchboard runs open due to fault level issues if both transformers operate in parallel.

Hornsey Grid

The Hornsey area is fed via 2 x 132kV fluid filled cables rated at 193MVA winter, 176MVA summer, connected to both 132/33kV and 132/11kV substations at Hornsey Grid. Hornsey Grid 132/33kV in turn feeds 4 x 33/11kV Primary substations. Also located at Hornsey Grid are 2 x 132/25kV National Rail transformers.

Hornsey Grid is equipped with two 90MVA, 132/33kV transformers. The site comprises indoor 33kV switchgear dating back to 1964. Hornsey Grid supplies a total of four Primary sites: Watsons Rd. West Green. Cranley Gardens. Crouch End.

11kV switchgear replacements are planned at West Green and Watsons Rd. 6.6kV switchgear replacement is planned at Crouch End.

The 132kV fluid filled cable supplying Hornsey Grid is included for replacement within ED1.

Hornsey Grid also comprises two 30MVA, 132/11kV Grid transformers connected to a single bus 11kV switchboard dating back to 1964. The switchboard runs open due to fault level issues if both transformers operate in parallel. An ITC and 11kV switchgear replacement is planned at this site within the ED1 period.

The switchboard runs open due to fault level issues if both transformers operate in parallel.

Palmers Green

The Palmers Green area is fed via 2 x 132kV 6.1km fluid filled cables rated at 213MVA winter, 195MVA summer, connected to both 132/33kV and 132/11kV substations at Palmers Green Grid. Palmers Green Grid 132/33kV in turn feeds 4 x 33/11kV Primary substations.

Palmers Green is equipped with two 90MVA, 132/33kV transformers. The site comprises indoor 33kV switchgear dating back to 1966 which is due to be replaced within the ED1 period. Palmers Green Grid supplies a total of four Primary sites: Central Edmonton. Bury Street. Lonsdale Drive. North Enfield.

11kV switchgear replacements are planned at Lonsdale Drive and North Enfield. The Primary transformers at Bury Street are due to be refurbished within the ED1 period.

Palmers Green Grid also comprises two 30/30MVA, 132/11kV Grid transformers connected to a double bus 11kV switchboard dating back to 1967. The switchboard runs open due to fault level issues if both transformers operate in parallel.

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Brimmsdown North

Brimmsdown North Grid is located at the same site as Brimmsdown 132 and is directly connected to the Brimmsdown 132kV bars. The site is equipped with two 90MVA, 132/33kV transformers. Brimmsdown North Grid supplies a total of seven Primary sites: Cuffley, The Cross, Ladysmith Rd, North Chingford, East Enfield, South Chingford and Waltham Abbey.

11kV switchgear replacements are planned at North Chingford, South Chingford and Waltham Abbey and Cuffley is due to be retrofitted. Waltham Abbey T3 will be refurbished. An ITC at South Chingford is also planned.

The 33kV circuits between Brimmsdown and Cuffley and Turnford and The Cross, are due to be rebuilt during the ED1 period.

Load at Brimmsdown North Grid will be managed by transferring South Chingford on to Tottenham Grid within the ED1 period.

Brimmsdown South

Brimmsdown South Grid comprises two 30MVA, 132/11kV transformers fed from Brimmsdown 132 via 2 x 750m 132kV fluid filled cables rated at 113MVA winter and 103MVA summer. The site utilises a single bus 11kV switchboard dating back to 1983. Waltham Park Grid is teed from the same circuit breakers at Brimmsdown 132 as Brimmsdown South Grid, and is fed via 2 x 3.8km 132kV cables rated at 240MVA winter and 227MVA summer.

Barnet Grid

Barnet Grid comprises two 90MVA, 132/33kV transformers fed via a 175mm dual circuit tower line (which is also teed to Elstree 132 to provide the interconnection) rated at 123MVA winter and 99MVA summer. The site utilises outdoor 33kV switchgear dating back to 1963 which is due to be replaced during the ED1 period. Barnet Grid supplies a total of six Primary sites: Rowley Lane, Tapster Street, Whetstone, Central Potters Bar, Elstree and Cockfosters.

Interconnection

Interconnection between these sites exists at:

- Brimmsdown 132 has 132kV interconnection capacity to Elstree 132 via a 175mm dual circuit tower line. The interconnecting circuits are run open at Elstree 132.
- Tottenham does not have any 132kV interconnection to any other substation groups.
- Hornsey Grid interconnects with Palmers Green Grid via Watsons Rd Primary
- Hornsey Grid interconnects with Tottenham Grid via Central Tottenham Primary
- Hornsey Grid interconnects with Finchley Grid via Cranley Gardens Primary
- Palmers Green Grid interconnects with Brimmsdown North Grid via Central Edmonton and Bury St Primaries

2.2 Network changes in progress

Work already underway (Gate B/C approved)

Elstree/South Mimms Tee (PMD) Malone Replacement

This is a 132 kV double circuit line which runs from Elstree to South Mimms Tee. It consists of 30 towers built in the 1930s, predominantly to the PL1(A) design. It has Lynx phase conductors (175mm² ACSR) and Horse earth wire (70mm² ACSR), neither of which have any record of being reconducted.

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It has been found while looking at the route schedule for BT21 feasibility work that the foundations on 25 of the towers are Malone Anchors. These have been found to not provide the strength required by foundations and so must be replaced when found and before any work can be done on the towers. any defects on the route shall be rectified during this work.

West Green and Central Tottenham 33/11kV Primary Substations - Replace 33kV switchboard (2000A)

The 33kV YSE HIVE18 switchboards at West Green were installed in 1963. The highest health index at this site is HI5. As part of the asset management strategy it is proposed to replace them.

This project will include the replacement of the 33kV outdoor raft at Central Tottenham with indoor switchgear and incorporate replacement switchgear for West Green.

Hendon 132/33kV Grid Substation - replace switchboard (2500A)

The 33kV switchgear at Hendon Grid is SWS ET outdoor cubicle type installed about 1964. As part of the asset replacement strategy it is proposed to replace the switchboard with an indoor board in a new building.

Lonsdale Drive 33/11kV Primary Substation - Replace 11kV Switchgear

The condition assessment of the 1958/61 BTH JB721/JB821 indoor oil insulated switchgear installed at Lonsdale Drive 33/11kV Primary Substation has shown that the probability of failure due to degradation will become unacceptable. It is not possible to keep these assets in use without compromising operational requirements; therefore this project recommends its replacement. Completion of the project will see 10 circuit breakers replaced with 10 new circuit breakers.

Golders Green 33/11kV Primary Substation - replace switchboard (2000A)

Golders Green Primary was established in the current form in 1957 and is equipped with two 15MVA 33/11kV ONAF transformers connected to a 13 panel 11kV switchboard. The board is made up of British Thompson Houston oil switchgear manufactured in 1956 with transformer circuit breakers rated at 1200A (JB422), bus sections at 800A (JB821) and the feeders at 400A (JB721). The switchgear is hand charged with the bus section and feeders not equipped with remote control facilities and cannot therefore be SCADA controlled. There is no recognised truck replacement to allow this. In line with OFGEM output measures for health index, the replacement of the switchboard at Golders Green will result in the elimination of HI4 and HI5 assets

Rebuild Brimsdown/Cuffley No.2 33 kV with wood pole line

The Brimsdown/Cuffley No2 feeder runs on a mix of 37 steel poles and narrow based towers for 4km of the route. These were first built in the 1930s and have had little treatment since then. The towers themselves are all heavily corroded and the steel core earthwire and the associated fittings are corroded and worn. There have been two failures between Nov 11 and Feb 12 caused by the earthwire falling down when the fittings failed. It is proposed to rebuild this section of overhead line with a wood pole line. All structures will be replaced along with signage, ACDs and fittings.

Elstree 33/11kV Primary Substation - ITC (1 x 12/24MVA) (1.33.01.2272)

The predicted load at Elstree substation will exceed the existing firm capacity, including the transfer capacity to Rowley Lane S/S. It is therefore proposed to install a third 12/24MVA transformer which will be supplied from the Hatfield 33kV circuit. The existing switchgear will be replaced with a 3 section 16 panel 2000A rated switchboard. The existing circuits supplying the transformers are fully rated for the units that they supply.

Tottenham Grid – Bruce Grove 33kV circuit replacement

A project to replace the 33kV circuits from Tottenham Grid to Bruce Grove passed Gate C a number of years ago but has uncounted issues securing the route. The cable installation has stalled due to problems with a railway crossing. The cable is installed up to each side of the railway line. Negotiations with Network Rail are progressing and a conclusion is expected in 2013. NAMP spend is forecast as £1,344k in 2013 which is deemed to be on-track.

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3 Summary of issues

3.1 Development areas

The area is covered by Haringey Council, The major areas for development include:

- Tottenham - housing, commercial/industrial
- Wards Corner, Seven Sisters – housing, commercial/industrial
- Northumberland Development (Tottenham Hotspur football club) – housing, commercial/industrial

The area fed from Brimsdown 132 is covered by Enfield and Waltham Forest Councils (Brimsdown Grid) and Barnet Council (Barnet Grid). The major areas for development, and the Primaries supplying the area, include:

- Colindale - Colindale 11
- Mill Hill East - Church End Primary
- North East Enfield/Ponders End – Brimsdown South, Ponders End Primary
- Enfield – Ladysmith Rd Primary, North Enfield Primary
- Inglis Barracks - Church End Primary, Brockenhurst Primary, North Finchley Primary
- Claremont Rd - Tapster St Primary
- Tilling Rd - Hendon Way Primary, Bellevue Primary
- Aerodrome Rd – Colindale 11, Bellevue Primary, Church End Primary

Generation

The main generation into the area is provided by London Waste who have generation capacity of 50MW connected to Tottenham Grid via Deephams Primary. They have recently enquired about the possibility of increasing this to 60MW

Council development plans

Data taken from the core strategies for Waltham Forest, Barnet and Enfield Councils suggest the following increases in housing numbers throughout their regions:

Waltham Forest expects an increase in population of 20,000 between 2011 and 2031 with a total of 11,400 new homes being built between 2011 and 2026.

Housing growth throughout Enfield is estimated to be 5,600 homes between 2011 and 2021.

Barnet Council estimate an increase in population of 40,000 people between 2011 and 2026 with 28,000 new homes being built within the same period. The spatial distribution of these homes is as follows:

- Brent Cross – Cricklewood: 5,510
- Colindale: 8,520
- Mill Hill East: 2,130
- North London Business Park: 400
- Priority Estates of Dollis Valley: 180
- Stonegrove and Spur Rd: 290
- West Hendon: 1,540

None of the core strategies appear to provide estimated employment growth or development areas or types.

Customer enquiries

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There have been a number of enquiries for developments ranging between 2MW and 5MW in and around Cockfosters, Hornsey and Palmers Green. A number of enquiries for data centres have been received in the Enfield area. To date, all the data centre enquiries have been speculative.

Network Rail has enquired to establish a 26MVA supply at Hornsey. Additional power requirements were requested at Northumberland Park in 2010 (CP4) but following power quality monitoring an increase in the Firm Service Capacity (FSC) was only agreed if a corresponding reduction was made at Hornsey grid for the combined BR Wood Green and Ferme Park supplies which also originate from Tottenham grid.

Network Rail have identified that additional capacity will be required for CP5 in the Northumberland Park area and UKPN have proposed solution to establish a new dual circuit 132/25kV 26.5MVA supply at Brimsdown North grid using the 2 transformer bays at the rear of the site which are currently being used as storage areas. This proposal has been presented to NWR and they have indicated a 90% certainty that they will want to go ahead with this option with a possibility of requiring energisation in 2015.

Once the new Brimsdown supply is established, the existing Northumberland Park supply would be decommissioned and the 132/25kV transformers at Tottenham grid removed. Some or all of the capacity recovered by decommissioning Northumberland Park could then be utilised to provide an increase in the FSC for the combined Hornsey supplies to enable additional capacity to be provided for the East Coast Main Line and a new traction maintenance depot in the Hornsey area.

3.2 Asset replacement

Tottenham 132

Hornsey 132/11kV Grid Substation - Replace Grid Transformers (GT1A & GT2A)

The condition assessment of the 132/11kV Yorkshire Electric transformers installed at Hornsey Grid Substation has shown that the probability of failure due to degradation will become unacceptable. It is not possible to keep these assets in use without compromising operational requirements therefore this project recommends its replacement. Completion of the project will see 2 x 132/11kV, 30MVA Grid Transformer replaced with 2 x 132/11kV 30+30MVA (60MVA dual wound) Grid Transformer.

West Green 33/11kV Primary Substation - Replace 11kV Switchgear

The condition assessment of the 1957 MVI V1RH2R and 1959/61 MVI V1RH1S indoor oil insulated switchgear installed at West Green 33/11kV Primary Substation has shown that the probability of failure due to degradation will become unacceptable. Completion of the project will see 11 circuit breakers replaced with 11 new circuit breakers removing 2 x HI3, 1 x HI4 and 8 x HI5 assets from the network.

Lonsdale Drive 33/11kV Primary Substation - Replace 11kV Switchgear

The condition assessment of the 1958/61 BTH JB721/JB821 indoor oil insulated switchgear installed at Lonsdale Drive 33/11kV Primary Substation has shown that the probability of failure due to degradation will become unacceptable. Completion of the project will see 10 circuit breakers replaced with 10 new circuit breakers removing 1 x HI4 and 9 x HI5 assets from the network.

Ponders End 33/11kV Primary Substation - Replace 11kV Switchgear

The condition assessment of the 1957 MVI V1RH2R and MVI V1RH1S indoor oil insulated switchgear installed at Ponders End 33/11kV Primary Substation has shown that the probability of failure due to degradation will become unacceptable. Completion of the project will see 13 circuit breakers replaced with 13 new circuit breakers removing 13 x HI5 assets from the network.

North Enfield 33/11kV Primary Substation - Replace 11kV Switchgear

The condition assessment of the 1966 SCO UAE4/UAE12 indoor oil insulated switchgear (No R/C) installed at North Enfield 33/11kV Primary Substation has shown that the probability of failure due to degradation will

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become unacceptable. Completion of the project will see 11 circuit breakers replaced with 11 new circuit breakers removing 2 x HI3, 4 x HI4 and 5 x HI5 assets from the network.

Watsons Road 33/11kV Primary Substation - Replace 11kV Switchgear

The condition assessment of the 1969 EEC UAE64 indoor oil insulated switchgear installed at Watsons Road 33/11kV Primary Substation has shown that the probability of failure due to degradation will become unacceptable. Completion of the project will see 15 circuit breakers replaced with 15 new circuit breakers removing 15 x HI3 assets from the network.

Crouch End 33/6.6kV Primary Substation - Replace 6.6kV Switchgear

The condition assessment of the 1959/64 SCO UA20/UA6 indoor oil insulated switchgear installed at Crouch End 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 removing 7 x HI3, 1 x HI4 and 4 x HI5 assets from the network.

Tottenham 132kV Grid Supply Point - Replace 132kV Switchgear (NG)

NG has a planned switchgear replacement programme for Tottenham. The outdoor OBYR14 circuit breakers have a history of failure and it is proposed to replace our ABCBs at the same time. Replacement of the switchgear will remove a number of assets with HI4/5 ratings, as well as increasing the fault rating significantly. The fault rating of the existing switchgear is 15.3kA which results in the board having to be operated split in order to manage the fault levels at the site. The new circuit breakers will be indoor GIS installed within a new 132kV switchroom.

Tottenham Grid / Hornsey Grid 132kV Fluid Filled Cables - 132kV FFC Replacement

The condition assessment of the Tottenham Grid / Hornsey Grid 132kV Fluid Filled Cables has shown that the probability of failure due to degradation will become unacceptable. It is not possible to keep these assets in use without compromising CI and CML performance therefore this project recommends the replacement. Completion of the project will see 3.36 km of 132kV Fluid Filled Cables replaced.

Bury St 33/11kV Primary Substation - Replace 33kV Switchgear

The condition assessment of the 1963 SWS UE1 outdoor oil insulated switchgear installed at Bury St 33/11kV Primary Substation has shown that the probability of failure due to degradation will become unacceptable. Replacement of this switchgear will remove 4 x HI5 assets from the network.

Palmers Green 132/33kV Grid Substation - Replace 33kV Switchgear

The condition assessment of the 1966/71 SWS ET indoor oil insulated switchgear installed at Palmers Green 132/33kV Grid Substation has shown that the probability of failure due to degradation will become unacceptable. Replacement of this switchgear will remove 11 x HI5 assets from the network.

Bruce Grove 33/11kV Primary Substation - Replace 11kV Switchgear

The condition assessment of the 1968-73 AEI BVP17 indoor oil insulated switchgear installed at Bruce Grove 33/11kV Primary Substation has shown that the probability of failure due to degradation will become unacceptable. Replacement of this switchgear will remove 7 x HI3 and 7 x HI4 assets from the network.

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

The condition assessment of the 1959 JPH Primary Transformer installed at Bury St 33/11kV Primary Substation has shown that the probability of failure due to degradation will become unacceptable. Refurbishment of these transformers will improve the HI ratings from their predicted figures of HI3 and HI5.

Brimmsdown 132

North Chingford 33/11kV Primary Substation - Replace 11kV Switchgear

Brimmsdown and Tottenham GSP

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

The condition assessment of the 1963 AEI JB921 indoor oil insulated switchgear installed at North Chingford 33/11kV Primary Substation has shown that the probability of failure due to degradation will become unacceptable. Replacement of this switchgear will remove 13 x HI4 and HI5 assets from the network.

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

The condition assessment of the 1963/65 CPA OE5 outdoor oil insulated switchgear installed at Barnet 132/33kV Grid Substation has shown that the probability of failure due to degradation will become unacceptable. Replacement of this switchgear will remove 12 x HI5 assets from the network.

South Chingford 33/11kV Primary Substation - Replace 11kV Switchgear

The condition assessment of the 1957/65 BTH JB721/JB821 indoor oil insulated switchgear installed at South Chingford 33/11kV Primary Substation has shown that the probability of failure due to degradation will become unacceptable. Completion of the project will see 11 circuit breakers replaced with 11 new circuit breakers removing 3 x HI4 and 8 x HI5 assets from the network. The 11kV switchboard forms part of ED1 reinforcement strategy.

Waltham Abbey 33/11kV Primary Substation - Replace 11kV Switchgear

The condition assessment of the 1964 YSE 13 IVIO outdoor and 1965 AEI JB921 indoor oil insulated switchgear installed at Waltham Abbey 33/11kV Primary Substation has shown that the probability of failure due to degradation will become unacceptable. Replacement of this switchgear will remove 4x HI4 and 7 x HI5 assets from the network.

Turnford/The Cross 33kV OHL circuit - 33kV wood pole OHL replacement

The condition assessment of the Turnford/The Cross 33kV OHL circuit has shown that the probability of failure due to degradation will become unacceptable. It is not possible to keep these assets in use without compromising CI and CML performance therefore this project recommends the replacement. Completion of the project will see 26 km of 33kV OHL circuit replaced.

Cuffley 33/11kV Primary Substation - Retrofit 11kV Switchgear

The condition assessment of the 1965 SWS C8X indoor oil insulated switchgear installed at Cuffley 33/11kV Primary Substation has shown that the probability of failure due to degradation will become unacceptable. Refurbishment of this switchgear will remove 8 x HI3 and 4 x HI4 assets from the network.

Waltham Abbey 33/11kV Primary Substation - Refurbish Primary Transformer (T3)

The condition assessment of the 1968 BRU Primary Transformer installed at Waltham Abbey 33/11kV Primary Substation has shown that the probability of failure due to degradation will become unacceptable. Refurbishment of this transformer will improve its health rating from HI5.

3.3 Security of supply analysis

Substation	Demand (MW)	Supply Class	Demand (MVA)			P2/6	Comments
			2015	2018	2021		
Tottenham 132	364	E	422	442	455	Compliant	
Palmers Green Group	117	D	129	134	138	Compliant	
Tottenham Group	97	D	126	132	136	Compliant	
Hornsey Group	92	D	105	112	117	Compliant	

Substation	Demand (MW)	Supply Class	Demand (MVA)			P2/6	Comments
			2015	2018	2021		

Brimmsdown and Tottenham GSP

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

Brimmsdown 132	225	D	235	247	256	Compliant	NG owned busbars
Brimmsdown Sth / Waltham Pk group	43	C	47	48	49	Compliant	2 x 132/11kV substations

3.4 Operational and technical constraints

The 33kV switchboard at Barnet Grid does not have a bus section circuit breaker. A bus section fault or stuck circuit breaker can result in the loss of the whole substation.

The bus sections at Tottenham Grid 132/11, Palmers Green 132/11 and Hornsey Grid 132/11 are run open due to fault level issues. A network study indicates that the Hornsey 11kV bars could be run solid. The 132kV bars at Tottenham 132 are run split due to fault level issues. No more than two 275/132kV transformers can operate in parallel.

Crouch End and Cranley Gardens Primary networks operate at 6.6kV and, as such, there is no interconnection with the wider 11kV network. The loading on both sites combined is less than the firm rating of either site. Therefore, even an N-2 outage of one site could be accommodated by the other site. A study is underway to consider the costs of uprating this network to 11kV and whether this work can be justified.

There are a number of cable bridges in the Palmers Green area highlighted as potential pinch points. Of note, a trough bridge to the north of Palmers Green that crosses a waterway contains 3 x 33kV circuits and 5 pilot cables. A trough bridge to the south contains 2 x 132kV circuits and 3 pilots. 3104BR (TQ31175 92380) houses Tottenham Grid to Palmers Green 1 and 2 OF cables. 3128BR (TQ31186 92390) houses 1 LV and 1 HV cable. 3129BR (TQ31202 92394) houses Palmers Green to Brimmsdown North Tee Central Edmonton T1 33kV, Palmers Green to Brimmsdown North Tee Central Edmonton T2 33kV, Palmers Green to Brimmsdown North Tee Bury Street T1 33kV and Palmers Green to Brimmsdown North Tee Bury Street T2 33kV.

3.5 National Grid

National Grid intends to replace their OBYR14 Air Blast circuit breakers at Tottenham 132 in 2018/19. This may allow the 132kV bars to run solid.

There are no significant National Grid works planned in the Brimmsdown group.

4 Recommended strategy

Tottenham 132

Hornsey Grid 132/11kV Substation - 11kV Switchgear (2000A double bus)

The predicted load at Hornsey Grid 132/11kV substation will approach existing firm capacity. It is therefore proposed to replace the existing transformers with larger units. The existing switchgear is not fully rated for this increased load. It is therefore proposed to replace this switchgear.

The replacement of the transformers is driven by condition and will result in assets with a HI rating of HI3 at the end of the ED1 period being replaced with new assets with corresponding HI1 values.

Replacement of the switchboard is load-related and enables the transformer capacity of the new transformers to be fully utilised. Whilst the switchboard replacement is load-related it will result in assets which are predominantly HI3 being removed from the network.

Brimmsdown 132

Cockfosters 33/11kV Primary Substation - ITC T1 (1x 20/30/40MVA) & 11kV Switchgear

Brimsdown and Tottenham GSP

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

The predicted load at Cockfosters substation will exceed the existing site firm capacity. It is therefore proposed to replace the existing T1 15MVA transformer with a larger unit. The existing 11kV switchgear is not fully rated for this increased load; it is therefore proposed to replace the switchgear. The existing circuits supplying the transformers are fully rated for the larger unit.

Ladysmith Rd 33/11kV Primary Substation - ITC (2 x 18/30/40MVA), 11kV switchgear and 33kV cables

The predicted load at Ladysmith Road substation will increase to the existing firm capacity, It is therefore proposed to replace the existing transformers with larger units. The existing switchgear is not fully rated for this increased load. It is therefore proposed to replace this switchgear. The existing circuits supplying the transformers are not fully rated for the larger units. It is therefore proposed to replace one and double up the existing circuits to provide the second fully rated circuit.

4.1 Financial appraisal and benefits

The financial expenditure is shown in Appendix D.

5 Rejected strategies

5.1 Hornsey Grid 11

New Primary substation (£2.2m)

Install a new 33/11kV Primary substation at Hornsey connected to Hornsey Grid 132/33kV. There is limited space on site at Hornsey Grid and little prospect of securing additional land. There is insufficient additional capacity available on Hornsey Grid 132/33kV.

5.2 Tottenham 132

Tottenham 132kV Grid Supply Point - Replace 132kV Switchgear in existing bays (£6m)

Replace the existing air blast circuit breakers with AIS SF6 circuit breakers in the existing bays. This is not considered achievable due to the lack of space to be able to work within a bay with other bays live.

5.3 Central Tottenham

Transfer load to West Green (£0.8m)

In order to keep Central Tottenham firm for the ED1 period a minimum of approximately 5MVA of winter load needs to be moved onto Bruce Grove and West Green. This will use up the majority of the spare 11kV capacity for the whole area which is undesirable.

5.4 Ladysmith Rd Primary

Ladysmith Rd - Increase 11kV interconnection capacity to surrounding substations (£0.4m)

There is insufficient capacity available at the surrounding Primary substations to enable sufficient load to be transferred. The area around Ladysmith Primary has been in the local council RDP as an area for future growth.

5.5 North Chingford Primary

North Chingford – ITC (2 x 12/24MVA) (£1.4m)

Brimsdown and Tottenham GSP

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

Replace the existing 2 x 15MVA transformers with 2 x 12/24MVA transformers. The switchboard is due to be replaced in 2017 due to condition.

5.6 Brimsdown North Grid

Total cost of rejected options for proposed project “South Chingford 33/11kV Primary Substation - Transfer to Tottenham Grid” - £10.2m

Brimsdown North Grid – ITC (1 x 90MVA), 1 x 33kV circuit and 33kV switchboard (£5.6m)

Install a 3rd 132kV circuit from Brimsdown 132 and a 3rd 132/33kV, 90MVA transformer at Brimsdown North Grid. The 33kV switchgear at Brimsdown North Grid will also need to be replaced with a new 3 section 33kV switchboard.

South Chingford 33/11kV Primary Substation – ITC (2 x 20/40MVA) and 33kV circuits (£4.6m)

It is proposed to replace the existing 15MVA transformers for new 20/40MVA. The 7km 33kV circuits to Brimsdown North Grid are underated (20/22.3MVA) so it is proposed to lay 33kV new cables. The existing switchgear is rated for 1200A (22.8MVA). The 11kV switchgear is due to be replaced in 2018 due to condition.

5.7 Tapster St Primary

Tapster St - Increase 11kV interconnection capacity to surrounding substations (£0.4m)

There is insufficient capacity available at the surrounding Primary substations to enable sufficient load to be transferred. The area around Tapster St Primary has been identified in the local council RDP as an area for future growth.

6 References

References	Description
Reference 1	Planning Load Estimates EPN Area
Reference 2	132kV Network HV Schematic Operating Diagrams East of England (date)
Reference 3	33kV Network HV Schematic Operating Diagrams East of England (date)
Reference 4	Council Masterplans
Reference 6	Current and forecast asset health information (HI) as per 2013 RIIO-ED1 submission

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

Brimmsdown and Tottenham GSP

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

Appendix E	Output Measures – Load Index Table (LI)
Appendix F	Output Measures – Health Index Table (HI)
Appendix G	Generation Heat Map

6.2 Document History

Version	Date of Issue	Author	Details
0.1	03/02/2013	Steve Mould	Draft version combining separate Brimmsdown and Tottenham RDP documents.
0.8	07/02/2013	Nuno da Fonseca	Updated tables and Appendix
1.0	19/02/2013	Steve Mould	Updated following peer review
1.1	01/03/2013	Steve Mould	Updated following SMT review
1.3	13/05/2013	Nuno da Fonseca	Version to be published
1.4	21/06/2013	Steve Mould	Updated with 5 th June NAMP, EPN HI List 2013 data v0.4 and latest LI information
1.5	12/03/2014	Paul Ramsbotham	Updated with 19 th February 2014 NAMP, EPN HI List and latest LI information

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
Paul Ramsbotham	Infrastructure Planner		19/03/14
Nuno da Fonseca	Planning Manager (EPN)		

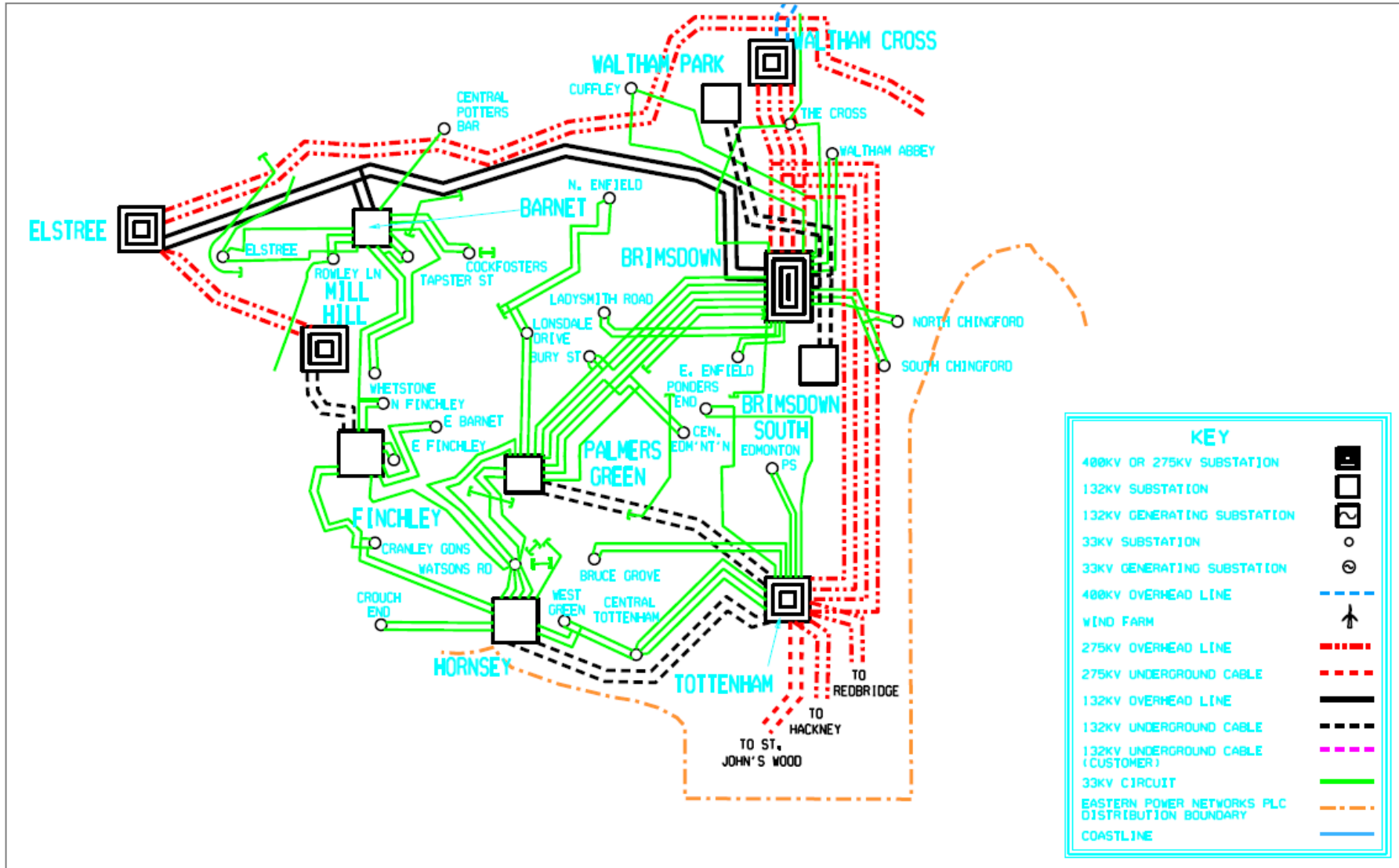
Approval by:

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

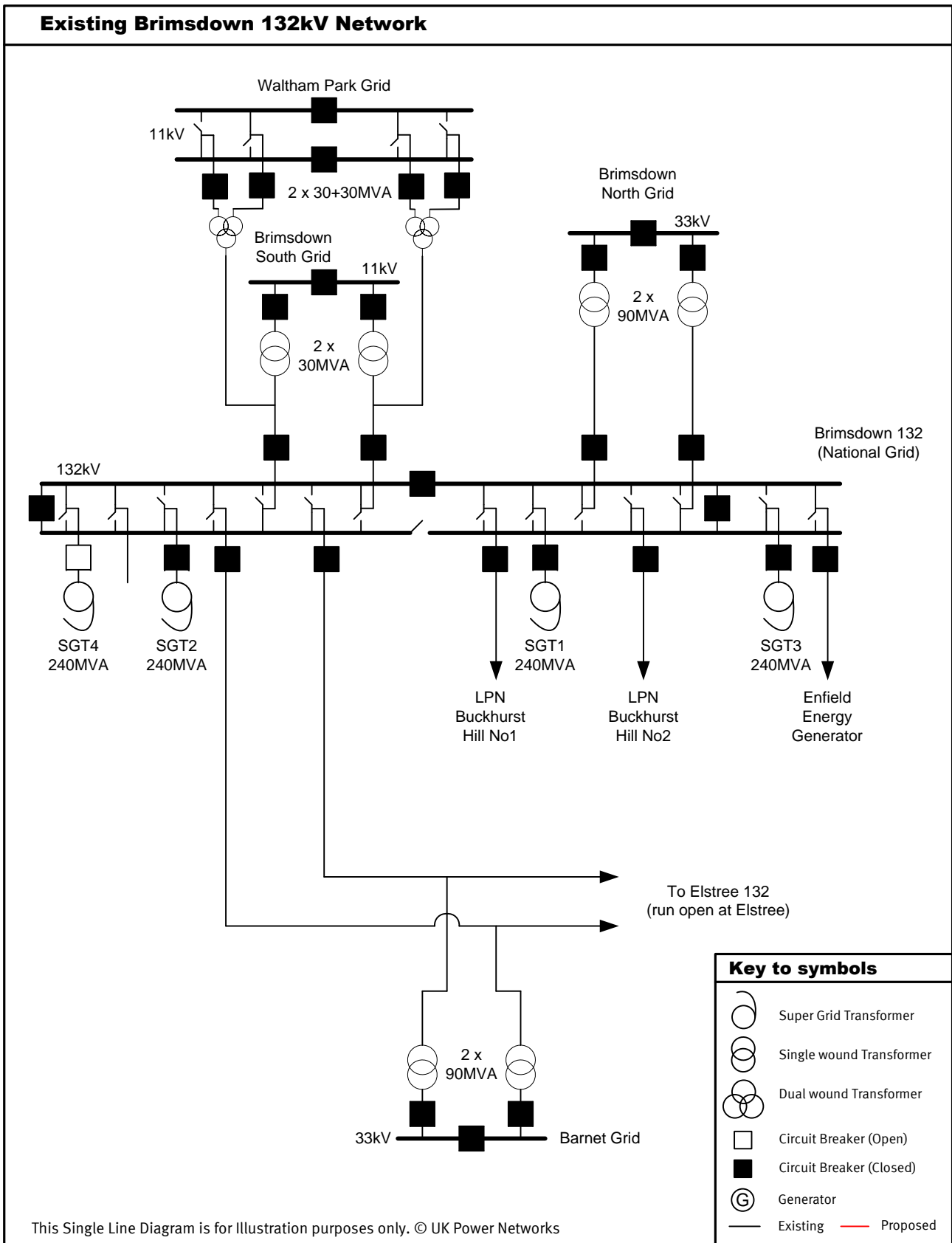
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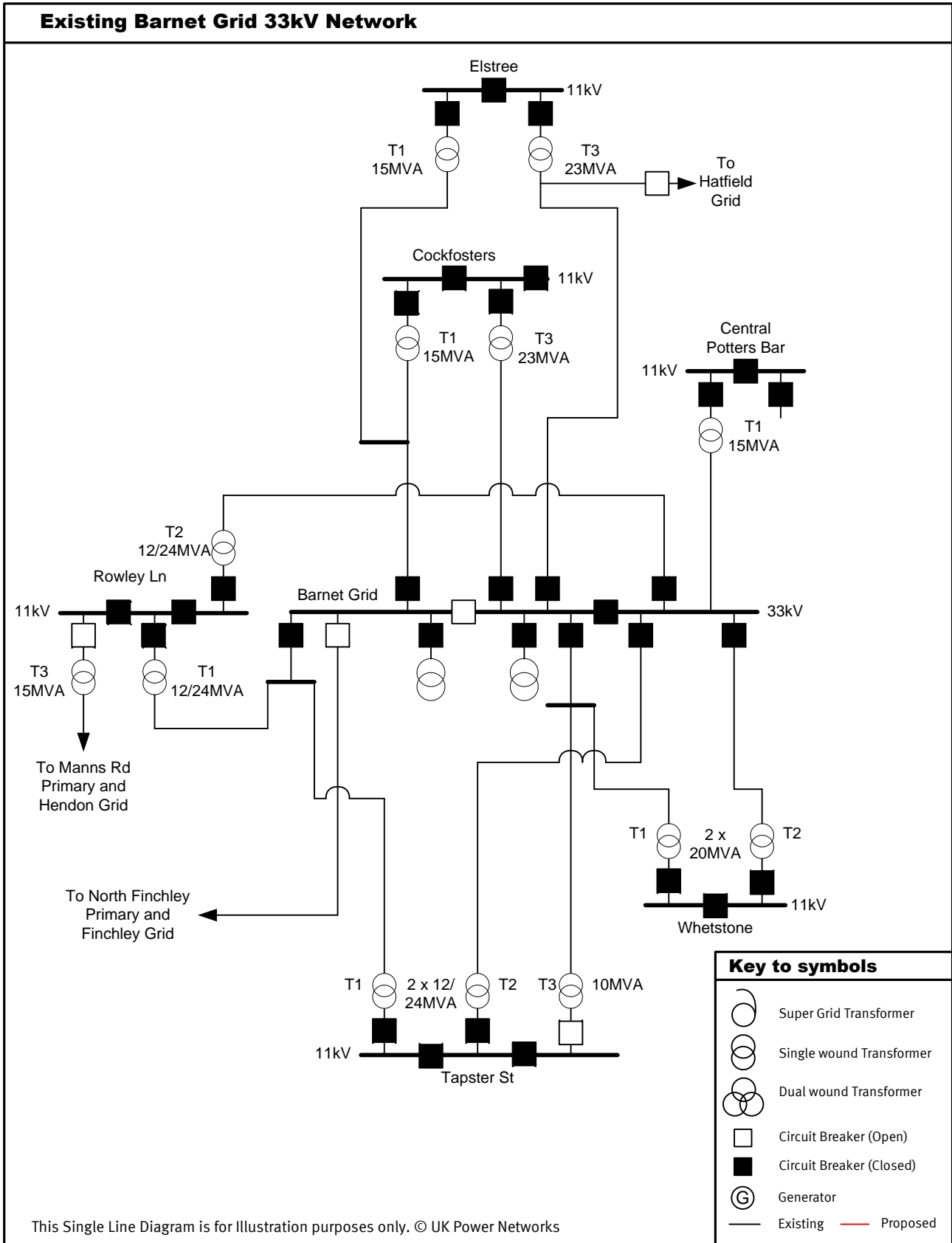
APPENDIX A: GEOGRAPHICAL DIAGRAM



APPENDIX B: SINGLE LINE DIAGRAM – EXISTING NETWORK

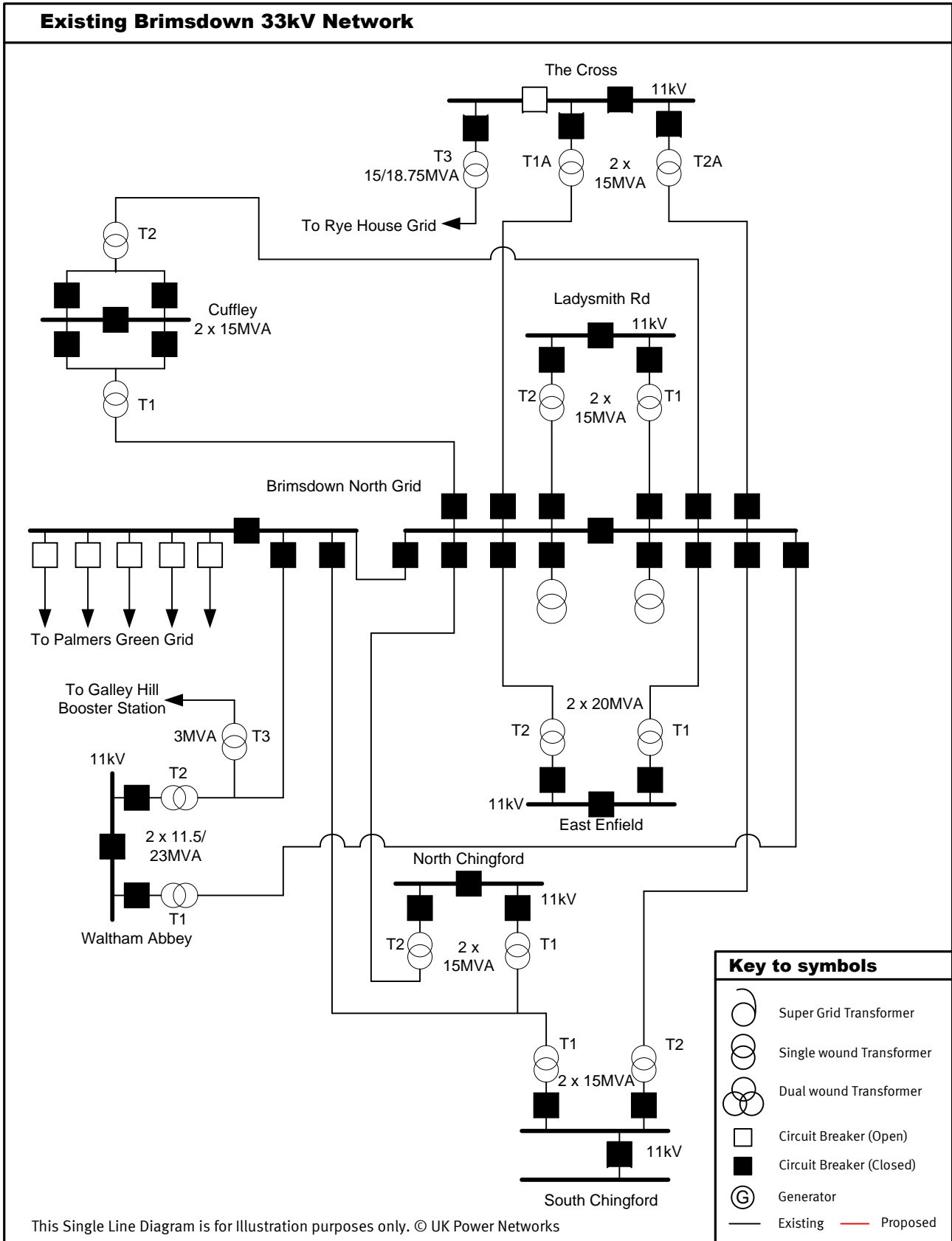


All of the cost numbers displayed in this document are before the application of on-going efficiencies and real price effects.



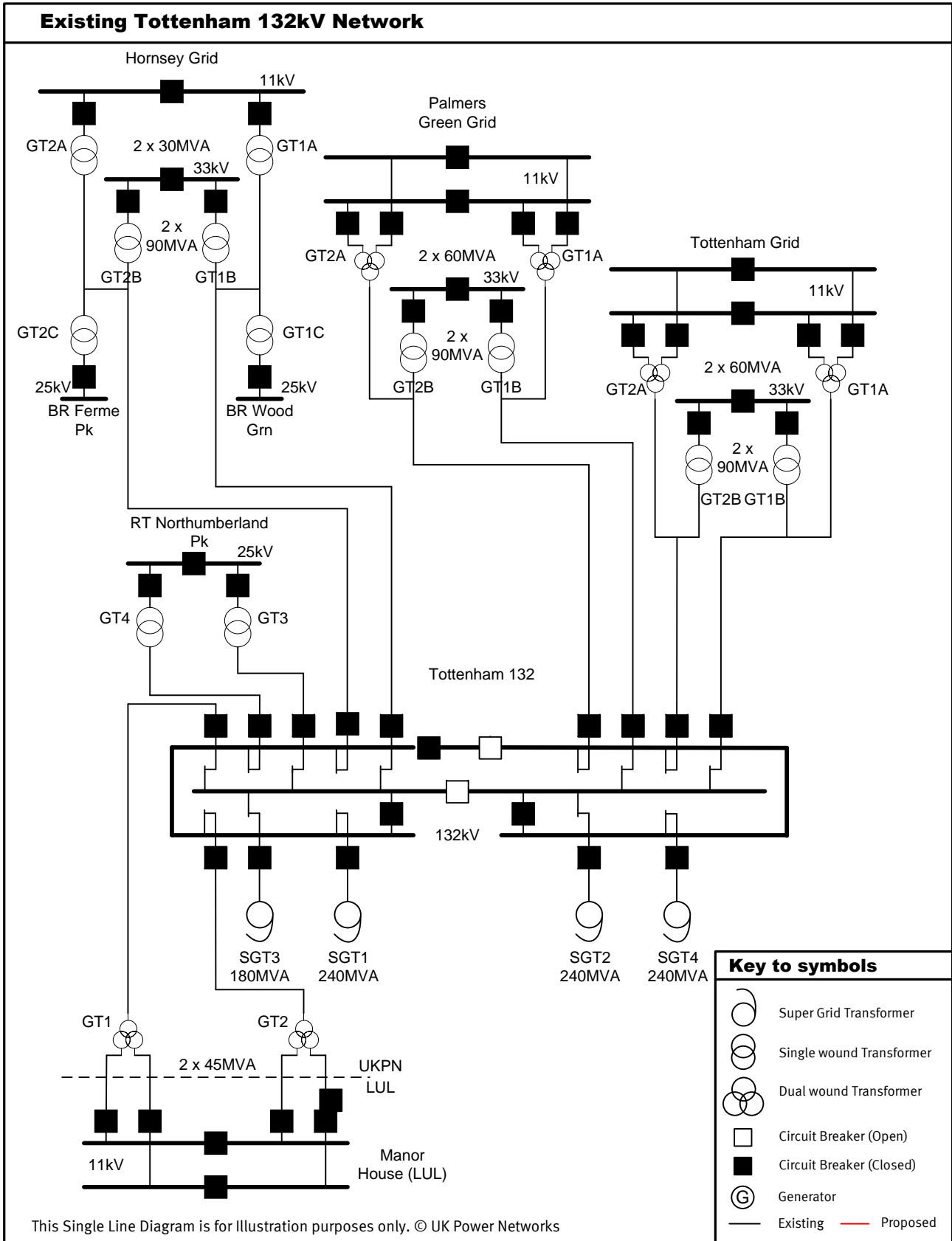
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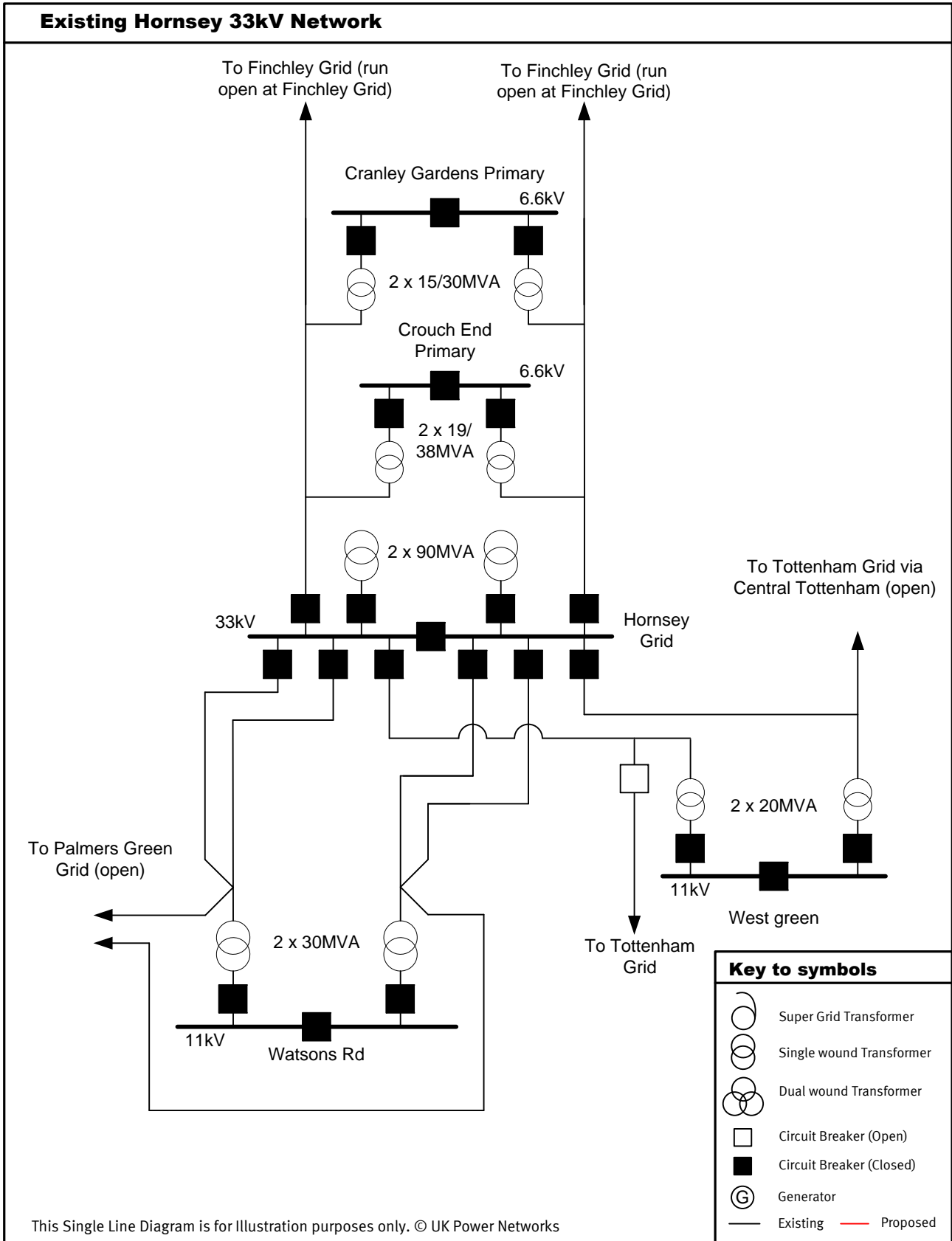


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All of the cost numbers displayed in this document are before the application of on-going efficiencies and real price effects.

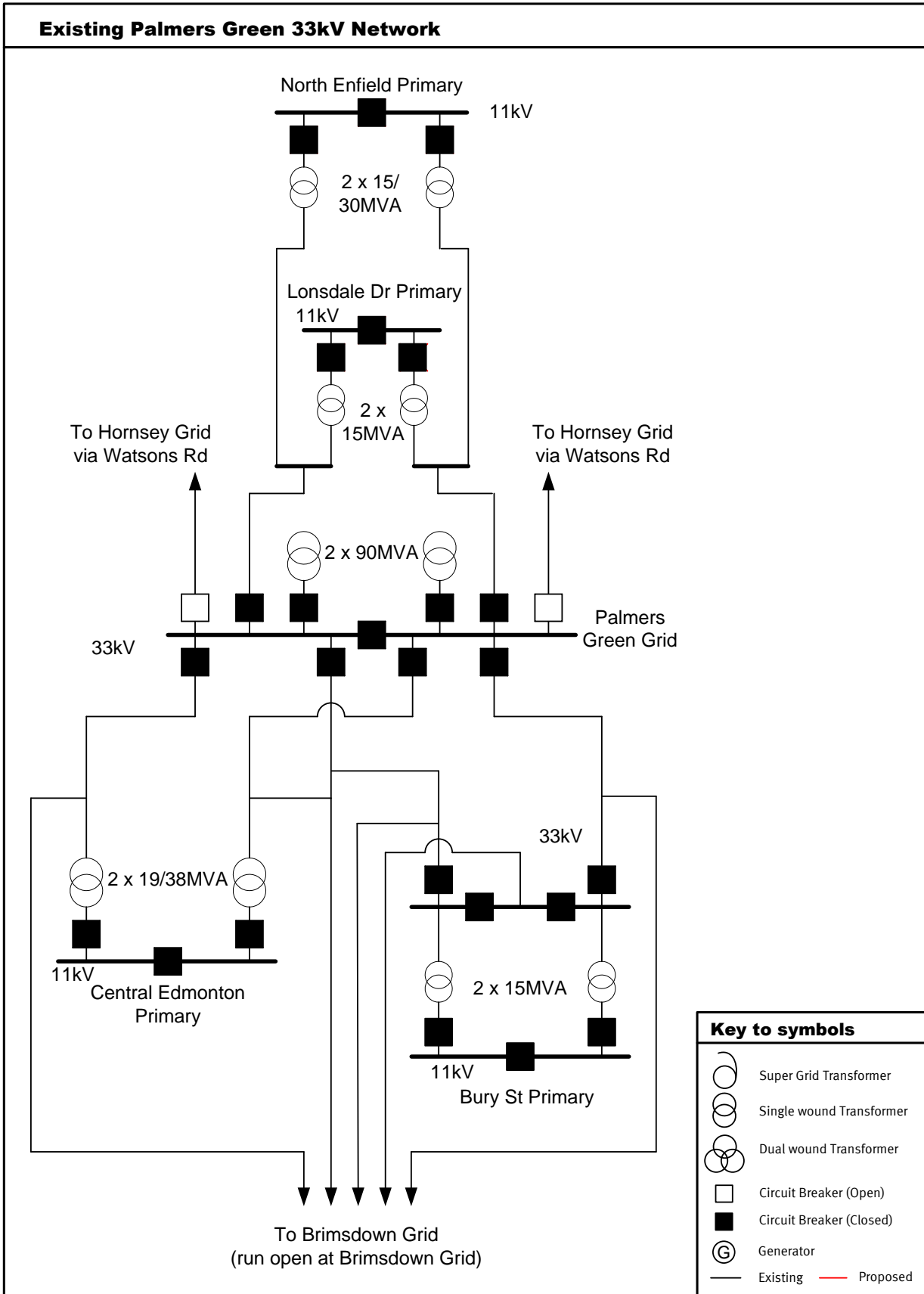


All of the cost numbers displayed in this document are before the application of on-going efficiencies and real price effects.



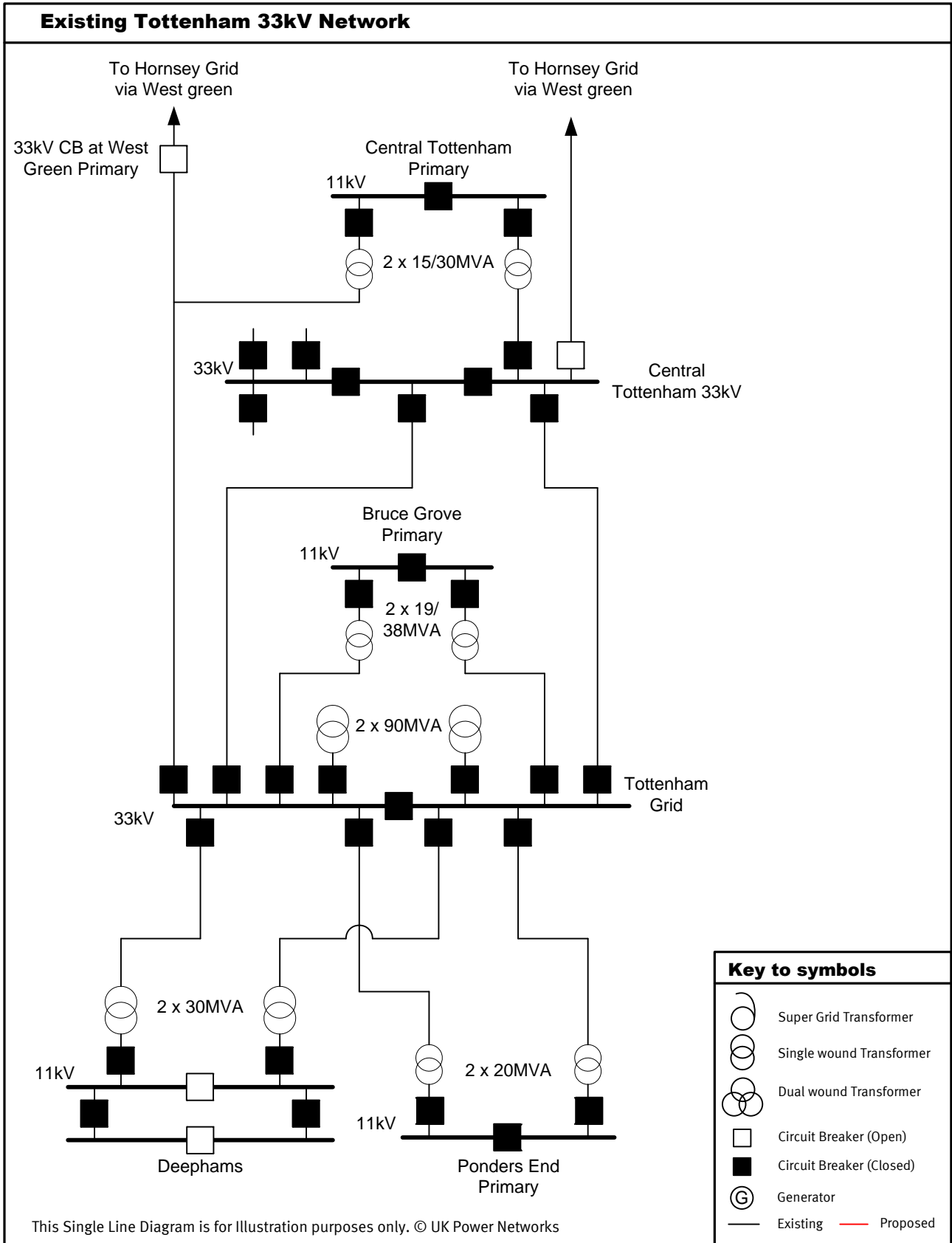
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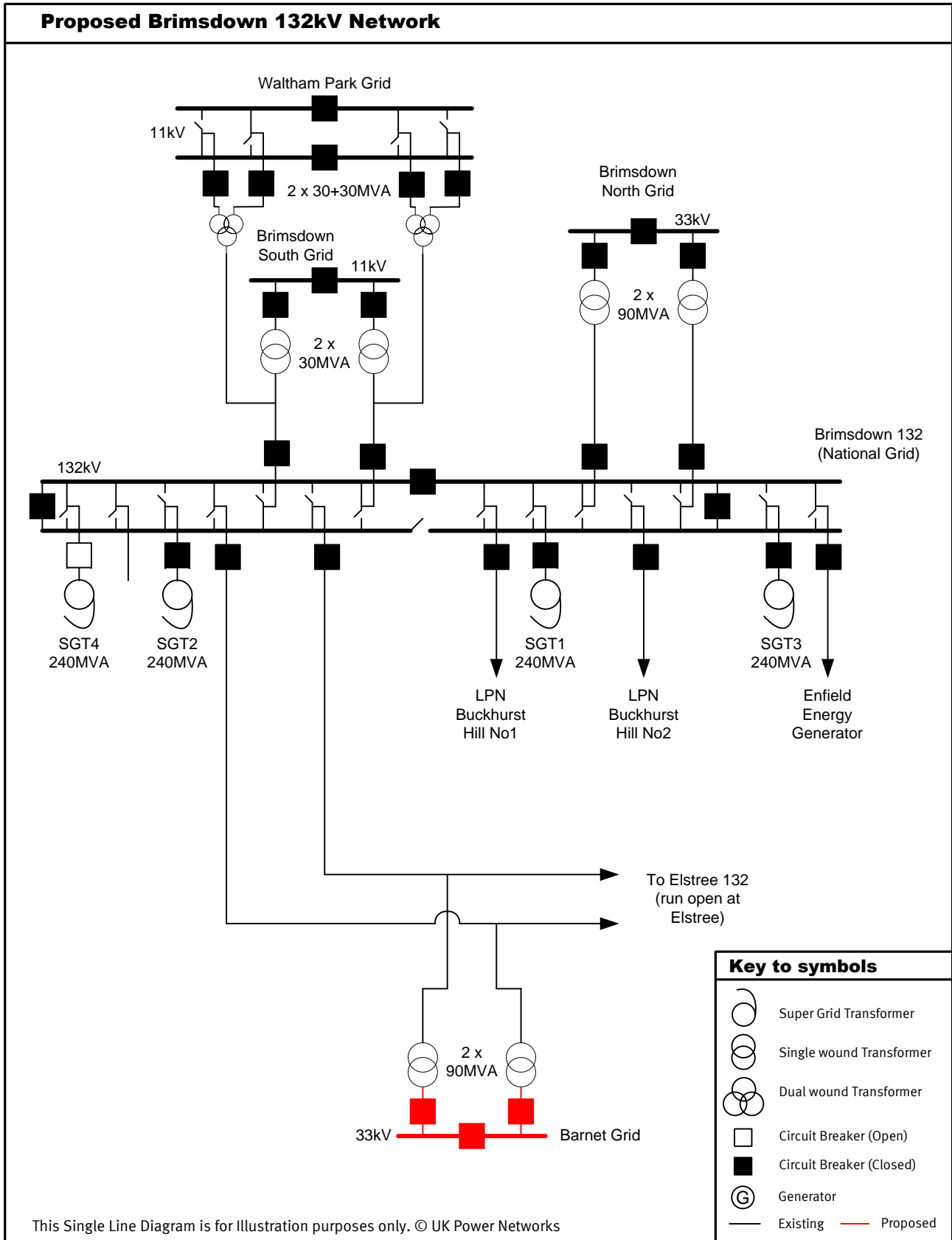
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All of the cost numbers displayed in this document are before the application of on-going efficiencies and real price effects.

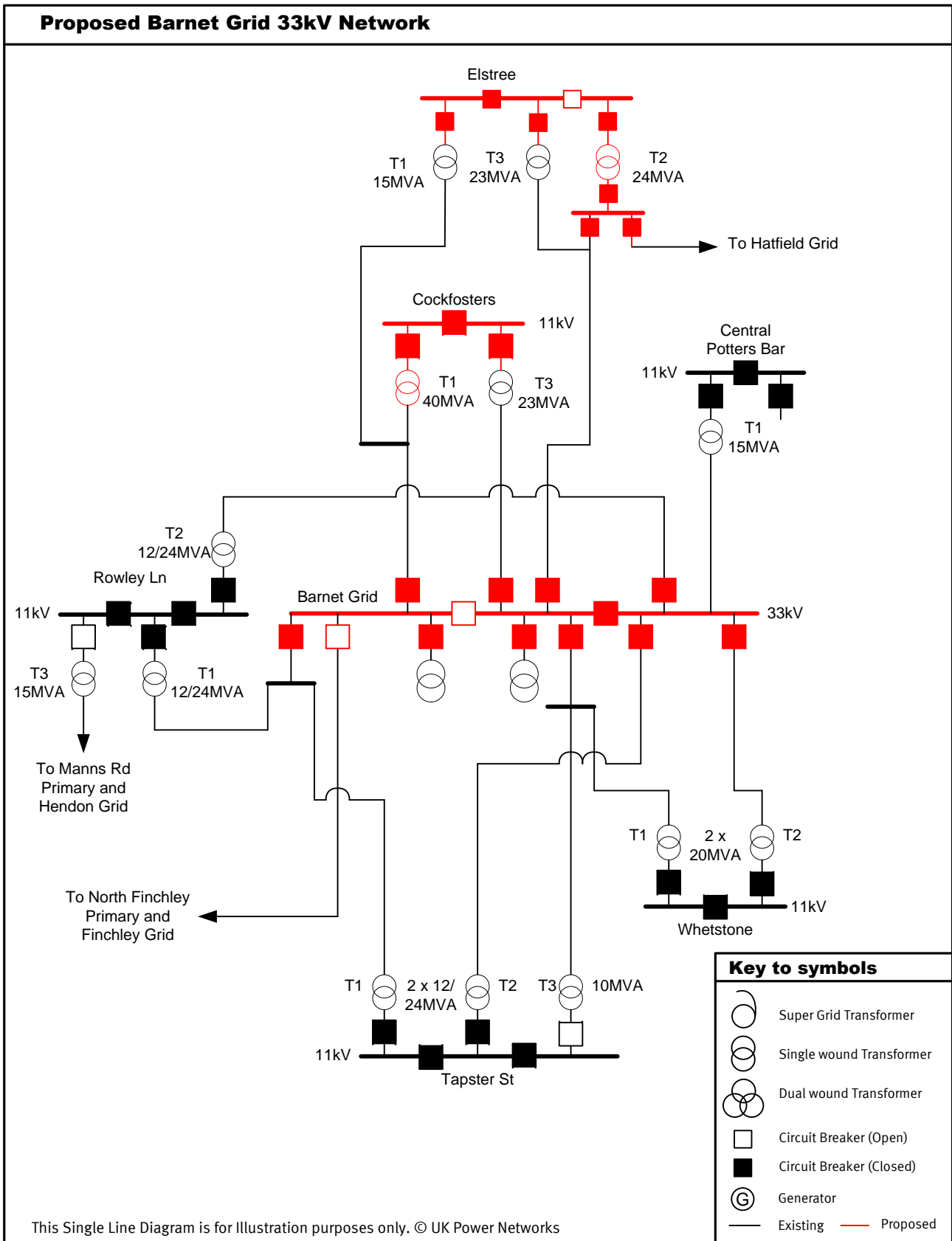


All of the cost numbers displayed in this document are before the application of on-going efficiencies and real price effects.

APPENDIX C: SINGLE LINE DIAGRAM – PROPOSED NETWORK

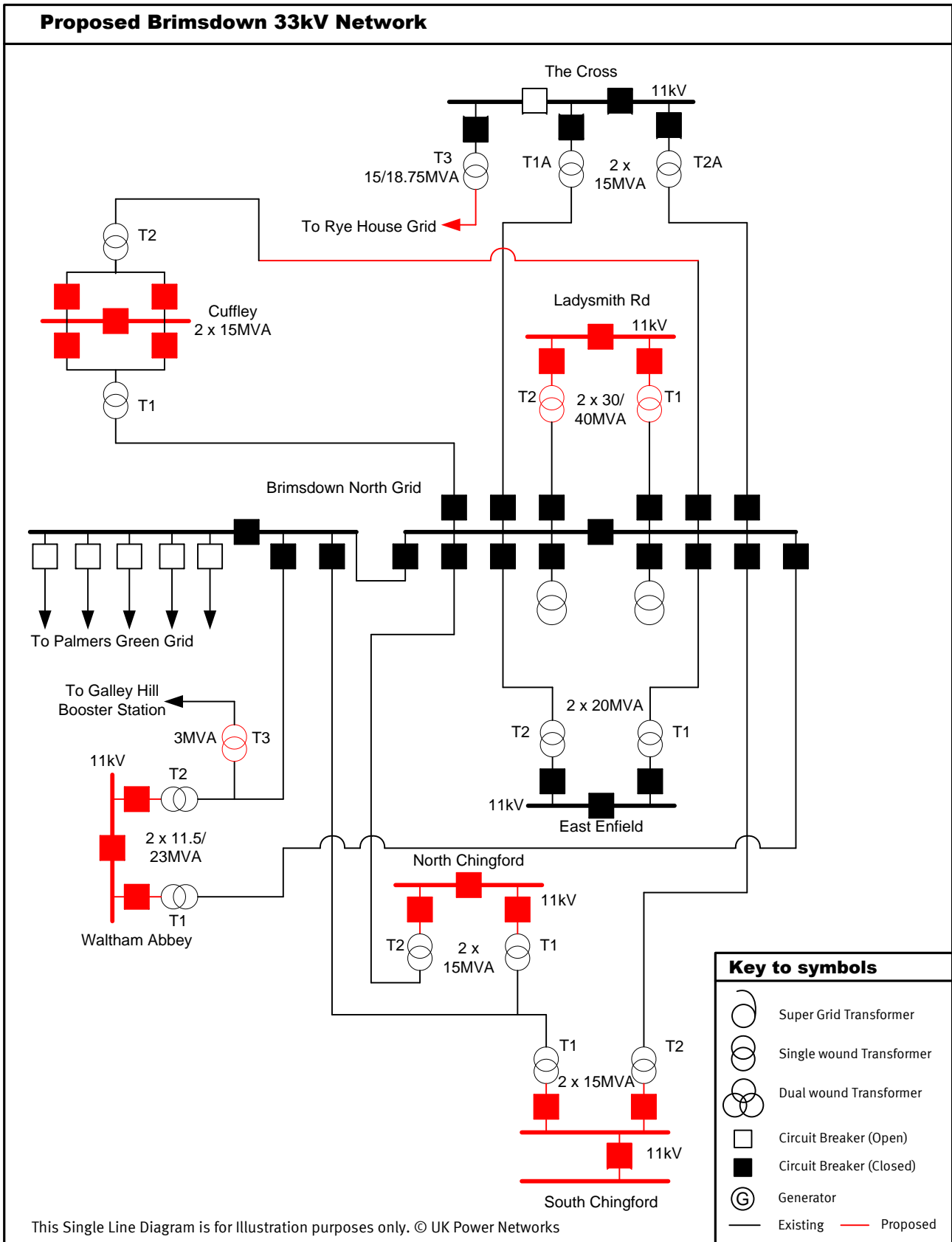


All of the cost numbers displayed in this document are before the application of on-going efficiencies and real price effects.



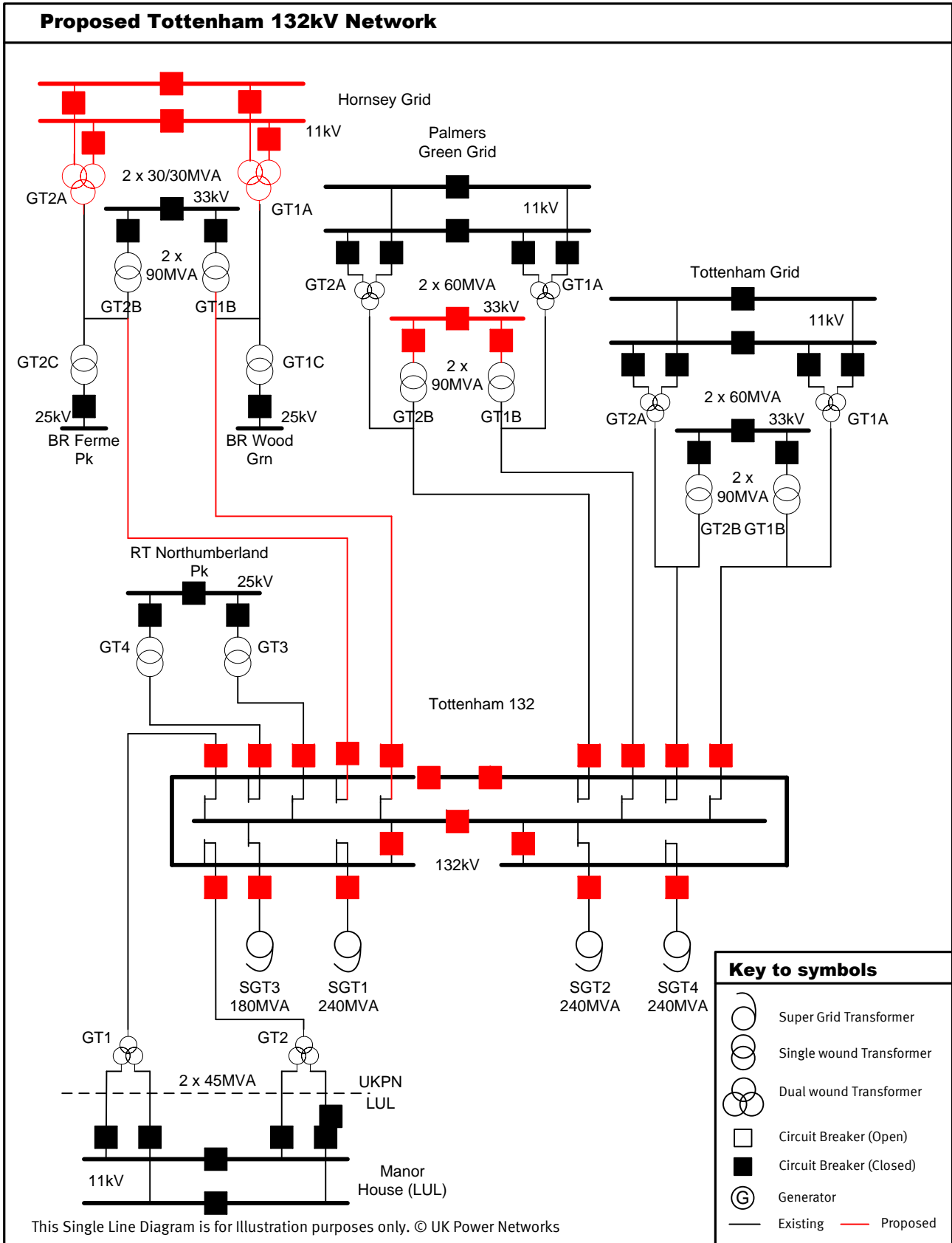
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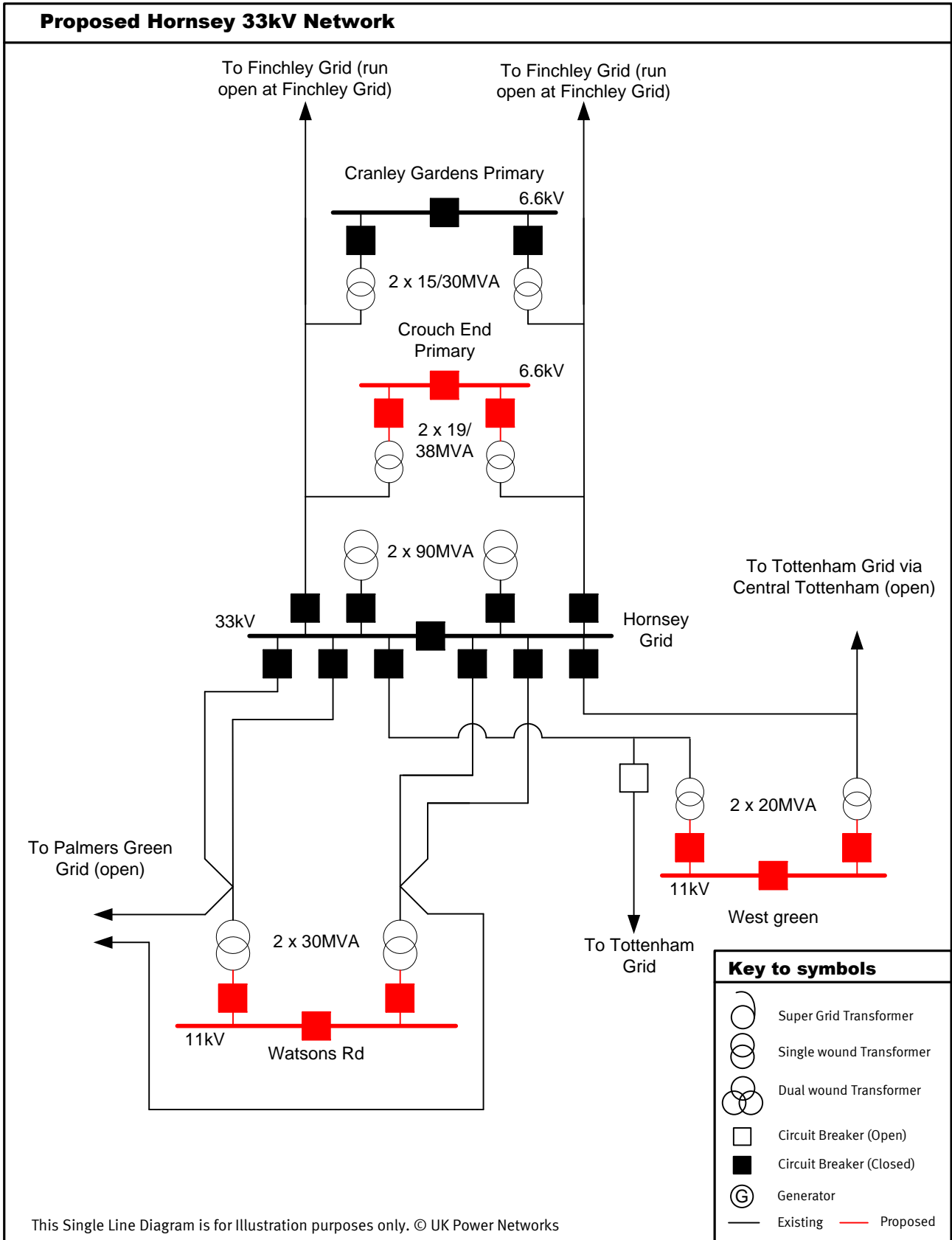


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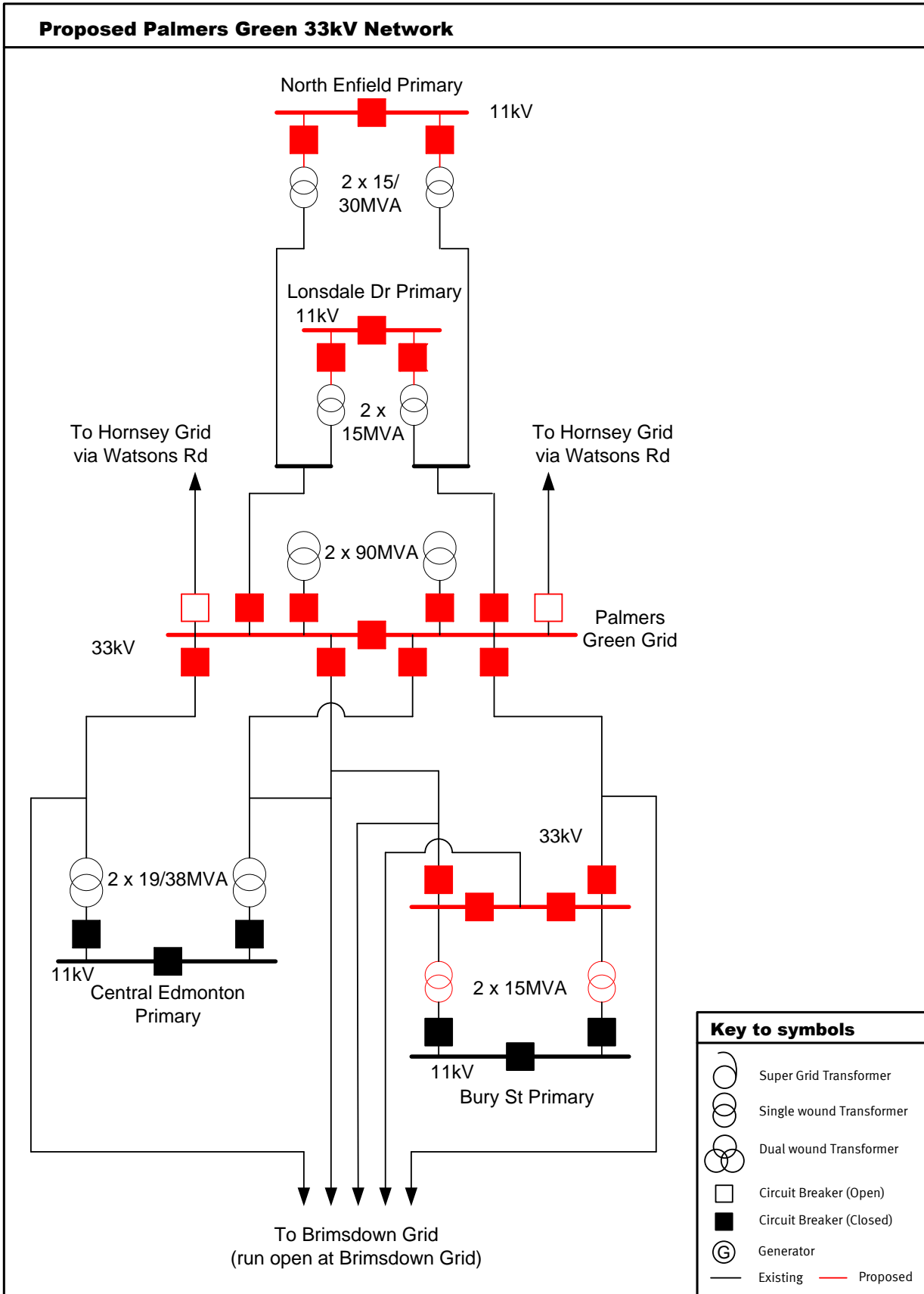
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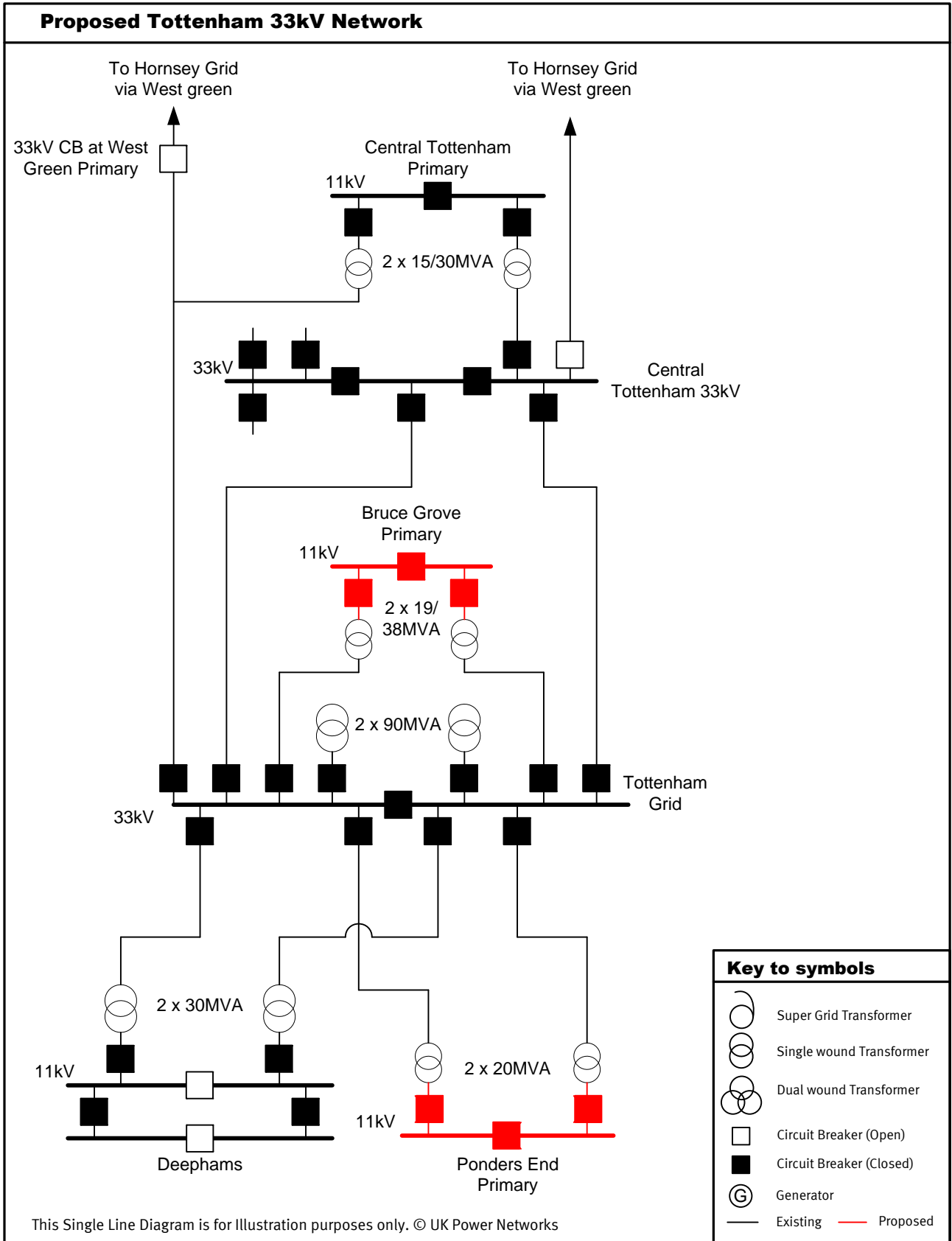


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APPENDIX D: DETAILED COSTS FOR RECOMMENDED STRATEGY

NAMP version: Table J Less Indirect Baseline 19th February 2014 ED1 resubmission (£)

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	1.02.05	5857	PMD - Elstree/South Mimms Tee - Foundation Replacement	135,693									
A	1.09.01	5803	Rebuild Brimsdown/Cuffley No.2 33 kV with Wood Pole Line	466,000									
A	1.09.01	7591	3F43E Rye House to Turnford3 and The Cross 3 - 33kV Wood Pole OHL Refurbishment				415,395	1,050,840					
A	1.48.02	2355	West Green and Central Tottenham 33/11kV Primary Substations - Replace 33kV Switchboard (2000A)	52,804									
A	1.48.02	7619	Bury St 33/11kV Primary Substation - Replace 33kV Switchgear								420,067		
A	1.48.06	3404	Tottenham 132kV Grid Supply Point - Replace 132kV Switchgear (NG*)					757,237	2,704,278	3,996,909	3,197,927		
A	1.48.11	2249	Barnet 132/33kV Grid Substation - Replace 33kV Switchgear					331,992	845,789	263,473			
A	1.48.11	7624	Palmers Green 132/33kV Grid Substation - Replace 33kV Switchgear				382,619	965,658	273,897				
A	1.50.01	2248	North Chingford 33/11kV Primary Substation - Replace 11kV Switchgear				253,523	672,178					
A	1.50.01	2356	West Green 33/11kV Primary Substation - Replace 11kV Switchgear				251,179	637,429					
A	1.50.01	2357	Lonsdale Drive 33/11kV Primary Substation - Replace 11kV Switchgear	154,289	713,447								
A	1.50.01	2358	Ponders End 33/11kV Primary Substation - Replace 11kV Switchgear			253,523	672,178						
A	1.50.01	2469	Golders Green 33/11kV Primary Substation - Replace Switchboard (2000A)	24,801									
A	1.50.01	2472	North Enfield 33/11kV Primary Substation - Replace 11kV Switchgear						251,179	637,429			
A	1.50.01	2473	South Chingford 33/11kV Primary Substation - Replace 11kV Switchgear					251,179	637,429				

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DETAILED COSTS FOR RECOMMENDED STRATEGY

NAMP version: Table J Less Indirect Baseline 19th February 2014 ED1 resubmission (£)

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	1.50.01	2475	Waltham Abbey 33/11kV Primary Substation - Replace 11kV Switchgear				251,179	637,429					
A	1.50.01	2476	Watsons Road 33/11kV Primary Substation - Replace 11kV Switchgear							335,384	937,428		
A	1.50.01	2506	Crouch End 33/6.6kV Primary Substation - Replace 6.6kV Switchgear								252,267	653,264	
A	1.50.01	7634	Bruce Grove 33/11kV Primary Substation - Replace 11kV Switchgear								279,043	673,398	
A	1.50.01	7677	Cuffley 33/11kV Primary Substation - Retrofit 11kV Switchgear										97,958
A	1.51.01	7723	Hornsey 132/11kV Grid Substation - Replace Grid Transformers (GT1A & GT2A)			801,942	2,502,885						
A	1.51.11	7725	Bury St 33/11kV Primary Substation - Refurbish Primary Transformers (T1, T2)						51,020	250,814			
A	1.51.11	7739	Waltham Abbey 33/11kV Primary Substation - Refurbish Primary Transformers (T3)				25,510	125,407					
H	1.29.02	7599	Tottenham Grid / Hornsey Grid 132kV Fluid Filled Cables - 132kV FFC Replacement						945,159	2,815,150	852,152		
R	1.33.01	2272	Elstree 33/11kV Primary Substation - ITC (1 x 12/24MVA)	1,805,863	900,184								
R	1.33.01	2451	Cockfosters 33/11kV Primary Substation - ITC T1 (1x 20/30/40MVA) & 11kV Switchgear			406,120	1,096,131						
R	1.33.01	5399	Ladysmith Rd 33/11kV Primary Substation - ITC (2 x 18/30/40MVA), 11kV Switchgear and 33kV Cables								24,382	790,658	2,152,536
R	1.33.03	6197	Hornsey Grid 132/11kV Substation - 11kV Switchgear (2000A Double Bus)			20,303	427,173	1,097,790					
R	1.37.07	2354	Tottenham/Bruce Grove 33kV Circuits - Reinforce Circuits (40MVA)	936,335									

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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
Barnet Grid 33	W	Switchgear	114.3	2272	114.3	100.7	108.2	LI2	LI2		114.3	LI2	D	Yes
Brimsgate North Grid 33	W	Switchgear	114.3		114.3	97.0	102.9	LI2	LI2		114.3	LI2	D	Yes
Brimsgate South Grid	S	Transformer	30.0		30.0	21.2	22.3	LI1	LI1		30.0	LI1	C	Yes
Bruce Grove	W	Circuit Rating	27.4	2354	38.0	25.3	27.0	LI1	LI1		38.0	LI1	C	Yes
Bury St	W	Transformer	18.0		18.0	13.1	14.4	LI1	LI2		18.0	LI2	C	Yes
Central Edmonton	W	Transformer	38.0		38.0	23.1	24.3	LI1	LI1		38.0	LI1	C	Yes
Central Potters Bar T1	W	Backfeed	9.9		9.9	7.9	8.8	LI2	LI2		9.9	LI2	B	Yes
Central Tottenham 11	W	Transformer	30.0		30.0	23.0	24.5	LI1	LI2		30.0	LI2	C	Yes
Cockfosters	W	Transformer	19.5		19.5	19.5	20.8	LI3	LI5	2451	29.7	LI1	C	Yes
Cranley Gardens	W	Switchgear	22.8		22.8	12.4	12.4	LI1	LI1		22.8	LI1	C	Yes
Crouch End	W	Transformer	39.0		39.0	9.3	9.3	LI1	LI1		39.0	LI1	B	Yes
Cuffley	W	Transformer	19.5		19.5	14.5	15.6	LI1	LI2		19.5	LI2	C	Yes
East Enfield	S	Transformer	20.0		20.0	11.5	12.2	LI1	LI1		20.0	LI1	C	Yes
Elstree Primary	W	Transformer	19.5	2272	39.0	21.6	23.4	LI1	LI1		39.0	LI1	C	Yes
Hornsey Grid 11	W	Transformer	36.0		36.0	30.6	33.2	LI2	LI2	6197	66.0	LI1	C	Yes
Ladysmith Road	S	Transformer	15.0		19.5	16.7	17.7	LI2	LI2	5399	19.5	LI2	C	Yes
Lonsdale Drive	W	Transformer	19.5		19.5	15.5	17.0	LI1	LI2		19.5	LI2	C	Yes
North Chingford	W	Transformer	19.5		19.5	15.4	16.4	LI1	LI2		19.5	LI2	C	Yes

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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
North Enfield	W	Circuit Rating	21.7		21.7	17.2	18.6	LI1	LI2		21.7	LI2	C	Yes
Palmers Green Grid	W	Transformer	72.0		72.0	53.3	57.3	LI1	LI1		72.0	LI1	C	Yes
Palmers Green Grid 33	W	Transformer	108.0		108.0	67.1	72.4	LI1	LI1		108.0	LI1	D	Yes
Ponders End	W	Circuit Rating	21.7		21.7	16.0	17.0	LI1	LI1		21.7	LI1	C	Yes
Rowley Lane total	S	Transformer	33.0		33.0	19.4	20.3	LI1	LI1		33.0	LI1	C	Yes
South Chingford	W	Transformer	19.5		19.5	15.1	15.1	LI1	LI1		19.5	LI1	C	Yes
Tapster Street	W	Switchgear	36.4		36.4	18.8	20.1	LI1	LI1		36.4	LI1	C	Yes
The Cross total	S	Transformer	30.0		30.0	17.2	18.7	LI1	LI1		30.0	LI1	C	Yes
Tottenham Grid	S	Transformer	30.0		30.0	23.3	24.1	LI1	LI2		30.0	LI2	C	Yes
Tottenham Grid 33 Total	W	Transformer	108.0		108.0	90.6	94.4	LI2	LI2		108.0	LI2	D	Yes
Waltham Abbey	W	Switchgear	22.8		22.8	15.8	16.8	LI1	LI1		23.0	LI1	C	Yes
Waltham Park Grid	S	Transformer	60.0		60.0	19.4	20.0	LI1	LI1		60.0	LI1	C	Yes
Watsons Rd	W	Transformer	38.0		38.0	23.7	25.3	LI1	LI1		38.0	LI1	C	Yes
West Green	W	Switchgear	19.1		19.1	18.5	19.5	LI3	LI1		26.0	LI1	C	Yes
Whetstone	W	Circuit Rating	21.4		21.5	14.1	15.5	LI1	LI1		21.5	LI1	C	Yes
Hornsey Grid 33	W	Switchgear	114.3		114.3	43.9	45.7	LI1	LI1		114.3	LI1	C	Yes

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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
BRIMSDOWN 132	6					6					6				
HORNSEY GRID	1					1					1				
TOTTENHAM 132	2	2	6	3		4		4	5		13				
TOTAL	2	9	6	3		11		4	5		13		7		

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
BARNET GRID				8	4					12	12				
BRIMSDOWN NORTH GRID	8	15					23					23			
BURY ST PRIMARY				3	1					4	4				
CENTRAL TOTTENHAM PRIMARY	9					9					9				
HORNSEY GRID		13						13					13		
PALMERS GRN GRID				10	1					11	11				
TOTTENHAM GRID		15					15					15			
WEST GRN PRIMARY					2					2					2
TOTAL	17	43		21	8	9	38	13		29	36	38	13		2

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Substation	11/6.6kV Switchgear														
	ED1 Start (2015)					ED1 End (2023) No Investment					End of ED1 (2023) With Investment				
	HI1	HI2	HI3	HI4	HI5	HI1	HI2	HI3	HI4	HI5	HI1	HI2	HI3	HI4	HI5
ARNOS GV		2	3	1	9			3	1	11			3	1	11
BRIMSDOWN SOUTH GRID		18					18					18			
BRUCE GV PRIMARY		4	10					7	7			14			
BURY ST PRIMARY		12					12					12			
CENTRAL EDMONTON PRIMARY		12	1				5	8				5	8		
CENTRAL POTTERS BAR PRIMARY	9					9					9				
CENTRAL TOTTENHAM PRIMARY		9	3					12					12		
COCKFOSTERS PRIMARY	6	8				6	8					14			
CRANLEY GDNS PRIMARY		1	6	6				3		10			3		10
CROUCH END PRIMARY		7	5					7	1	4		12			
CUFFLEY PRIMARY		1	11					8	4			12			
EAST ENFIELD PRIMARY		13					13					13			
ELSTREE PRIMARY			7	3	4				2	12				2	12
HORNSEY GRID		9	10				1	17	1			19			
LADYSMITH RD PRIMARY		3	10				3	10				3	10		
LONSDALE DR PRIMARY			2	8					1	9		10			
NORTH CHINGFORD PRIMARY	1		6	5	2	1			1	12		14			
NORTH ENFIELD PRIMARY			10	1				2	4	5		11			
PALMERS GRN GRID		18	5				1	22				1	22		
PONDERS END PRIMARY				13						13		13			
ROWLEY LN PRIMARY		8	9					15	2				15	2	
SOUTH CHINGFORD PRIMARY			8	1	2				3	8		11			
TAPSTER ST PRIMARY		12	5				9	8				9	8		
THE CROSS	20					20						20			
TOTTENHAM GRID	2		12			2		12				2		12	
WALTHAM ABBEY PRIMARY			5	4	2				4	7		11			
WALTHAM PARK GRID	18					18						18			
WATSONS RD PRIMARY		15						15				15			
WEST GRN PRIMARY		2	1	6	2			2	1	8		11			
WHETSTONE PRIMARY	11					11						11			
TOTAL	67	154	129	48	21	67	70	151	32	99	215	73	93	5	33

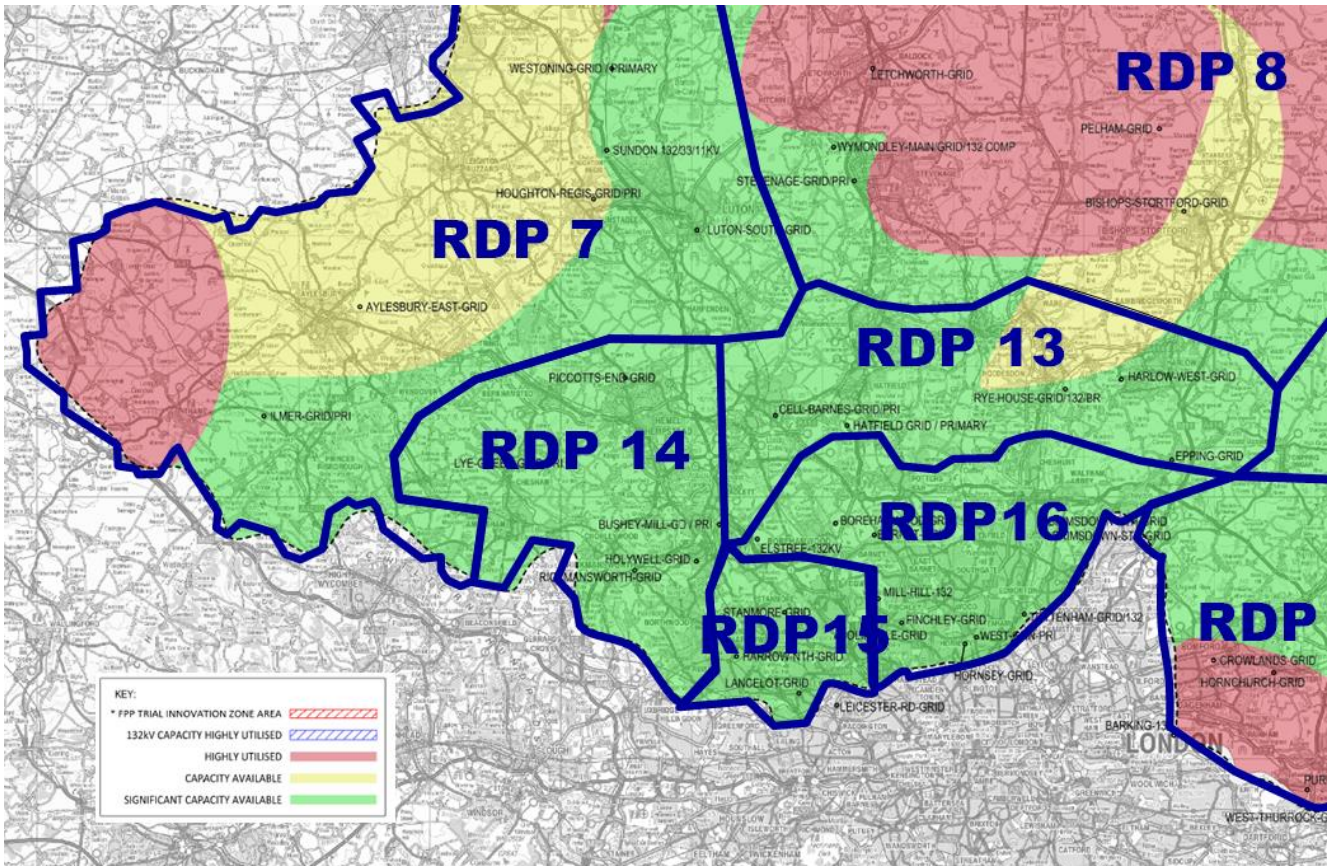
Brimsdown and Tottenham GSP

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
BARNET GRID		2						2					2		
BRIMSDOWN NORTH GRID		2						2					2		
BRIMSDOWN SOUTH GRID		2						2					2		
BRUCE GV PRIMARY		2						2					2		
BURY ST PRIMARY		1		1				1		1			2		
CENTRAL EDMONTON PRIMARY		2						2					2		
CENTRAL POTTERS BAR PRIMARY		1						1					1		
CENTRAL TOTTENHAM PRIMARY		2					1	1				1	1		
COCKFOSTERS PRIMARY		2						2			1	1			
CRANLEY GDNS PRIMARY		2						2					2		
CROUCH END PRIMARY		2						2					2		
CUFFLEY PRIMARY		2					1	1				1	1		
EAST ENFIELD PRIMARY		2						2					2		
ELSTREE PRIMARY	1	2				1	2				1	2			
HORNSEY GRID	2	3		1			4	1		1	2	4			
LADYSMITH RD PRIMARY		2						2					2		
LONSDALE DR PRIMARY		2						2					2		
MANOR HOUSE GRID	2							2					2		
NORTH CHINGFORD PRIMARY		2						2					2		
NORTH ENFIELD PRIMARY		2						2					2		
PALMERS GRN GRID		4						2	2				2	2	
PONDERS END PRIMARY		2						2					2		
ROWLEY LN PRIMARY		3						2	1				2	1	
SOUTH CHINGFORD PRIMARY		2						1	1				1	1	
TAPSTER ST PRIMARY		3						1	2				1	2	
THE CROSS		2	1					3					3		
TOTTENHAM GRID	2	3	1			1	1	4			1	1	4		
WALTHAM ABBEY PRIMARY		2			1			2		1			1	2	
WALTHAM PARK GRID	2							2					2		
WATSONS RD PRIMARY		2						2					2		
WEST GRN PRIMARY		2						2					2		
WHETSTONE PRIMARY		2						2					2		
TOTAL	9	64	2	2	1	2	29	44		3	5	31	42		

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APPENDIX G: GENERATION HEAT MAP

The heat map presented in this page is indicative of the capability of the high voltage electrical network to accept connection of new generation equipment. The area in red indicates that the network in that area is effectively at saturation point with respect to 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.



Eastern Power Networks Generation Capacity Map 14-01-2014