Regional Development Plan

RDP13 Elstree & Rye House GSP (EPN)

Planner: Paul Ramsbotham

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Document History

Version	Date	Revision Class	Originator	Section Update	Details
1.4	05/03/2014	Major	Paul Ramsbotham	1.2, Appendix D	Expenditure aligned to the 19th February 2014 NAMP version J less indirect costs.
1.4	05/03/2014	Major	Paul Ramsbotham	1,2,3,4,5	RDP narrative updated to reflect latest position
1.4	05/03/2014	Major	Paul Ramsbotham	1.2, Appendix E, Appendix F	LI and HI output measures updated in line with current NAMP plan and RIG tables
1.4	05/03/2014	Minor	Paul Ramsbotham	2.2	Network changes in progress updated to reflect interventions to date
1.4	05/03/2014	Major	Paul Ramsbotham	4	Recommended strategy reflects latest position
1.4	05/03/2014	Major	Paul Ramsbotham	Appendix G	Generation activity reflects latest position
1.4	19/03/2014	Mino	Steve Mould	All sections	All sections checked for consistent section numbering, content etc.
2.0	27/03/2014	Minor	Regulation	All	Final publication

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

Contents

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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 Elstree 132 Grid Supply Point (GSP) covering the geographic areas of Harlow, Epping, St Albans and Hatfield. This area comprises Epping Grid, Harlow West Grid, Rye House Grid, Cell Barnes Grid, Hatfield Grid, Black Fan Grid and Welywn Grid. Elstree 132 also supplies a wider geographic area that is outside the scope of this document, but is captured in RDP14 and 15.

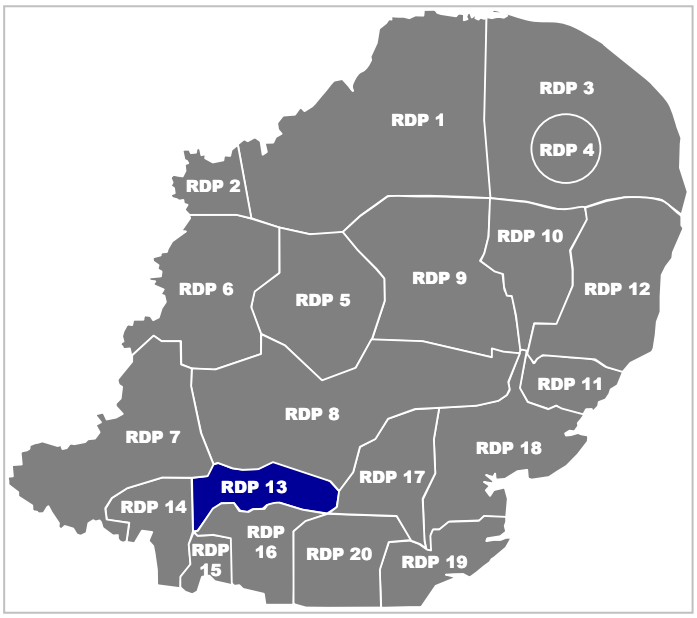

Figure 1 – Area covered by the RDP

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 two rail traction substations; BR Welwyn and BR Rye House.

It should be noted that there are a number of sites in this region that may be subject to large developments in the future which include: The Nortel site to the east of Harlow (data centre ranging between 10MVA and 40MVA), the former Glaxo site to the western side of Harlow (data centre ranging between 10MVA and 20MVA) and Elms Park to the western side of Harlow (data centre of up to 30MVA capacity). Merck, Sharpe and Dohme have recently relinquished their 33kV supply with an MPR of 6MW. This was a teed supply off the Rye House – North Harlow 33kV circuits.

1.1 Summary of issues addressed

Detailed within this RDP are the proposed works within the Rye House 132 area 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.

It is necessary for the development strategy to take account of schemes that have already passed Gate B. The nature of this document means that development proposals are made on the assumptions that these schemes will be delivered in line with their existing Gate C dates.

The projects below passed Gate B but are yet to be delivered

- New Harlow Primary substation – ITC (3 x 20/40MVA)
- Rye House Grid – Replace 33kV switchboard
- Elstree 33/11kV Primary Substation - ITC (1 x 12/24MVA) (included in RDP16)

The main focus of the RDP is to:

- Increase the firm rating at Rye House Grid and transfer load from Harlow West Grid to Rye House Grid
- Maintain P2/6 compliance of the Harlow West Grid/Epping Grid group

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- Increase 11kV capacity in the wider Harlow and Epping areas and ensure all sites remain firm
- Asset replacement schemes in line with the asset strategy requirements

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
RDP13	LRE	£3.6m	£1.2m	£0.3m	£1.5m	£2.8m	£1.9m	£0.0m	£0.0m	£0.0m	£7.7m
	NLRE	£5.8m	£1.9m	£1.5m	£2.1m	£2.1m	£1.6m	£3.8m	£3.7m	£1.2m	£17.8m
	TOTAL	£9.4m	£3.0m	£1.8m	£3.6m	£4.9m	£3.5m	£3.8m	£3.7m	£1.2m	£25.5m

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 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 below.

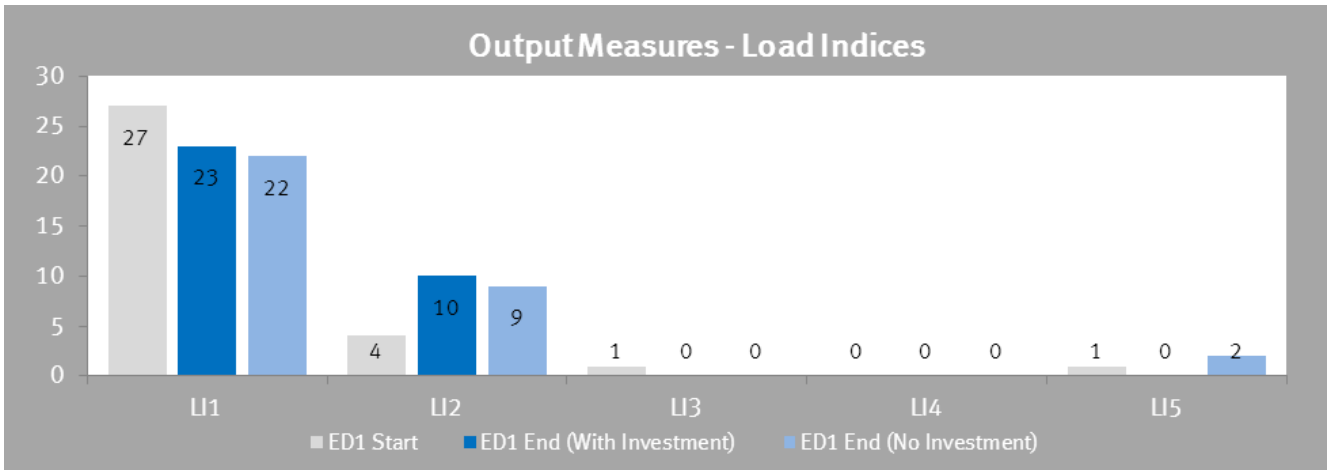
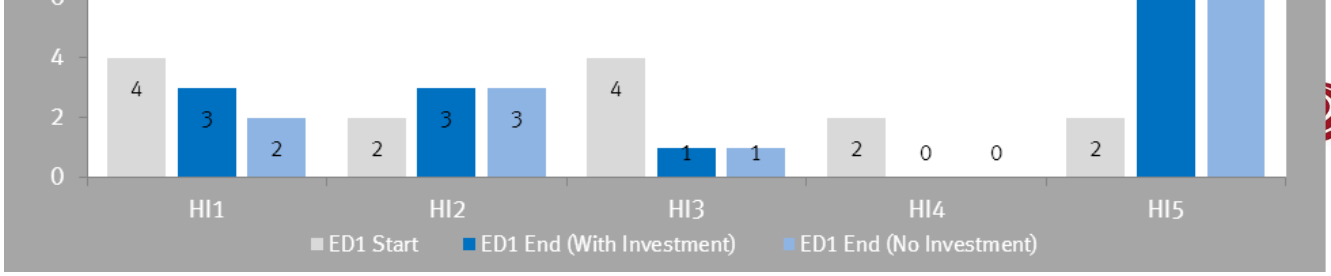
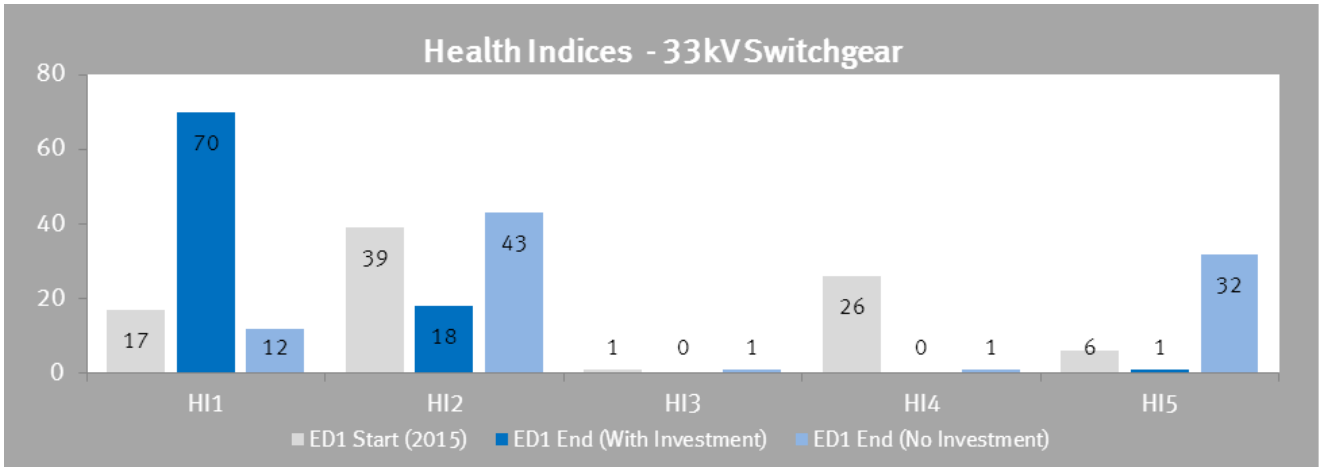
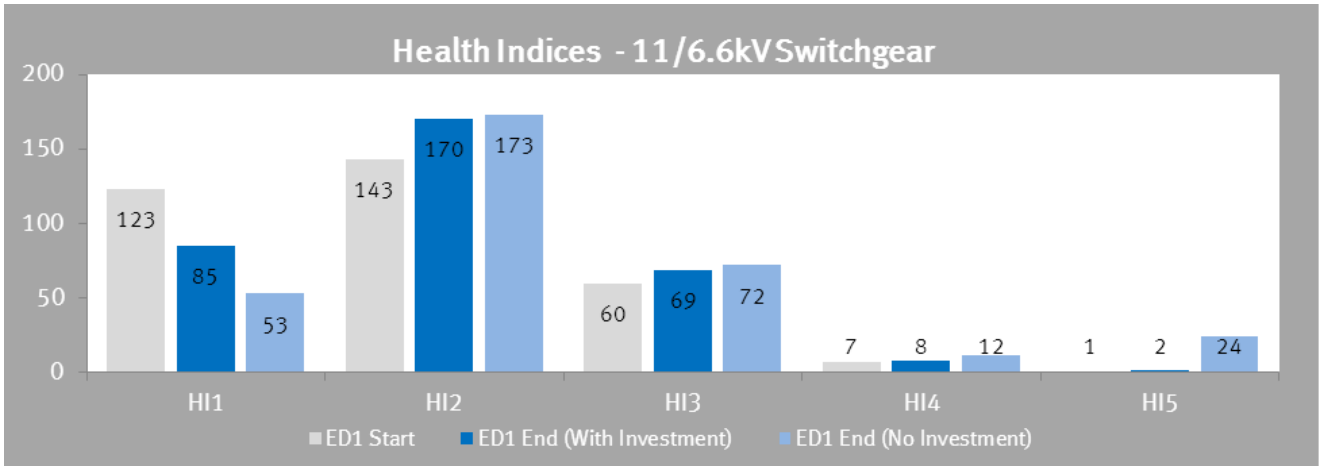


Figure 2. Load Indices (LI)

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.







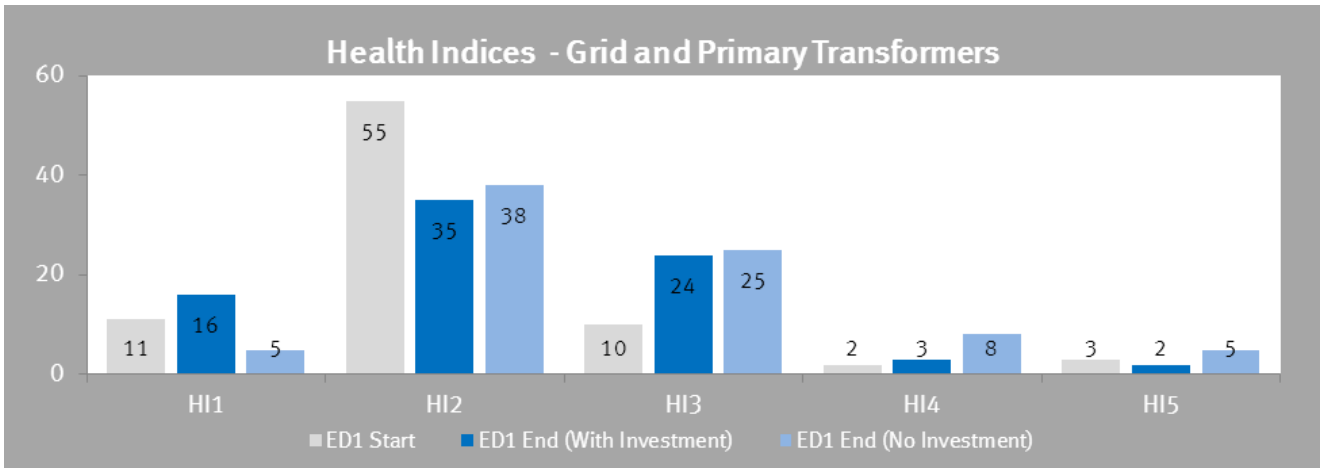


Figure 3. Health Indices by asset category

Scenarios considered

The largest costs within the recommended reinforcement strategy are associated with schemes that focus on managing load in and around the Harlow area. Rather than reinforcing Harlow West Grid directly focus is given to realising the full transformer capacity at Rye House Grid, currently restricted by the configuration of the 33kV switchboard. Once the full capacity at Rye House is established load is transferred out of the Harlow West group, via an ITC at New Harlow, on to Rye House Grid. P2/6 compliance of the group is largely maintained currently via 33kV interconnection between Rye House Grid and Harlow West. As P2/6 compliance approaches its limits this transfer capacity will be increased by separating the 132kV circuits that supply Epping Grid and Harlow West Grid. This will release further capacity in the area and will enable reinforcement of Harlow West Grid when it's required (outside the scope of this RDP). This is likely to take the form of either a third Grid transformer or direct transformation at the site. Load on the Primary sites within the Harlow area will be managed through interconnection at 11kV rather than conventional ITCs. In the Epping area load on Lindsey St and Ongar Primaries will be reduced through the establishment of a new Primary at Epping Grid which will accommodate load from both sites and help to maintain them within their firm rating.

The rejected strategy for the Harlow area focussed on a single transformer Grid site at New Harlow to manage the load at Harlow West Grid and also to enable continued P2/6 compliance. Whilst overall this would have been a cheaper option it is rejected due to anticipated difficulties establishing a 132kV trident line to the site. A more certain approach would be to supply the site via a 132kV cable but the cost increase of this approach makes the strategy economically unviable. Alternative reinforcement of the Epping area considered direct transformation at Epping Grid to manage the existing 11kV load in the area. This was rejected on the grounds of cost, but also that it creates more capacity than is currently envisaged to be required.

The previous strategy for managing the 11kV load distribution in the Harlow area was to establish a new Primary site to the east of Harlow. This would be supplied from Epping Grid and would achieve three objectives. It would allow load to be transferred from South Harlow, New Harlow and Harlow West Primaries helping to keep the sites within their firm ratings. It would transfer load from Harlow West Grid to Epping Grid. It would help the Harlow/Epping group maintain its P2/6 compliance. Unfortunately, after many years of protracted negotiations, land purchase negotiations for the Harlow East site could not be concluded and this approach is no longer feasible.

RDP Dependencies and Interactions

This RDP assumes the work to replace the 132kV bars at Elstree 132 is completed.

The ITC at New Harlow (1.33.01.5843) relies on the replacement of the 33kV switchgear at Rye House Grid being completed (1.35.01.2409). The interaction of these two schemes is being monitored closely as the risk is that the majority of the money is spent in the DPCR period with the network benefits not being realised until the ED1 period. Detailed phasing of the works including all interim load transfers is detailed within the Gate B paper for that scheme.

The level of connection activity in Harlow is high, particularly to the West of the area, for loads ranging from 1MVA to 100MVA. The East side of Harlow has also been identified as a development area by Harlow Council, and there are significant housing proposals to the north of the area too. The strategy outlined in this RDP may need to be significantly revised dependant upon which connections applications proceed and the timescales within which they occur.

The Rye House 132 network interconnects with Elstree 132. For an overview of the wider area the following RDPs should also be considered:

- RDP14 Elstree – Watford South Group
- RDP15 Elstree – Mill Hill – Willesden GSP

2 Network configuration

2.1 Existing network

This RDP considers a total of six Grid substations supplied from Rye House 132 GSP.

Harlow West Grid

Harlow West is equipped with two 90MVA, 132/33kV transformers supplied by a dual circuit 132kV overhead line from Rye House 132. The site comprises outdoor 33kV AIS switchgear dating back to the late 1950s and mid 1960s. Harlow West Grid is reaching the limit of firm capacity and 4 of the 33kV circuit breakers are HI 4/5. There is currently 33kV interconnection from Harlow West Grid, via New Harlow, to Rye House Grid (55MVA winter, 44MVA summer circuit capacity) and Bishops Stortford Grid (25MVA winter, 20MVA summer circuit capacity). The 2 x 33kV wood pole circuits from Rye House Grid to North Harlow are in poor condition and require rebuilding.

Harlow West Grid supplies Harlow West, New Harlow and South Harlow Primaries. All three sites are currently approaching their firm ratings.

Epping Grid

Epping Grid is equipped with 2 x 90MVA, 132/33kV transformers supplied by a dual circuit 132kV overhead line from Rye House 132. The site comprises outdoor 33kV AIS switchgear dating back to 1967. The second Grid transformer at Epping Grid was commissioned in 2010 and formed part of the previous strategy for the area. The intention was that 33kV supplies to Harlow East would be taken from this site which would have two benefits. The first would be to offload existing Primary sites supplied from Harlow West Grid. The second benefit would be to improve 33kV interconnection between the two Grid sites and thus maintain P2/6 for a longer period. However these benefits will be achieved through a different approach, detailed in this RDP, as the land purchase for Harlow East was not possible. Work has been ongoing for a number of years to secure a new Primary substation site to the East of Harlow, however, although a suitable site has been identified, agreement cannot be reached to secure sufficient rights for the cables to the new substation site. In December 2012 the decision was taken to cease pursuance of the land acquisition and focus on an alternative reinforcement strategy. 33kV interconnection exists between Epping Grid and Harlow West via a single 33kV cable (30MVA winter/28MVA summer).

The Grid transformers installed at Epping supply Lindsey St and Ongar Primary substations, and currently have spare capacity. Both Lindsey St and Ongar Primary substations are reaching the limit of firm capacity.

Rye House Grid

The Rye House Grid network is fed from Rye House 132 via 4 x 132kV circuits and comprise 4 x 45MVA transformers connected to a 33kV indoor 2 section switchboard dating back to 1980. In the event a half bar outage 2 transformers will be lost therefore limiting the site firm capacity to 90MVA summer and 117MVA winter. A project is underway to replace the 33kV switchboard at the site in order to increase the firm rating to that of the site transformer capacity. All four 132/33kV Grid transformers are rated as either HI3 or HI4.

Rye House Grid supplies a total of ten Primary sites: Ware. Hoddesdon. East Hertford. Much Hadham. North Harlow. MS&D Hoddesdon. Turnford. The Cross. Broxbourne. Rye House Local. Of these, East Hertford, Much Hadham and Turnford are approaching their firm ratings. The 11kV circuit breakers at Hoddesdon Primary are rated as HI 3/4 and have been identified for asset replacement.

There are also 2 x 26.5MVA, 132/25kV rail traction transformers located at the site which supply BR Rye House.

Rye House Grid – New Harlow 33kV overhead circuits have a poor HI rating and are due for refurbishment.

Welwyn Grid

The Welwyn Grid network is fed from Rye House 132 via a 132kV, 400mm dual tower circuit from Rye House 132 to Elstree 132. Welwyn Grid is teed off the main tower line on a 132kV, 300mm dual circuit tower line. Also

connected to this circuit is a 25MVA data centre at Black Fan Rd. The grid substation at Welwyn is equipped with 2 x 90MVA, 132/33kV transformers connected to a mixture of outdoor 33kV switchboard dating back to the 1960s and early 1970s. The substation is reaching the limit of firm capacity towards the end of the ED1 period and 9 of the 33kV circuit breakers are HI 3/4. The 33kV switchgear is due to be replaced within the ED1 period.

Welwyn Grid supplies seven Primary sites and also interconnects with Hatfield Grid via The Cross Primary. The seven Primary sites are: Welwyn. Tunnel. Central Welwyn. West Hertford. Mundells. Old Welwyn. Lyle.

The transformers at Old Welwyn are in a poor condition, are not bunded and are equipped with old slow speed tapchangers. The transformers are rated as HI4/5 and a scheme will be raised within the IDP to replace these within ED1 as they don't currently feature in the NAMP.

Cell Barnes Grid

Cell Barnes Grid is fed from Elstree 132 via 1 x 132kV dual steel tower circuit. This circuit interconnects with Rye House 132 and also supplies Hatfield Grid, Welwyn Grid and Black Fan Grid. Cell Barnes is equipped with 2 x 90MVA, 132/33kV transformers connected to indoor 33kV OCB switchgear dating back to 1966. The 33kV switchgear is due for replacement in the ED1 period. There is 33kV interconnection between Cell Barnes Grid and Hatfield Grid rated at 30MVA winter/28MVA summer.

Cell Barnes Grid supplies four Primary sites: Park St. Cell Barnes. Adelaide St. Marshalswick.

Hatfield Grid

Hatfield Grid is fed from Elstree 132 via 1 x 132kV dual steel tower circuit. This circuit interconnects with Rye House 132 and also supplies Cell Barnes Grid, Welwyn Grid and Black Fan Grid. Hatfield Grid is equipped with 2 x 90MVA, 132/33kV transformers connected to indoor 33kV GIS switchgear dating back to 2000. There is 33kV interconnection between Cell Barnes Grid and Hatfield Grid. Hatfield Grid also has interconnection to Welwyn Grid and Barnet Grid.

Hatfield Grid supplies seven Primary sites: Tunnel. Chantry Lane. West Potters Bar. Elstree. Shenley. Park St and Hatfield.

33kV interconnection

Interconnection between these Grid sites exists at 33kV between:

- Epping Grid and Harlow West Grid via 1 x 33kV circuit (30MVA winter/28MVA summer)
- Harlow West Grid and Rye House Grid via 2 x 33kV circuits (55MVA winter/44MVA summer)
- Rye House Grid and Bishops Stortford Grid via 1 x 33kV circuit (25MVA winter/20MVA summer)
- Cell Barnes Grid and Hatfield Grid via 1 x 33kV circuit (30MVA winter/28MVA summer).
- Hatfield Grid also has interconnection to Welwyn Grid via Tunnel Primary (30MVA winter/28MVA summer).

Network constraints

This strategy assumes that the project to split Rye House 132 and Elstree 132 by opening the 132kV line circuit breakers at Hatfield Grid will be implemented. This is required to enable the Rye House 132kV switchboard to run solid. If the switchboard is run split, the differing impedances of the National Grid transformers and associated circuits cause load imbalances on the UKPN network.

Epping Grid and Harlow West Grid are currently fed via 1 x 132kV dual steel tower circuit from Rye House 132 initially, which then splits to provide each site with two separate 132kV circuits. An N-2 outage of these 132kV circuits at Rye House 132 would result in loss of both Grid sites. P2/6 compliance is currently maintained through several 33kV circuits detailed in the summary, but the P2/6 limits are due to be reached in ED1 without intervention.

This strategy therefore looks at the network changes required to provide the reinforcement required on the existing 132kV and 33kV network to maintain firm capacity based on the existing connected customers.

2.2 Network changes in progress

New Harlow 33/11kV Primary Substation - ITC (1 x 20/40MVA)

To reduce the load at Harlow West Grid and reinforce New Harlow it is proposed to replace the existing 15MVA transformer with a new 20/40MVA transformer. The 11kV bars will be reconfigured such that the new 20/40MVA transformer will be connected on an outside section and the 2 x existing 20/40MVA transformers will be connected to the middle section and other outside section. The new transformer will be supplied from Rye House Grid via the existing 2 x 33kV circuits. The 11kV bus between the new and existing transformers will be run open with an auto-close scheme. This will increase the firm capacity at New Harlow to 80MVA winter, 60MVA summer and remove approximately 20MVA of load from Harlow West Grid.

The reinforcement should be completed by summer 2016 to ensure Harlow West Grid remains firm, but cannot be completed until the project to reconfigure Rye House Grid has been completed.

Once the project to replace New Harlow T3 has been completed approximately 15MVA of load will be transferred from South Harlow to New Harlow. South Harlow will then remain firm for the ED1 period.

This should be completed as soon as the project to reinforce New Harlow has been completed.

Rye House 132/33kV Grid Substation - Replace the existing 33kV switchboard with a new 3 section switchboard

Rye House Grid is equipped with 4 x 132/33kV, 45MVA transformers connected to a two section 33kV outdoor switchboard. The firm capacity of the site is limited to 90MVA summer, 117MVA winter due to the fact that two transformers are connected onto a single section of 33kV bar, therefore in the event of a single bar outage there are only two transformers remaining energised. The existing switchboard will be replaced with a new indoor 3 section switchboard.

The reinforcement must be completed by winter 2015/16 at the latest. This reinforcement must be completed before the project to reinforce New Harlow can be completed and should therefore go ahead as soon as possible.

Elstree 33/11kV Primary Substation - ITC (1 x 12/24MVA) (see Brimsdown & Tottenham RDP)

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. This project forms part of the Brimsdown RDP.

Elstree GSP 132kV Exit Point - replace 132kV switchgear

The OB14 circuit breakers at Elstree are reaching the end of their useful life. Access restrictions are in place due to the known defects, concrete support structures, aerials, VTs and other associated plant are also showing signs of a deteriorating condition. National Grid, who own the 132kV bus-bar, plan to replace their 132kV switchgear at this site. The UK Power Networks equipment is of the same type and age and recent operational restrictions affect this switchgear therefore it is proposed to replace them at the same time. NG has reviewed the possibility of refurbishing the existing AIS switchboard and have concluded that operational and HSE considerations mean that this is not possible. They therefore propose to construct a GIS switchboard. NG are also rationalising the 132kV substation and will transfer the Stanmore 132kV circuits from dedicated SGT to the proposed GIS132kV busbar.

The existing cable tails to Rye House and to Watford South are not matched to the rating of the 400mm OHL. It is therefore proposed to replace these cables.

Rye House 132kV Network Reinforcement - Protection Works at Hatfield Grid

A review of the 132kV running arrangement at Elstree & Rye House group was undertaken as part of an initial 132kV switchgear replacement project in order to manage the fault levels at the GSP. It is proposed to separate

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Elstree and Rye House exit points by opening the circuit breakers at Hatfield Grid and run Rye House with 3 Super Grid transformers solidly connected to the 132kV busbars.

The current running arrangement is not recommended as it leads to unbalanced load flow, decrease of the available capacity at Rye House, overloads for a FCO on the 132kV overhead circuit and decreased network resilience.

This project to install CVTs at Hatfield will enable the change of the running arrangement at 132kV and enable the split of both networks during normal operation. The works are to be coordinated with the works to replace the 132kV BTH VTs at Hatfield Grid.

Rye House / Turnford No.1 33kV circuit – Replace fluid filled cable
The oil-filled cable section of the Rye House – Turnford No.1 33kV circuit faulted. Due to the condition of the cable and environment which it is installed a project is underway to replace the remaining 2km of the oil-filled cable with a polymeric cable.

Hatfield 33/11kV Primary Substation - ITC (11/18/24MVA)
This project was been brought forward following a fault on one of the original 7.5/15MVA AEI primary transformers, which dated from the 1960s. The replacement of the second unit was also carried out to safe guard against the risk of a similar fault and also avoid the duplication of costs for works on site. 2 x 11/18/24MVA transformers were commissioned in 2013.

3 Summary of issues

3.1 Development areas

Load
The figures given are based on global estimates of growth and have not been adjusted for the estimates of new load given below as there is no firm timetable, or commitment, for any of the developments to be built. Similarly the effect of low-carbon requirements on both domestic and commercial/industrial load may change the ADMD and/or profile of the load.

The present economic downturn has depressed industrial load and any revival will affect some substations to a greater extent than others. The Harlow area, in particular, is likely to see more load growth of the existing connections along with an increased volume of new connection enquiries.

Generation
This area is subject to far fewer generation enquiries than the wider EPN area. As a result generation referrals are not considered further within this RDP.

Council development plans
With the exception of Welwyn Hatfield Borough Council, Individual Council plans have not been considered within this RDP. The following information is taken from the East of England plan > 2031 which was published in March 2010.This document was written after the economic downturn that occurred post 2008 and as such is considered a fair representation of the likely development of the area.

Job growth within the region, between 2011 and 2031, is estimated to be as follows:

- Epping Forest: 3,600 jobs
- Harlow: 8,100 jobs
- St Albans: 11,400 jobs

Housing growth in the regions during the same period is predicted to be as follows:

- Epping Forest: 3,200 dwellings

- Harlow: 16,000 dwellings
- St Albans: 7,000 dwellings

The core strategy for Welwyn Hatfield suggests creation of 12,200 jobs between 2011 and 2029 with a corresponding increase in housing stock of 7,200 new homes. Housing growth focuses on Hatfield with 3,230 new houses and Welwyn Garden City with 2,750 new houses. Retail floor space in and around Hatfield is predicted to increase by 2,824m² by 2029. The document makes reference to UK Power Networks' infrastructure in the area. Any comments that have been made are reflective of the existing network and the RDP planned development in the area.

Customer enquiries

- There is significant connection activity on the West side of Harlow with several separate quotation requests for Data Centres varying from 5MVA up to 100MVA.
- Terlings Park – The former Merck-Sharp-Dohme site to the north of Harlow at Terlings Park has been decommissioned and it is expected that this site will be re-developed in the next few years.
- Eastwick (DR247), to the north of Harlow, is a proposed development initially indicated to involve up to 25,000 homes and associated facilities. No formal requests have been received.
- Latton Priory will involve a housing development to the south east of Harlow with a load of up to 16MW. No formal requests have been received.
- The west side of Harlow has been designated a development zone and a number of quotes have been issued for the connection of data centres varying from 5MVA up to 100MVA.

The following areas have been identified for development in the Welwyn area:

- Aquarius House, Bessemer Park has requested a load increase from 1.5MVA to 3MVA.
- Developers have requested a budget quote for a 30MVA data centre on Bessemer Rd.
- North Weald Airfield development is expected to commence during ED1 with loads up to 14MVA. This is not yet signed up and therefore does not appear in the PLE, however, the PLE shows sufficient capacity to accommodate the potential additional load on Epping Grid. No formal requests have been received.

The following areas have been identified for development in the St Albans area:

- Central and western St Albans (5-6MVA, housing and commercial).

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).

Hatfield/Elstree 132kV Tower Line (PLB) - 132kV Tower Line Refurbishment

The condition assessment of the Hatfield/Elstree 132kV Tower Line (PLB) has shown that the probability of failure due to degradation will become unacceptable. Completion of the project will see 22 km of 132kV Tower Line replaced.

Hatfield Grid/Welwyn Tunnel 33kV OHL circuit - 33kV wood pole OHL replacement

The condition assessment of the Hatfield Grid/Welwyn Tunnel 33kV OHL circuit has shown that the probability of failure due to degradation will become unacceptable. Completion of the project will see 3 km of 33kV OHL circuit replaced.

Hatfield Grid/West Potters Bar 33kV OHL circuit - 33kV wood pole OHL replacement

The condition assessment of the Hatfield Grid/West Potters Bar 33kV OHL circuit has shown that the probability of failure due to degradation will become unacceptable. Completion of the project will see 15 km of 33kV OHL circuit replaced.

Rye House Grid/North Harlow 33kV OHL circuit - 33kV wood pole OHL replacement

The condition assessment of the Rye House Grid/North Harlow 33kV OHL circuit has shown that the probability of failure due to degradation will become unacceptable. Completion of the project will see 11 km of 33kV OHL circuit replaced.

Rye House Grid (Ware) / Much Hadham 33kV OHL circuit - 33kV wood pole OHL replacement

The condition assessment of the Rye House Grid (Ware) / Much Hadham 33kV OHL circuit has shown that the probability of failure due to degradation will become unacceptable. Completion of the project will see 11 km of 33kV OHL circuit replaced.

Welwyn 132/33kV Grid Substation - replace 33kV switchgear (2000A)

The condition of the existing 33kV, two section outdoor switchgear at Welwyn Grid is such that is needs to be replaced. (9 of the 15 CBs are HI3/4). It is proposed to replace the switchgear with a new 33kV, three section indoor switchboard.

Harlow West 132/33kV Grid Substation - Replace 33kV Switchgear

4 of the 8, 33kV outdoor circuit breakers at Harlow West Grid are HI 4/5. The existing outdoor 33kV circuit breakers will be replaced with a new indoor 2 section switchboard. The switchboard should be designed to allow a 3rd section to be installed in the future if required.

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

The condition assessment of the 1967 SCO K30 outdoor oil insulated switchgear installed at Epping 132/33kV 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.

Cell Barnes 132/33kV Grid Substation - Replace 33kV Switchgear

The condition assessment of the 1966 SWS ET Kiosk oil insulated switchgear installed at Cell Barnes 132/33kV 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.

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

The condition assessment of the 1958/60 BTH JB721 indoor oil insulated switchgear installed at Shenley 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.

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

The condition of the existing 11kV indoor switchboard at Hoddesdon Primary is such that it needs to be replaced (11 of the 16 CBs are HI3/4). It is proposed to replace the switchgear with a new 11kV, two section switchboard.

Adelaide St 33/11kV Primary Substation - Retrofit 11kV Switchgear

The condition assessment of the 1960 SWS C8X indoor oil insulated switchgear installed at Adelaide St 33/11kV Primary Substation has shown that the probability of failure due to degradation will become unacceptable. This project recommends its retrofit. Completion of the project will see 1 circuit breaker retrofitted.

Park St 33/11kV Primary Substation - Retrofit 11kV Switchgear

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 1967 SWS D8-12X indoor oil insulated switchgear installed at Park St 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 retrofit.

Rye House 132/33kV Grid Substation - Replace Grid Transformers (GT1B, GT2A, GT4B, GT3A)

The condition of the 4 x 45MVA 132/33kV transformers is such that they need to be replaced. It is proposed to replace them with 3 x 90MVA transformers. The 33kV switchboard at Rye House is due to be replaced in approximately 2015 and will be configured to enable the 3 transformer connection.

Central Welwyn 33/11kV Primary Substation - Replace Primary Transformers (T1, T3)

The condition assessment of the 1952 BET Primary Transformer installed at Central Welwyn 33/11kV Primary Substation has shown that the probability of failure due to degradation will become unacceptable. This project recommends its replacement.

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

The condition assessment of the 1964 FER Primary Transformer installed at Ongar 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 refurbishment. Completion of the project will see 1 Primary Transformer refurbished.

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

The condition assessment of the 1967 FUL Primary Transformer installed at Park St 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 refurbishment.

Welwyn 33/11kV Primary Substation - Refurbish Primary Transformers (T4)

The condition assessment of the 1970 BLO Primary Transformer installed at Welwyn 33/11kV Primary Substation has shown that the probability of failure due to degradation will become unacceptable. This project recommends its refurbishment. Completion of the project will see 1 Primary Transformer refurbished.

3.3 Security of supply analysis

Substation	Demand (MW)	Supply Class	Demand (MVA)			P2/6	Comments
			2015	2018	2022		
Rye House 132	296	D	346	367	387	Compliant	
Harlow/Epping group	113	D	120	132	145	Compliant	Becomes P2/6 n-2 non compliant in 2023*
Welwyn Grid / Black Fan group	76	D	94	99	103	Compliant	
Rye House Grid	101	D	132	138	145	Compliant	Switchboard replacement will maintain compliance
Cell Barnes/Hatfield Group	140	D	169	174	180	Compliant	Assuming 132kV cable from Elstree CB to OHL replaced with switchboard

*Rye House – New Harlow 33kV circuits are able to pick up the New Harlow load with minimal switching. The PLE information for New Harlow indicates that in 2013 the load will be 33.9MW winter and 28MW summer. 2023 loads for this site are 44.8MW winter and 36.7MW summer. Merck, Sharpe and Dohme had an MPR of 6MW but have recently accepted an offer to disconnect their supply. This capacity is therefore excluded from any analysis on this network. Therefore in 2023, the combined Rye House circuit capacities (53.1MW) will be able to pick up 44.8MW of load leaving a spare capacity of 8.3MW on the circuits.

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

The Rye House 132kV switchboard should be run solid. If the switchboard is run split, the differing impedances of the National Grid transformers and associated circuits will cause load imbalances on the UKPN network. Network studies should be carried out before running the switchboard split.

The Rye House Grid switchboard is single bus, 2 section. There are 4 x 45MVA transformers connected to the switchboard, however the firm capacity is restricted to 90MVA summer, 117MVA winter as there are 2 transformers connected to each section. The switchboard is in the process of being replaced to relieve this issue, this is due for completion by the end of 2015.

Pinch points

Cable bridges within the area include:

Broxbourne – Multi purpose bridge over the River Lea which carries 1 x 33kV cable and pilot

Welwyn Garden City – Bridge no. 66 crossing Great North Railway which carries 1 x 33kV, 3 x 11kV and 1 x LV cable

3.5 National Grid

There are no known National Grid works which impact the distribution network apart from the Elstree 132kV switchboard replacement which is underway.

4 Recommended strategy

Harlow/Epping

Rye House/Harlow West 132kV Tower Line (PDE/PCK) - separate circuits
Reinforce the Harlow/Epping area by separating the 132kV circuits to Harlow West Grid and Epping Grid. 2 x new 132kV cables will be installed from Rye House 132 to the Harlow/Epping terminal towers to enable the 2 x dual circuit tower lines to be split. Existing P2/6 compliance relies on 33kV interconnection between Rye House and New Harlow, and Bishops Stortford and New Harlow.

Rye House Grid/Welwyn Grid

East Hertford Primary - Replace the existing 2 x 15MVA transformers with 2 x 12/24MVA transformers
The load at East Hertford Primary is predicted to exceed the site firm capacity. It is proposed to replace the existing 15MVA OFAF transformers with 2 x 12/24MVA 33/11kV transformers.

4.1 Financial Appraisal and Benefits

The financial expenditure is shown in the Appendices.

5 Rejected Strategies

5.1 Harlow area reinforcement

Harlow area - Replace the 2 x Rye House/North Harlow 33kV Circuits with 1 x 132kV Wood Pole circuit and Install 1 x 132/33kV 90MVA Transformer at North Harlow (£4.6m)
The 2 x 33kV circuits from Rye House Grid to North Harlow are in a poor condition and need rebuilding. It s proposed to replace both 33kV circuits with 1 x 132kV wood pole circuit and install a new 132/33kV 90MVA

transformer at North Harlow connected to the existing 33kV switchboard. The budget cost for the OHL and transformer is £3.6m, an additional £1m has been allowed for the legal work required to secure the 132kV OHL.

There are potentially significant planning issues that will need to be overcome before a 132kV wood pole circuit can be installed. If the issues could not be overcome the project would not be able to proceed and the rejected option to separate the 132kV circuits to Harlow/Epping would be required instead (£5.8m). To then also provide additional transformer capacity to the area would require an ITC at Harlow West (£2.8m)

This project should be completed by 2023 the exact timing of this project will most likely be dictated by new customer connections.

Harlow East – New 33/11kV Primary substation connected to Epping Grid (£9.2m) and separate Harlow and Epping 132kV circuits (£5.8m) (total £15m)
Install a new 33/11kV Primary substation on the east side of Harlow and transfer load from South Harlow and New Harlow. The new substation will be fed from Epping Grid via 2 x new 33kV cable circuits.

5.2 Epping area reinforcement

Epping Grid 132/11kV – Install a new 132/11kV 30MVA substation at Epping Grid (£5.2m)
Reinforce Epping Grid with a2 x 132/11kV, 30MVA transformers connected to the new 11kV switchboard. The transformers will be connected to the existing 400mm 132kV dual circuit OHL.

Ongar – ITC 2 x 12/24MVA and Lindsey St – ITC 2 x 20/40MVA (£10.4m)
Replace the existing transformers at Ongar with 2 x 12/24MVA transformers and the 33kV circuits with 2 x 13.5km cable circuits (£7.5m)

6 References

References	Description
Reference 1	Planning Load Estimates EPN Area
Reference 2	132kV Network HV Schematic Operating Diagrams East of England (Nov 2012)
Reference 3	33kV Network HV Schematic Operating Diagrams East of England (Nov 2012)
Reference 4	Welwyn Hatfield Council – Emerging Core Strategy (Nov 2012)
Reference 5	Welwyn Hatfield Council – Draft Infrastructure Delivery Plan (Nov 2012)
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
Appendix E	Output Measures – Load Index Table (LI)

Appendix F	Output Measures – Health Index Table (HI)
Appendix G	Welwyn and Hatfield development areas (reference 4)
Appendix H	Generation Heat Map

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:

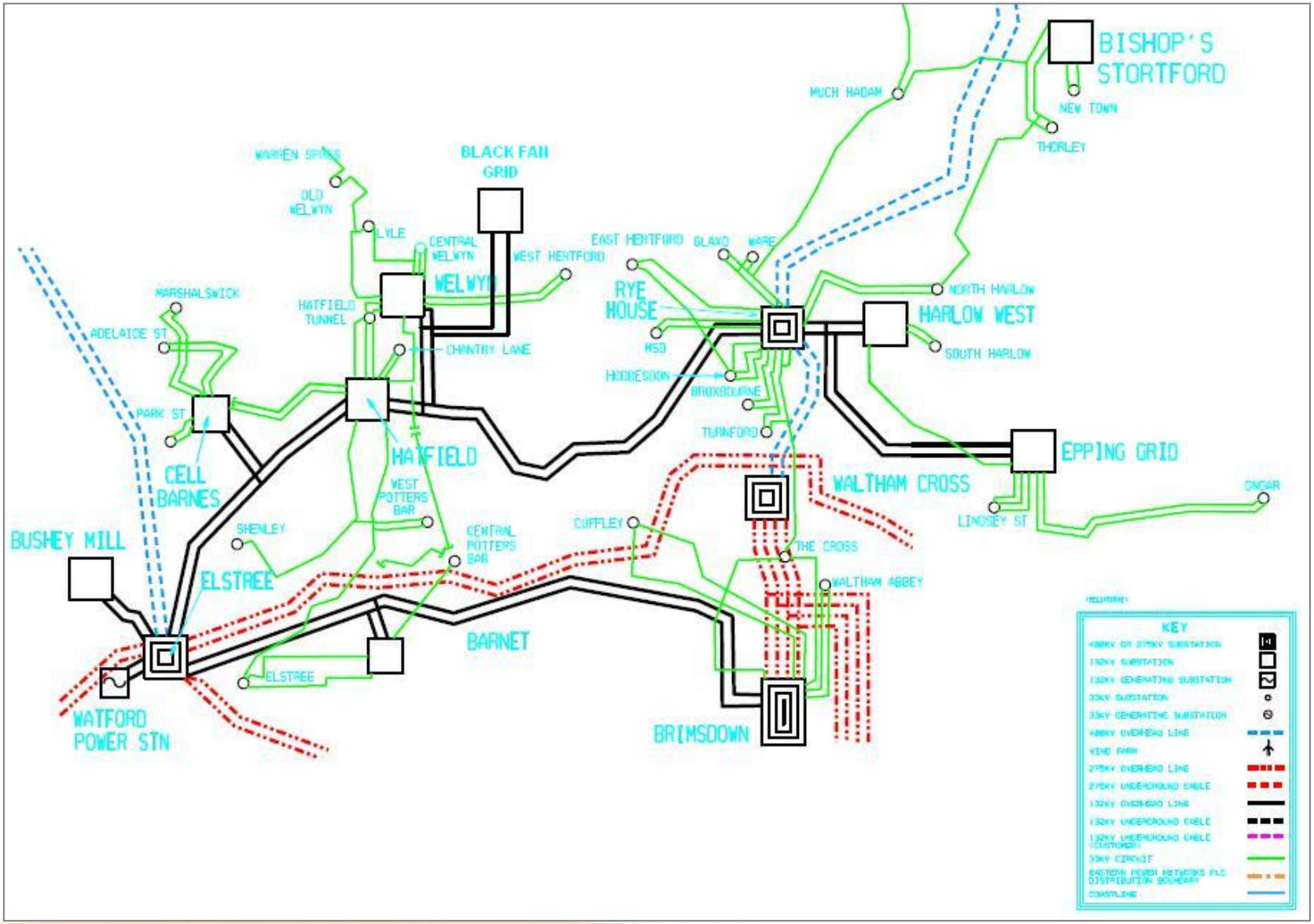
Name	Role	Signature	Date
Paul Ramsbotham	Infrastructure Planner		19/03/14
Nuno da Fonseca	Planning Manager (EPN)		

Approval by:

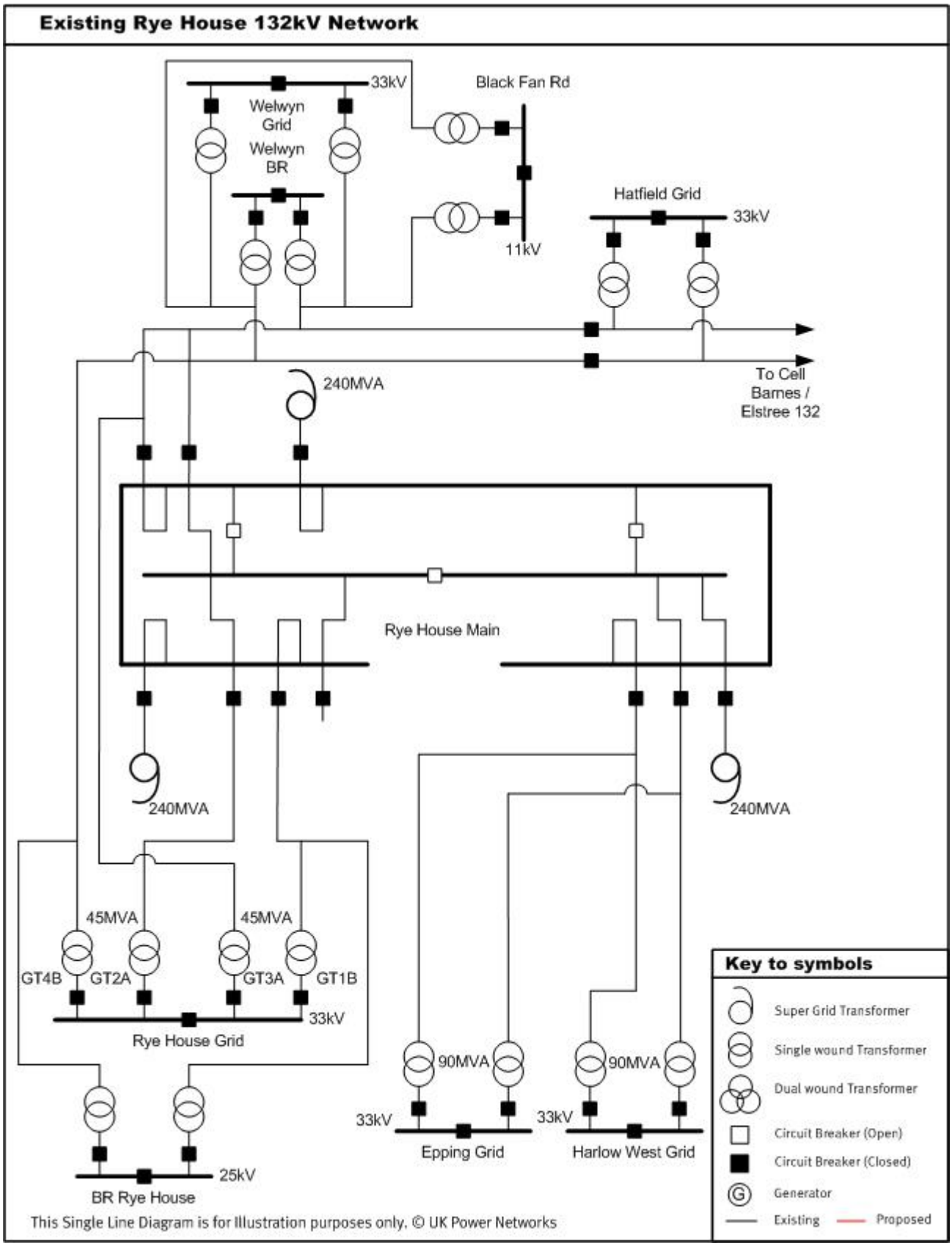
Name	Role	Signature	Date
Robert Kemp	Head of System Development		20/03/14
Barry Hatton	Director of Asset Management		

Elstree & Rye House GSP (EPN)

APPENDIX A: GEOGRAPHICAL DIAGRAM



APPENDIX B: SINGLE LINE DIAGRAM – EXISTING NETWORK



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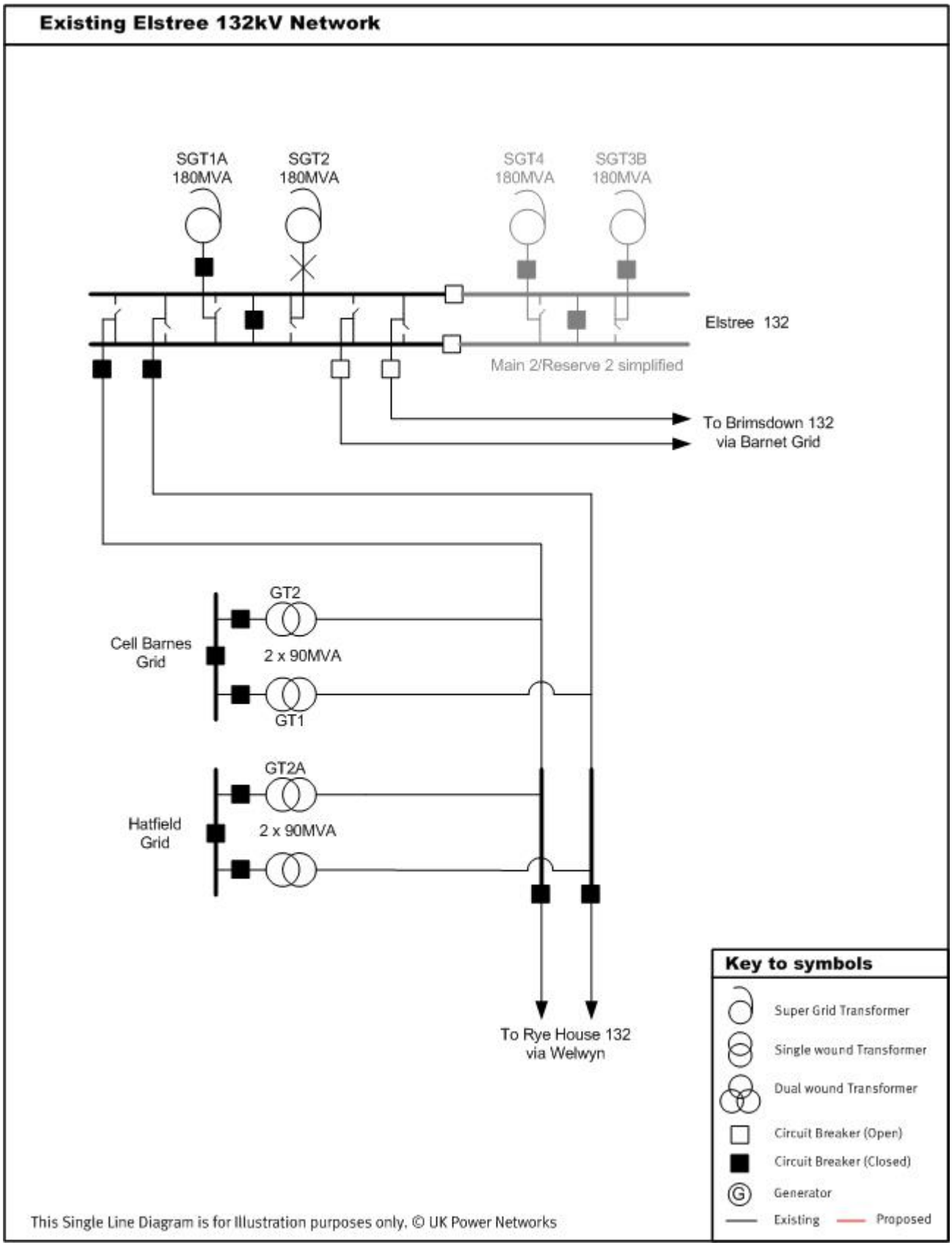
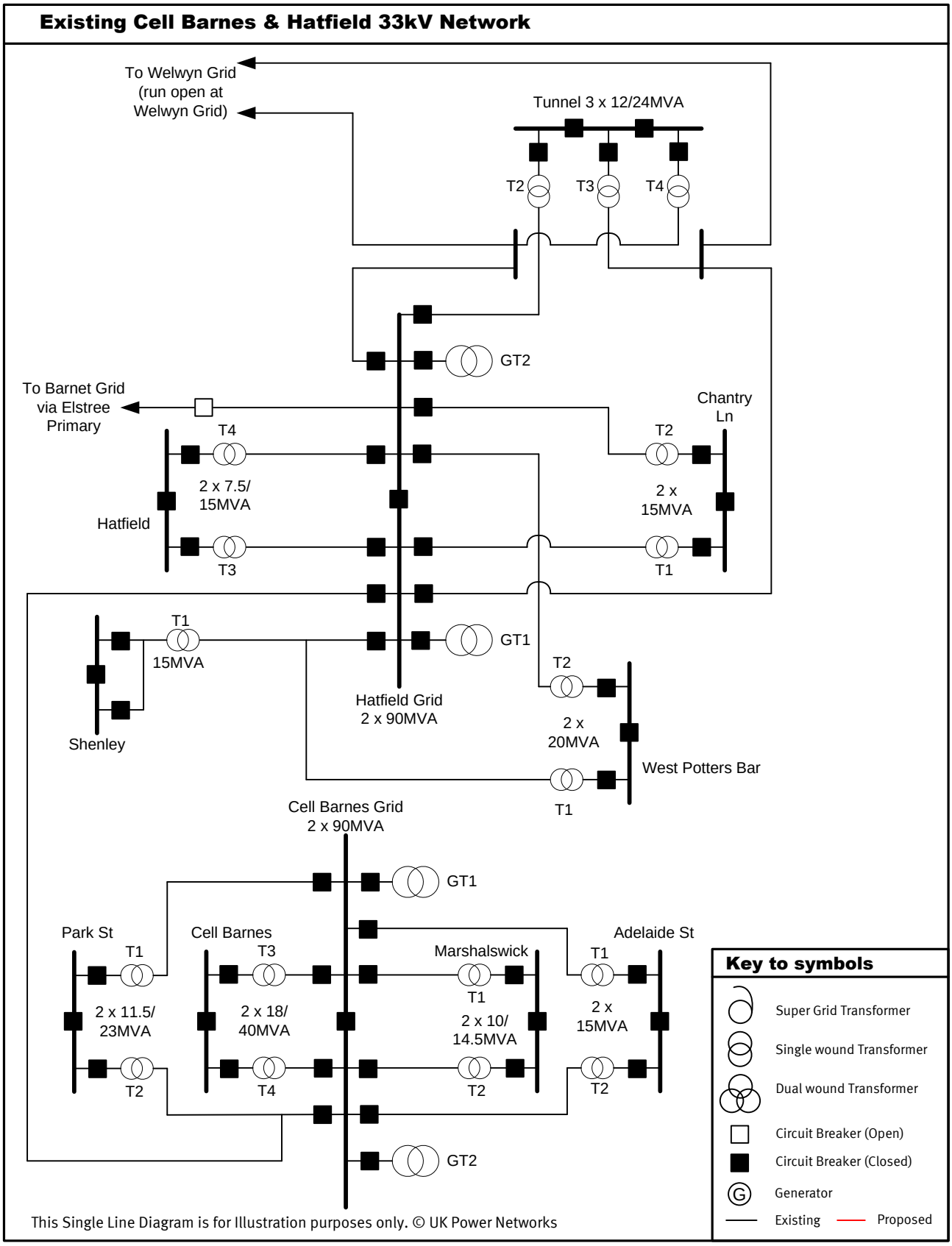


Existing Cell Barnes & Hatfield 33kV Network



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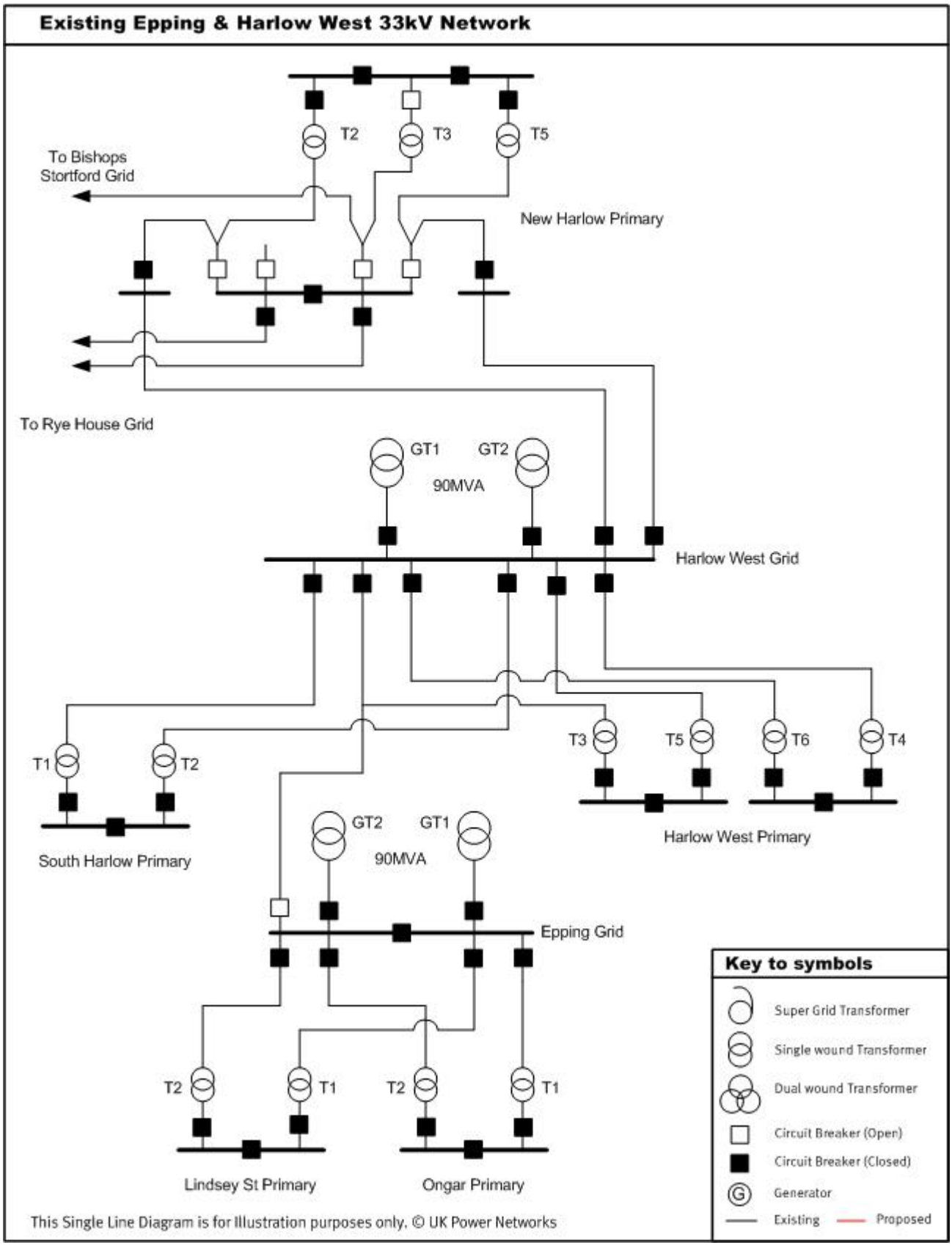
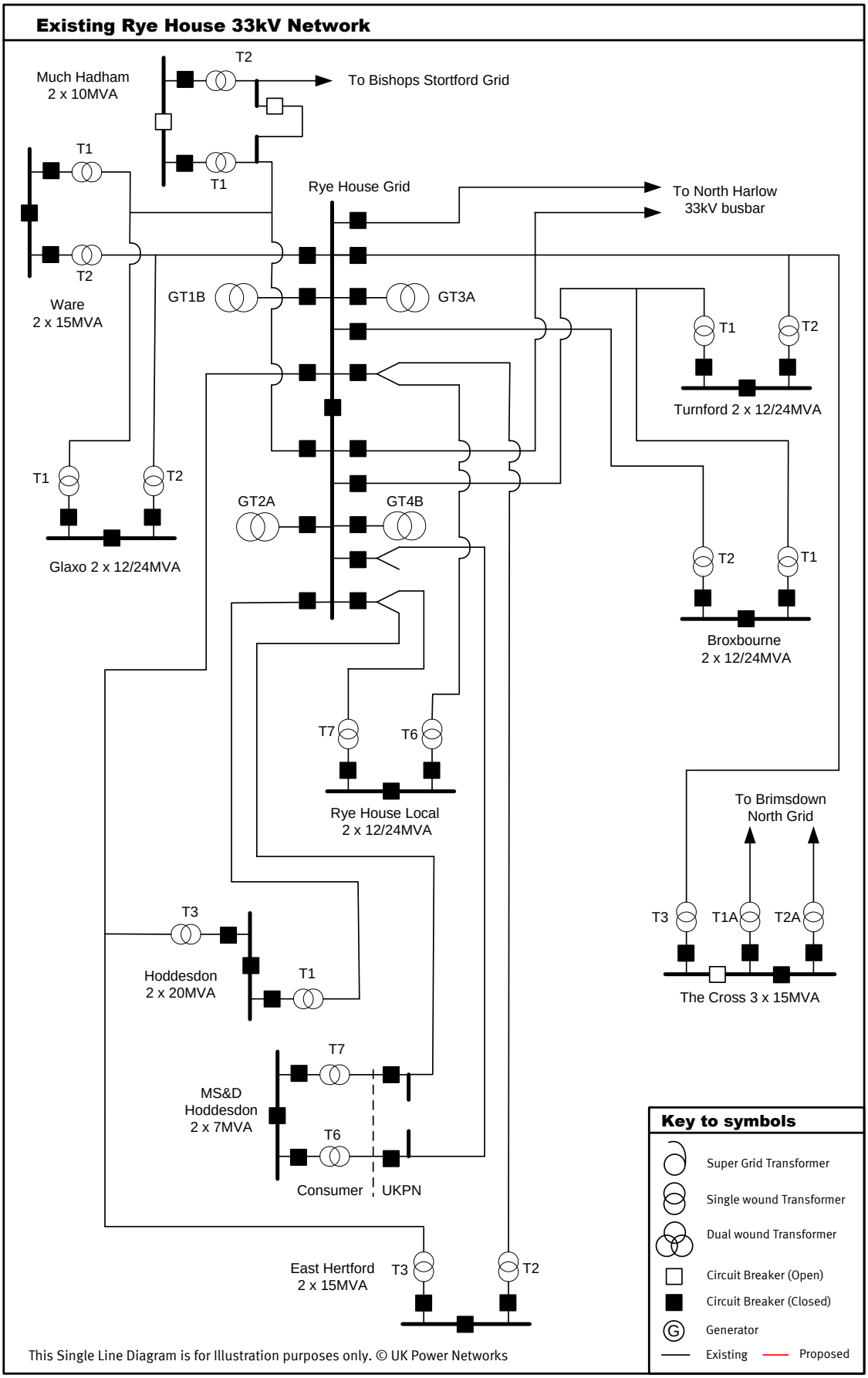
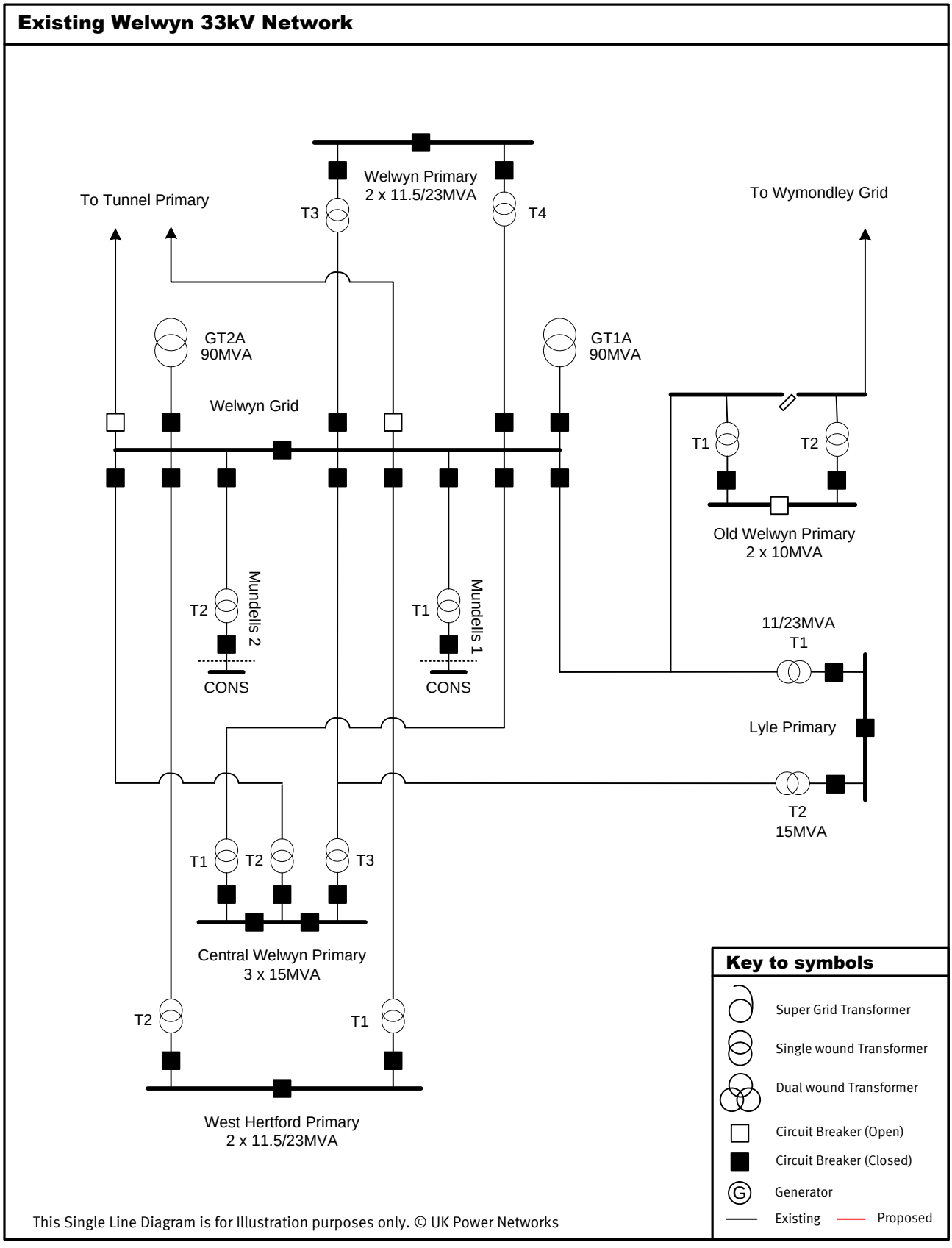


Elstree & Rye House GSP (EPN)



Existing Welwyn 33kV Network



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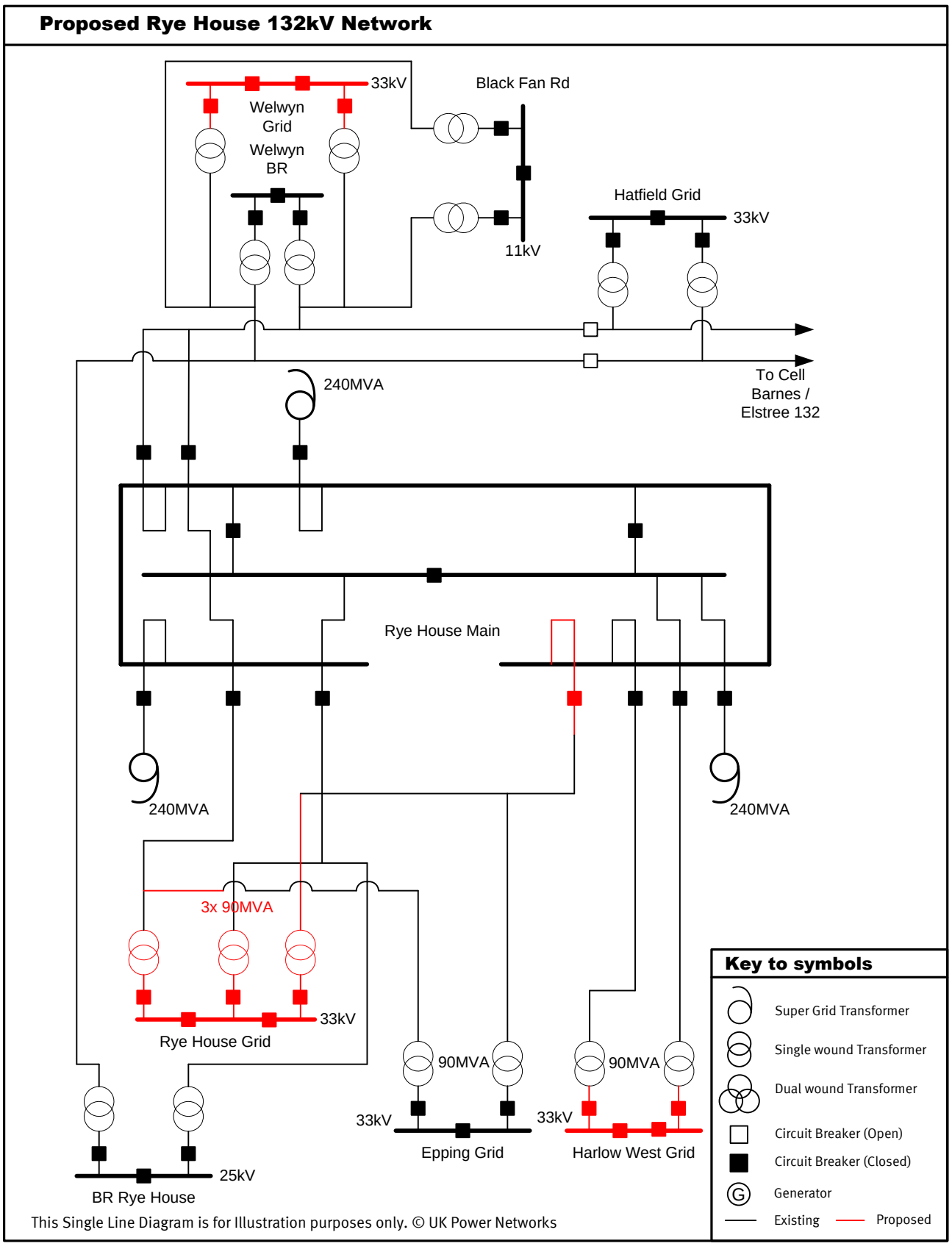
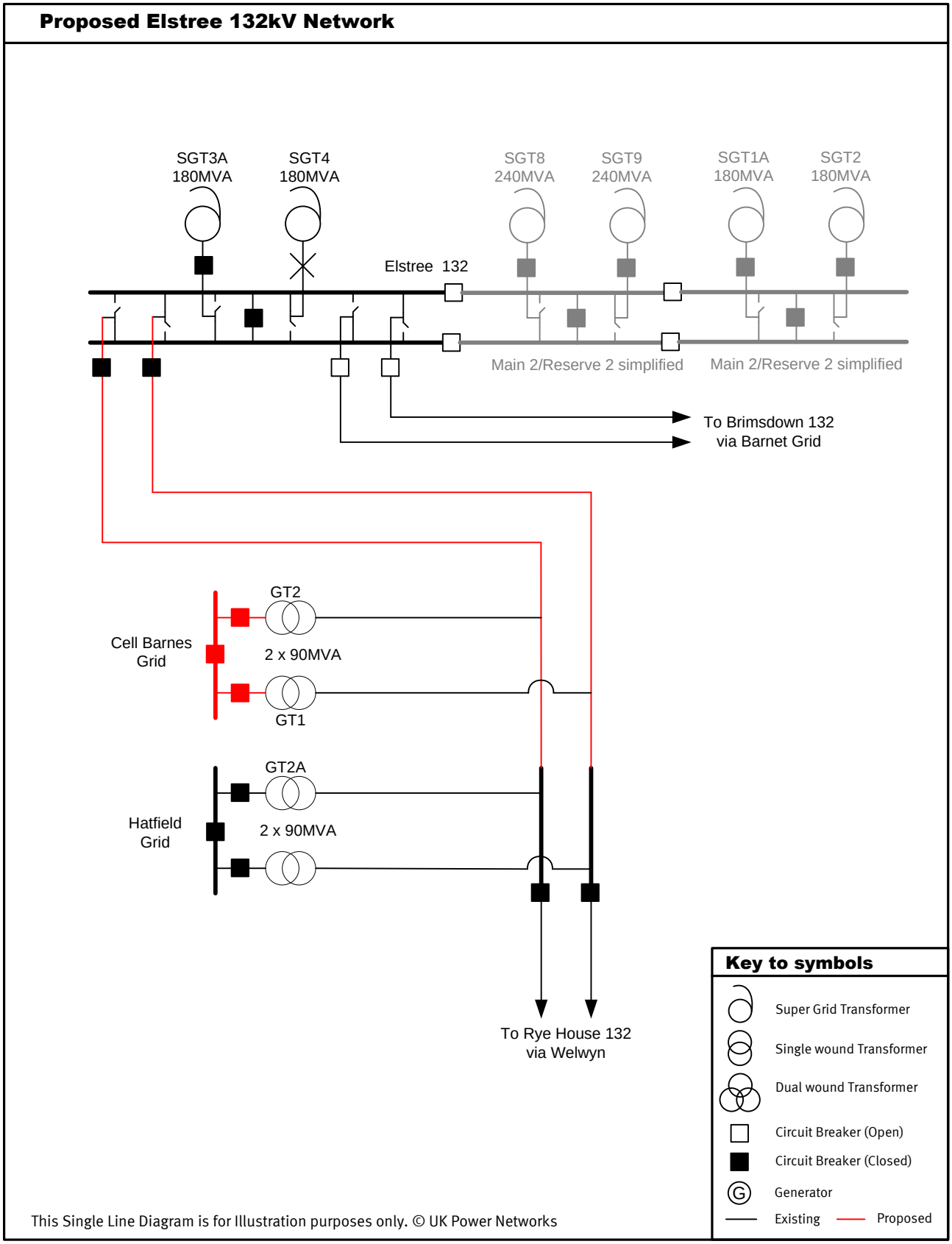
APPENDIX C: SINGLE LINE DIAGRAM – RECOMMENDED STRATEGY



Proposed Elstree 132kV Network



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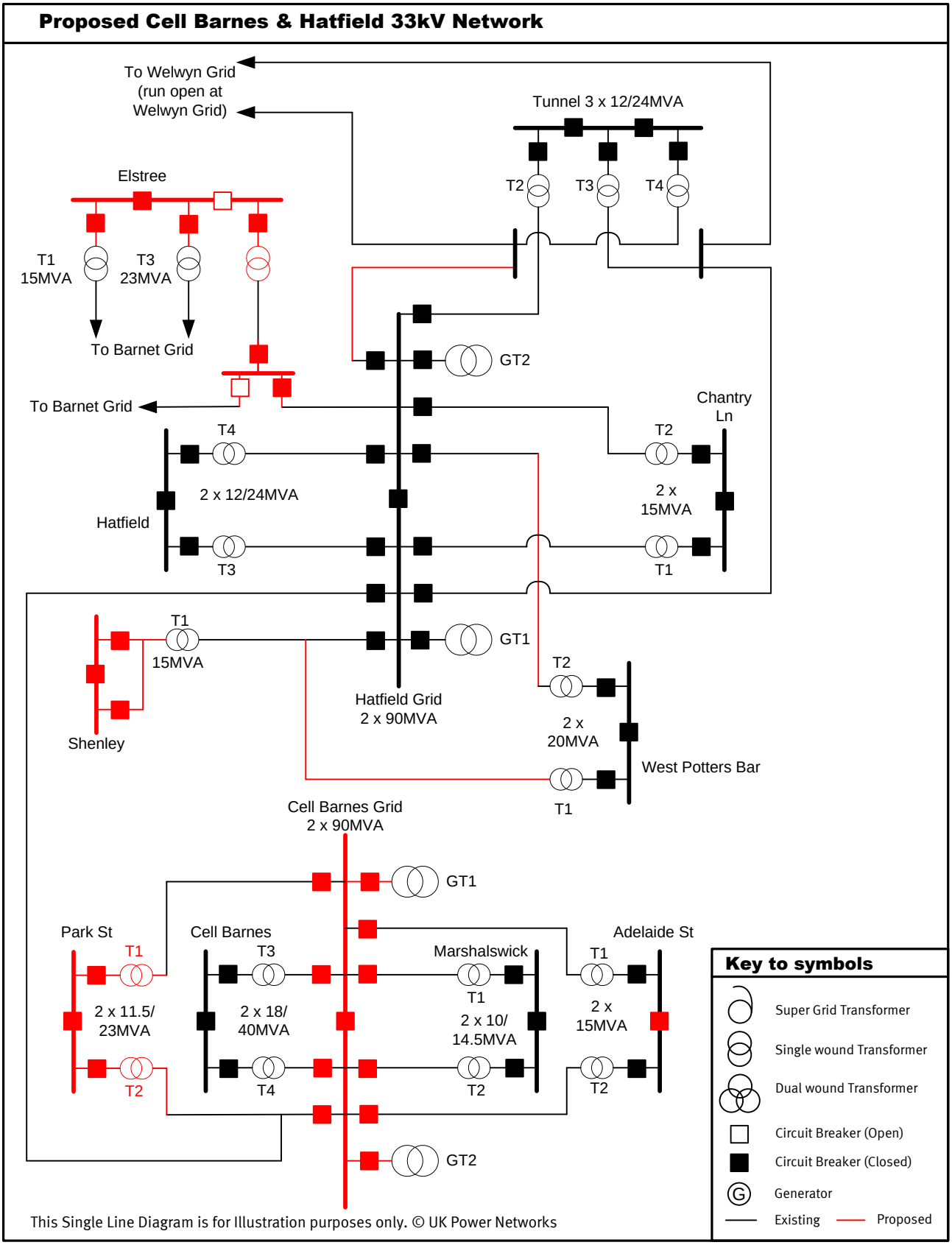
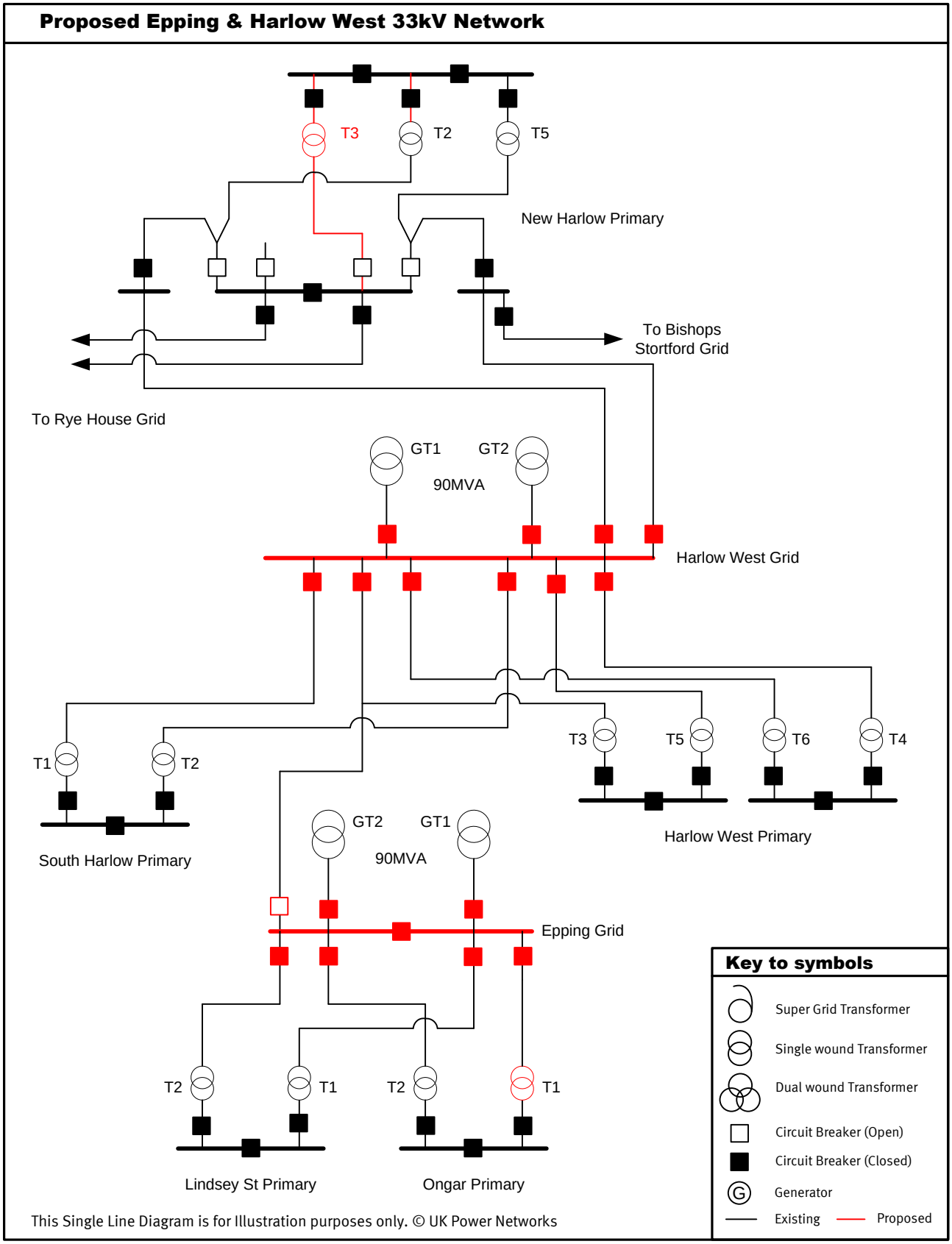
Proposed Cell Barnes & Hatfield 33kV Network



Proposed Epping & Harlow West 33kV Network



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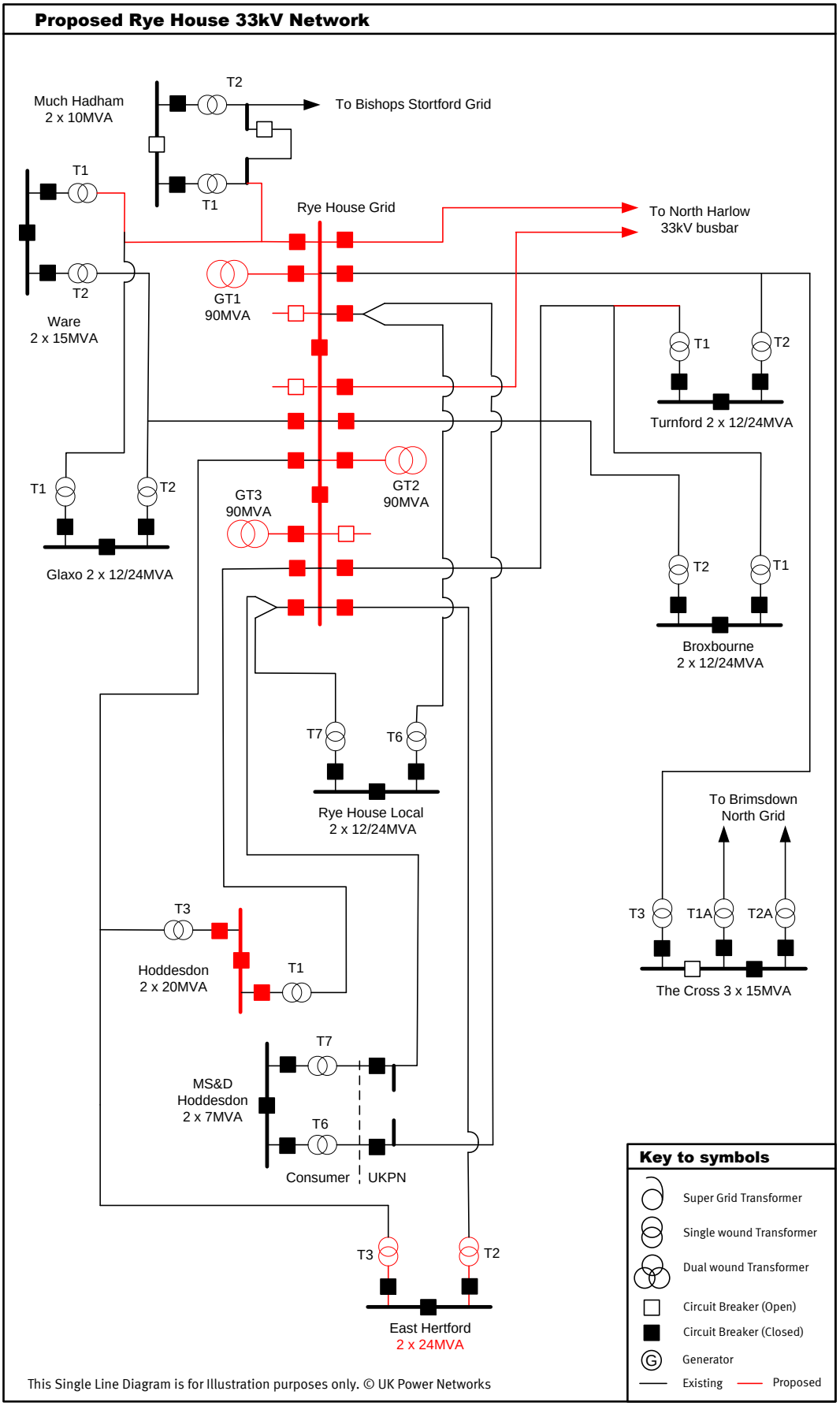
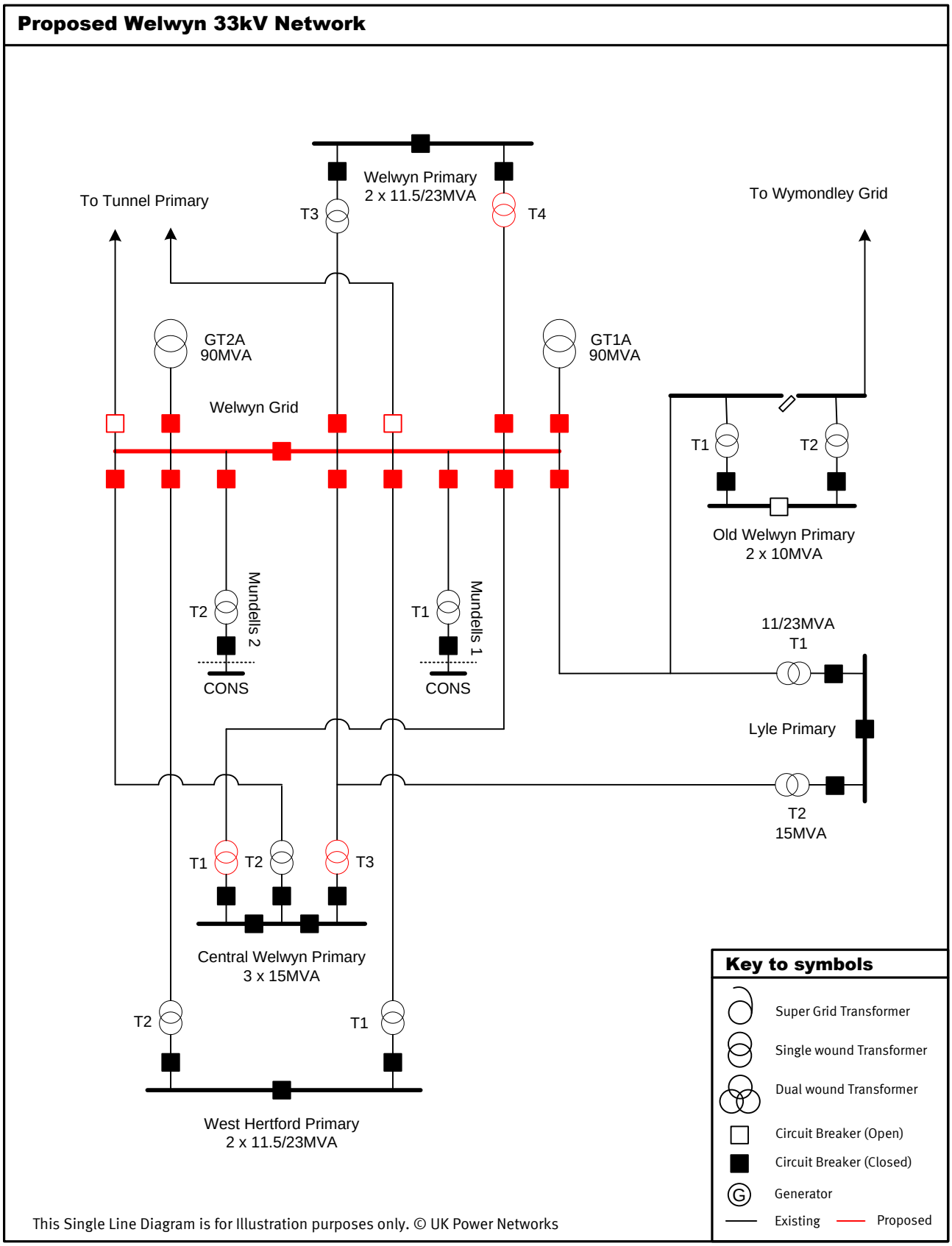


Proposed Welwyn 33kV Network



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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	1.02.03	7549	PLB - Hatfield - Elstree - Conductor Replacement							135,448	1,224,479		
A	1.09.01	7572	3J04J/I Hatfield Grid/Welwyn Tunnel No.4 - 33kV Wood Pole OHL Replacement									52,963	123,523
A	1.09.01	7574	3J04G - Hatfield Grid/West Potters Bar - 33kV Wood Pole OHL Replacement								236,651	630,792	
A	1.09.01	7582	Rye House Grid/North Harlow 33kV OHL Circuit - 33kV Wood Pole OHL Replacement						245,083	413,708			
A	1.09.01	7586	3F43C - Rye House Grid (Ware) / Much Hadham - 33kV Wood Pole OHL Replacement					196,066	462,725				
A	1.48.01	2296	Elstree GSP 132kV Exit Point - Replace 132kV Switchgear (NG*)	2,325,569	1,633,102	377,709							
A	1.48.11	2348	Welwyn 132/33kV Grid Substation - Replace 33kV Switchgear (2000A)		80,335	1,253,225	273,718						
A	1.48.11	7615	Harlow West 132/33kV Grid Substation - Replace 33kV Switchgear				324,923	816,269	229,758				
A	1.48.11	7616	Epping 132/33kV Grid Substation - Replace 33kV Switchgear						316,322	736,498	222,378		
A	1.48.11	7625	Cell Barnes 132/33kV Grid Substation - Replace 33kV Switchgear					324,626	823,079	226,145			
A	1.50.01	2285	Shenley 33/11kV Primary Substation - Replace 11kV Switchgear				244,832	617,425					
A	1.50.01	2344	Hoddesdon 33/11kV Primary Substation - Replace 11kV Switchgear			253,523	672,178						
A	1.50.01	7668	Adelaide St 33/11kV Primary Substation - Retrofit 11kV Switchgear										48,978
A	1.50.01	7702	Park St 33/11kV Primary Substation - Retrofit 11kV Switchgear										97,958
A	1.51.01	7717	Rye House 132/33kV Grid Substation - Replace Grid Transformers (GT1B, GT2A, GT4B, GT3A)								917,645	2,744,506	842,730

Elstree & Rye House GSP (EPN)

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	1.51.03	7746	Central Welwyn 33/11kV Primary Substation - Replace Primary Transformers (T1, T3)							41,576	1,100,827		
A	1.51.11	7733	Ongar 33/11kV Primary Substation - Refurbish Primary Transformers (T1)									25,510	125,407
A	1.51.11	7735	Park St 33/11kV Primary Substation - Refurbish Primary Transformers (T1, T2)								51,020	250,814	
A	1.51.11	7740	Welwyn 33/11kV Primary Substation - Refurbish Primary Transformers (T4)				25,510	125,407					
A	1.55.02	8426	Elstree 132kV GSP - BTH VT Replacement/Mitigation	271,315									
A	1.55.02	8430	Hatfield 132/33kV Grid Substation - BTH 132kV VT Replacement	104,591									
H	1.29.01	8625	Rye House / Turnford No.1 33kV Fluid Filled Cables - 33kV FFC Replacement	1,381,704									
R	1.33.01	5609	East Hertford 33/11kV Primary Substation - ITC (2 x 11/18/24MVA)			10,394	306,413	825,597					
R	1.33.01	5843	New Harlow 33/11kV Primary Substation - ITC (1 x 20/40MVA)	783,588	104,478								
R	1.34.02	5872	South Harlow 33/11kV Primary Substation - 11kV Interconnection to New Harlow	582,529	510,833								
R	1.35.01	2409	Rye House 132/33kV Grid Substation - Improved Transformer Utilisation	864,186	636,151	1,149,965							
R	1.35.02	6340	Rye House 132kV Network Reinforcement - Protection Works at Hatfield Grid	97,842									
R	1.37.09	4069	Rye House/Harlow West 132kV Tower Line (PDE/PCK) - Separate 132kV Circuits (N-2)					713,000	2,775,000	1,908,000			

Elstree & Rye House GSP (EPN)

APPENDIX E: OUTPUT MEASURES – LOAD INDICES

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

				DPCR5 Intervention		RIIO-ED1 without intervention				RIIO-ED1 with Intervention			P2/6 End of ED1	
Substation	**Season**	**First Limitation**	**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**	**Driver**	2022 (S) 22/23 (W)	**P2/6 Class**	**Comply**
Adelaide St	W	Transformer	19.5		19.5	15.9	17.5	LI2	LI2		19.5	LI2	C	Yes
Broxbourne	W	Transformer	21.6		21.6	16.5	17.8	LI1	LI2		21.6	LI2	C	Yes
Cell Barnes 11	W	Switchgear	38.1		40.0	27.5	29.7	LI1	LI1		40.0	LI1	C	Yes
Cell Barnes Grid 33	W	Transformer	108.0		108.0	68.3	74.2	LI1	LI1		108.0	LI1	D	Yes
Central Welwyn	S	Transformer	30.0		30.0	18.2	19.4	LI1	LI1		30.0	LI1	C	Yes
Chantry Lane	W	Transformer	18.0		18.0	10.2	11.2	LI1	LI1		18.0	LI1	B	Yes
East Hertford	W	Transformer	19.5		19.5	18.7	20.2	LI3	LI5	5609	24.0	LI2	C	Yes
Epping Grid 33	W	Switchgear	114.3		114.3	35.4	38.2	LI1	LI1		114.3	LI1	C	Yes
Glaxo	S	Transformer	18.0		18.0	11.0	11.4	LI1	LI1		18.0	LI1	B	Yes
Harlow West	S	Transformer	45.0	5843	45.0	26.3	27.6	LI1	LI1		45.0	LI1	C	Yes
Harlow West Grid 33	S	Transformer	90.0		90.0	69.9	74.5	LI1	LI2		90.0	LI2	D	Yes
Hatfield 11	S	Transformer	11.5		18.0	13.3	14.2	LI1	LI1		18.0	LI1	C	Yes
Hatfield Grid 33	S	Transformer	90.0		90.0	60.4	64.1	LI1	LI1		90.0	LI1	D	Yes
Hoddesdon	W	Transformer	26.0		26.0	14.2	15.6	LI1	LI1		26.0	LI1	C	Yes
Lindsey St	W	Transformer	24.0		24.0	19.5	21.1	LI2	LI2		24.0	LI2	C	Yes
Lyle	S	Transformer	15.0		15.0	10.6	11.4	LI1	LI1		15.0	LI1	B	Yes
Marshalswick	W	Transformer	18.4		18.4	12.3	13.4	LI1	LI1		18.4	LI1	C	Yes
Much Hadham total	W	Transformer	13.0		13.0	10.2	11.2	LI1	LI2		13.0	LI2	B	Yes

Elstree & Rye House GSP (EPN)

				DPCR5 Intervention		RIIO-ED1 without intervention				RIIO-ED1 with Intervention			P2/6 End of ED1	
Substation	**Season**	**First Limitation**	**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**	**Driver**	2022 (S) 22/23 (W)	**P2/6 Class**	**Comply**
New Harlow total	S	Transformer	45.0	5843	45.0	35.0	36.5	LI1	LI2		45.0	LI2	C	Yes
Old Welwyn total	W	Transformer	13.0		13.0	7.0	7.9	LI1	LI1		13.0	LI1	B	Yes
Ongar	W	Circuit Rating	19.3		19.3	15.9	17.1	LI2	LI2		19.3	LI2	C	Yes
Park St	W	Transformer	23.0		23.0	14.4	15.5	LI1	LI1		23.0	LI1	C	Yes
Rye House Grid 33	W	Transformer	175.5		117.0	119.9	127.5	LI5	LI5	2409	175.5	LI1	D	Yes
Shenley	W	Backfeed	15.2		15.2	11.4	12.2	LI1	LI2		15.2	LI2	C	Yes
South Harlow	W	Transformer	28.0		28.0	14.7	17.5	LI1	LI1		28.0	LI1	C	Yes
Tunnel	S	Transformer	36.0		36.0	23.9	25.0	LI1	LI1		36.0	LI1	C	Yes
Turnford	W	Circuit Rating	22.0		22.0	17.7	18.8	LI2	LI2		22.0	LI2	C	Yes
Ware	W	Transformer	18.0		18.0	10.7	11.9	LI1	LI1		18.0	LI1	B	Yes
Welwyn Grid 33	W	Switchgear	114.3		114.3	66.1	71.3	LI1	LI1		114.3	LI1	D	Yes
Welwyn Primary	W	Switchgear	22.9		22.8	14.5	15.9	LI1	LI1		22.8	LI1	C	Yes
West Hertford	W	Transformer	23.0		23.0	13.9	15.0	LI1	LI1		23.0	LI1	C	Yes
West Potters Bar	W	Transformer	24.0		24.0	15.6	16.7	LI1	LI1		24.0	LI1	C	Yes
Rye House Local	S	Transformer	18.0		18.0	9.3	9.6	LI1	LI1		18.0	LI1	B	Yes

Elstree & Rye House GSP (EPN)

APPENDIX F: OUTPUT MEASURES - HEALTH INDICES

	132kV Switchgear														
	ED1 Start (2015)					ED1 End (2023) No Investment					End of ED1 (2023) With Investment				
Substation	HI1	HI2	HI3	HI4	HI5	HI1	HI2	HI3	HI4	HI5	HI1	HI2	HI3	HI4	HI5
HATFIELD GRID		2					1	1				1	1		
RYE HOUSE 132	2		4	2	2		2			8	1	2			8
WELWYN GRID	2					2					2				
TOTAL	**4**	**2**	**4**	**2**	**2**	**2**	**3**	**1**		**8**	**3**	**3**	**1**		**8**

	33kV Switchgear														
	ED1 Start (2015)					ED1 End (2023) No Investment					End of ED1 (2023) With Investment				
Substation	HI1	HI2	HI3	HI4	HI5	HI1	HI2	HI3	HI4	HI5	HI1	HI2	HI3	HI4	HI5
CELL BARNES GRID				10	1					11	11				
EPPING GRID	1			7			1			7	8				
HARLOW WEST GRID	1	5		1	3		4	1	1	4	10				
HATFIELD GRID		14					14					14			
MS&D HODDESDON 33KV INTAKE SUBSTATION	2						2					2			
NORTH HARLOW 33KV	9			1		9				1	9				1
RYE HOUSE 132		2					2					2			
RYE HOUSE GRID		16			1		17				17				
WELWYN GRID	4	2	1	7	1	3	3			9	15				
TOTAL	**17**	**39**	**1**	**26**	**6**	**12**	**43**	**1**	**1**	**32**	**70**	**18**			**1**

Elstree & Rye House GSP (EPN)

	11/6.6kV Switchgear														
	ED1 Start (2015)					ED1 End (2023) No Investment					End of ED1 (2023) With Investment				
Substation	HI1	HI2	HI3	HI4	HI5	HI1	HI2	HI3	HI4	HI5	HI1	HI2	HI3	HI4	HI5
ADELAIDE ST PRIMARY		4	8					9	1	2	1		9		2
BLACK FAN GRID	2					2					2				
BROXBOURNE PRIMARY		8	2				7	3				7	3		
CELL BARNES PRIMARY	14						14					14			
CENTRAL WELWYN PRIMARY	21					7	14				7	14			
CHANTRY LN PRIMARY	8						8					8			
EAST HERTFORD PRIMARY		11					11					11			
GLAXO PRIMARY		14					14					14			
HARLOW WEST GRID		24					14	10				14	10		
HATFIELD PRIMARY		11					11					11			
HODDESDON PRIMARY			7	5	1				1	12	13				
LINDSEY ST PRIMARY	12						12					12			
LYLE PRIMARY		3	7					10					10		
MARSHALSWICK PRIMARY	9					9					9				
MUCH HADHAM PRIMARY		8						8					8		
MUNDELLS 2 PRIMARY	1					1					1				
NEW HARLOW PRIMARY	2	17					19					19			
OLD WELWYN PRIMARY		3	4					7					7		
ONGAR PRIMARY		12					12					12			
PARK ST PRIMARY		3	5				3	3	2		8				
RYE HOUSE LOCAL PRIMARY	9					9					9				
SHENLEY PRIMARY			8	2						10	10				
SHERRARDS EX PRIMARY		2	3					5					5		
SOUTH HARLOW PRIMARY	14					14					14				
TUNNEL PRIMARY	20						20					20			
TURNFORD PRIMARY		5	4				5	3	1			5	3	1	
WARE PRIMARY		9					9					9			
WELWYN PRIMARY		6	5					6	5				6	5	
WEST HERTFORD PRIMARY		3	7					8	2				8	2	
WEST POTTERS BAR PRIMARY	10					10					10				
TOTAL	**123**	**143**	**60**	**7**	**1**	**53**	**173**	**72**	**12**	**24**	**85**	**170**	**69**	**8**	**2**

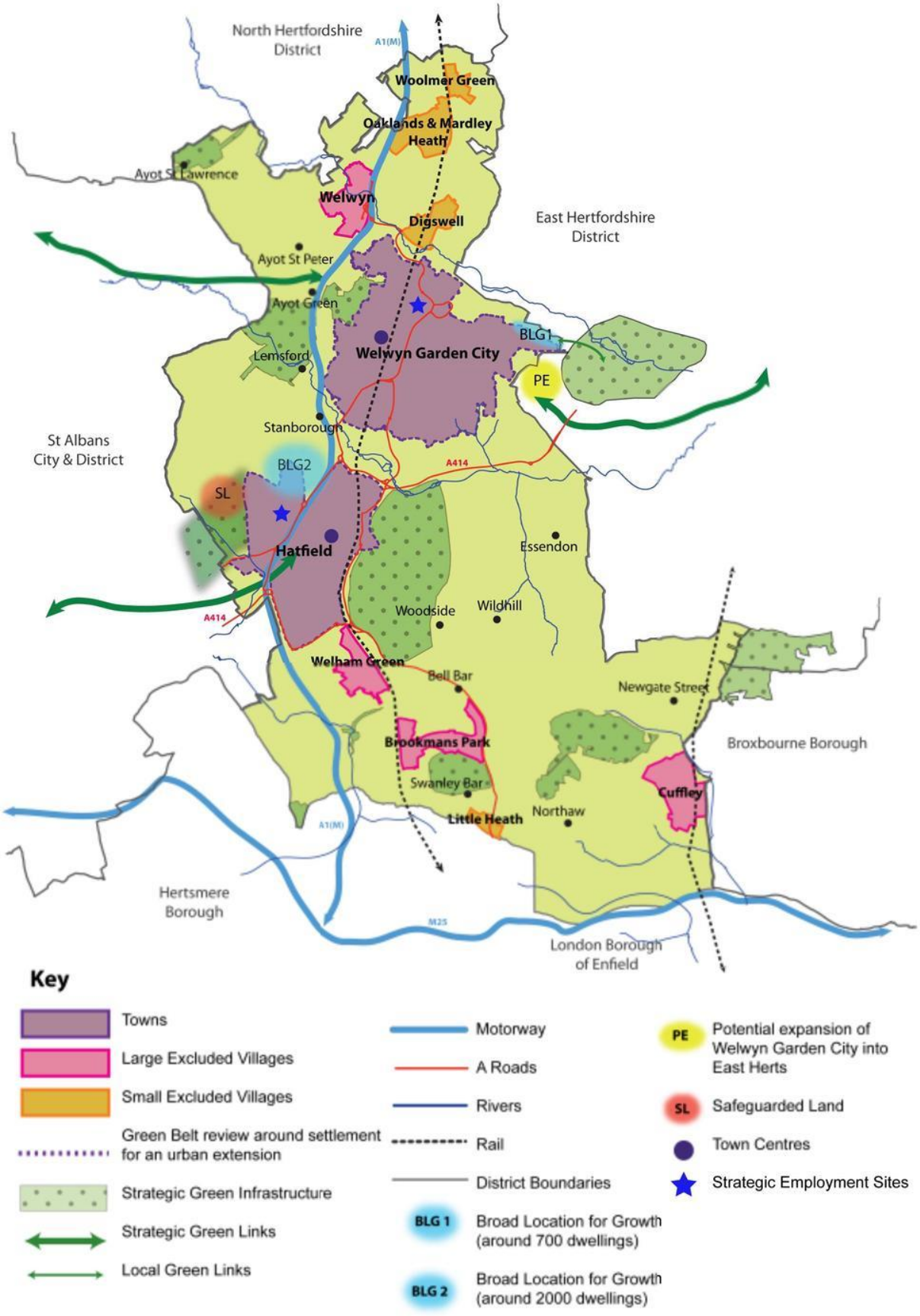
Elstree & Rye House GSP (EPN)

	Grid and Primary Transformers														
	ED1 Start (2015)					End of ED1 (2023) No Investment					End of ED1 (2023) With Investment				
Substation	HI1	HI2	HI3	HI4	HI5	HI1	HI2	HI3	HI4	HI5	HI1	HI2	HI3	HI4	HI5
ADELAIDE ST PRIMARY		2						2					2		
BLACK FAN GRID	2					2					2				
BROXBOURNE PRIMARY		1	1				1		1			1		1	
CELL BARNES GRID		2						2					2		
CELL BARNES PRIMARY		2					1	1				1	1		
CENTRAL WELWYN PRIMARY		1			2			1		2	2		1		
CHANTRY LN PRIMARY		2						2					2		
EAST HERTFORD PRIMARY		2					2				2				
EPPING GRID		2						2					2		
GLAXO PRIMARY		1	1					1	1				1	1	
HARLOW WEST GRID		6					3	3				3	3		
HATFIELD GRID		2						2					2		
HATFIELD PRIMARY	2					2					2				
HODDESDON PRIMARY		2					1	1				1	1		
LINDSEY ST PRIMARY		1	1				1		1			1		1	
MARSHALSWICK PRIMARY		1	1					2					2		
MUCH HADHAM PRIMARY		2					2					2			
MUNDELLS 1 PRIMARY	1						1					1			
MUNDELLS 2 PRIMARY	1						1					1			
NEW HARLOW PRIMARY	2	1					3					3			
OLD WELWYN PRIMARY		1		2			1			2		1			2
ONGAR PRIMARY		2					2				1	1			
PARK ST PRIMARY		1	1					1	1		2				
RYE HOUSE 132	1	1	4				2		4		3	2			
RYE HOUSE LOCAL PRIMARY	1	1					2					2			
SHENLEY PRIMARY			1					1					1		
SOUTH HARLOW PRIMARY		2					1	1				1	1		
TUNNEL PRIMARY		3					3					3			
TURNFORD PRIMARY		2					2					2			
WARE PRIMARY		2					2					2			
WELWYN GRID		4					3	1				3	1		
WELWYN PRIMARY		1			1			1		1	1		1		
WEST HERTFORD PRIMARY	1	1				1		1			1		1		
WEST POTTERS BAR PRIMARY		2					2					2			
TOTAL	**11**	**55**	**10**	**2**	**3**	**5**	**38**	**25**	**8**	**5**	**16**	**35**	**24**	**3**	**2**

Elstree & Rye House GSP (EPN)

APPENDIX G: WELWYN AND HATFIELD DEVELOPMENT AREAS

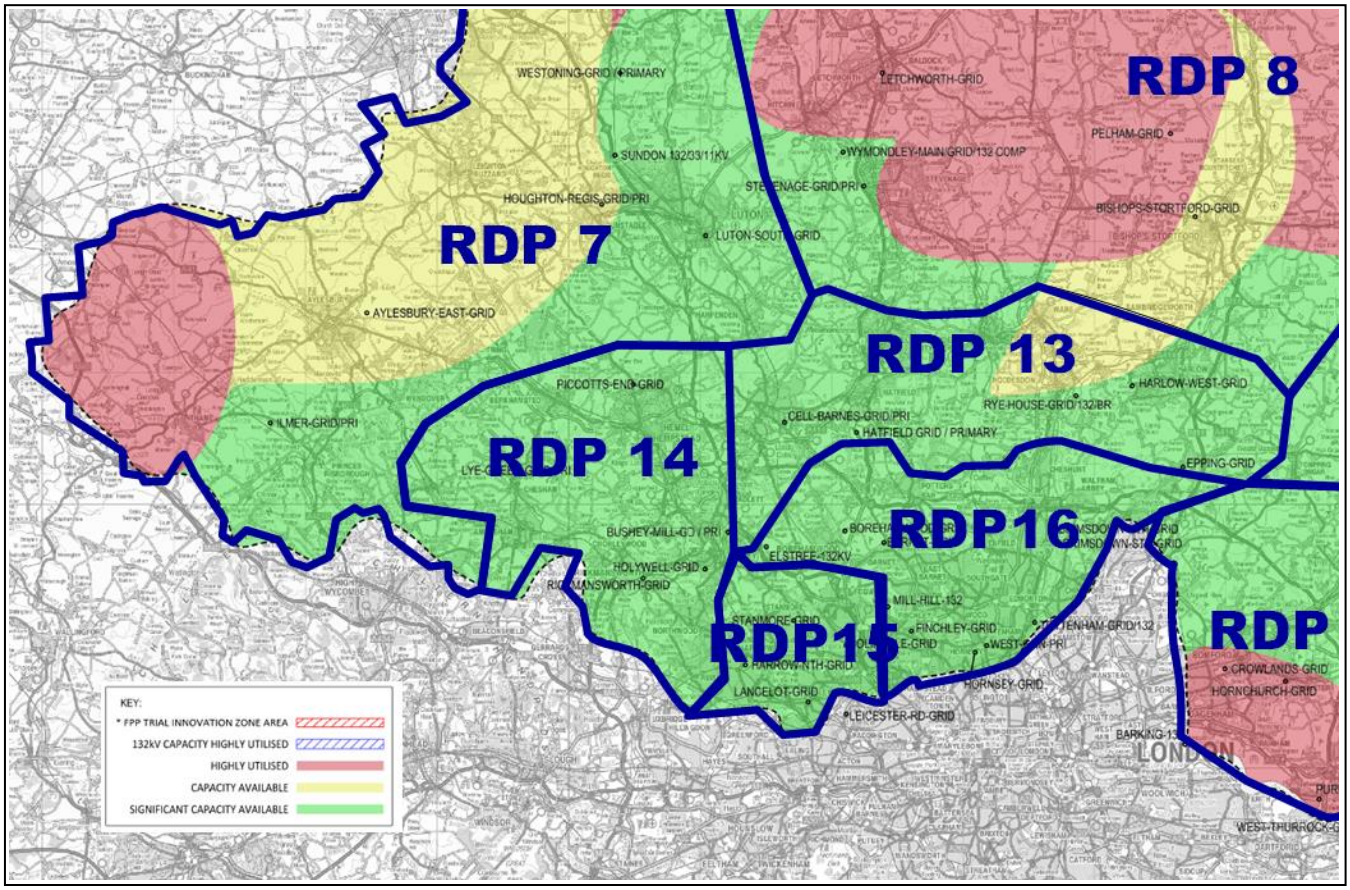
Welwyn Hatfield Council – Emerging Core Strategy (Nov 2012)



Elstree & Rye House GSP (EPN)

APPENDIX H: GENERATION HEAT MAP

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