



Regional Development Plan

RDP07 Amersham and Sundon GSP

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

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Executive Summary

This Regional Development Plan (RDP) reviews sections of UK Power Networks (UKPN) EPN HV and EHV network supplied from Amersham and Sundon Grid Supply Points (GSP). The National Grid 132kV bars at Amersham are shared between UKPN and SSE, with just two circuits to Ilmer Grid belonging to UKPN. While the load growth on the existing Ilmer group of Primary Substations is low, Ilmer Grid will be used to support the growth of Aylesbury town which is approximately 8km north east of Ilmer.

There are no significant generation projects associated with this network. A large part of the network serves Areas of Outstanding Natural Beauty which will limit the opportunity for wind and solar farms.

Sundon Grid is located with National Grid's Sundon 400kV Supergrid. This is a major NG site at the intersection of the North/South Corby – Elstree circuits and the East/West Wymondley- East Claydon circuits. The exit point has four 240 MVA, 400/132kV transformers

The 132kV Grid site forms a Distribution hub site supplying Grid Substations at Sundon, Luton (2), Aylesbury, Houghton Regis, and Bedford. The associated 33kV networks extend to cover all of Bedfordshire, north Buckinghamshire and North Hertfordshire. The Bedford 132kV circuits interconnect with Supergrids at Eaton Socon and Burwell. Within the distribution area of Sundon Grid the principal growth areas are Bedford, Luton, Houghton Regis, Leighton Buzzard and Aylesbury.

With the recent replacement of the 132kV switchboard, the re-building and reinforcement of the PNA 132kV circuits to Bedford, and the planned reinforcement of Eaton Socon Supergrid, the growth levels anticipated from the new development areas can be met by the existing 132kV network capacity. The expansion of Aylesbury in Buckinghamshire is being addressed by using Ilmer Grid to provide additional capacity to support the load growth.

The widening of the M1 between Junctions 10 and 13 and the proposed construction of a new Junction 11a has a major impact on the 132kV tower lines from Sundon to Luton South and Houghton Regis. A project to divert and underground these circuits is planned for 2014.

Work to build a new roundabout at the end of the M1 Junction 10 spur will impact three OHL 33kV circuits from Luton South Grid.

1.1 Summary of issues addressed

Amersham

The area supplied by Ilmer Grid is at the western extremity of the UKPN network. It is predominantly rural with little or no housing or commercial/industrial growth identified in local authority development framework plans. There is one major 33kV customer, BOC, at Thame.

The development of this network is primarily focused on providing support for the expansion of Aylesbury town which is the largest planned development area in Buckinghamshire.

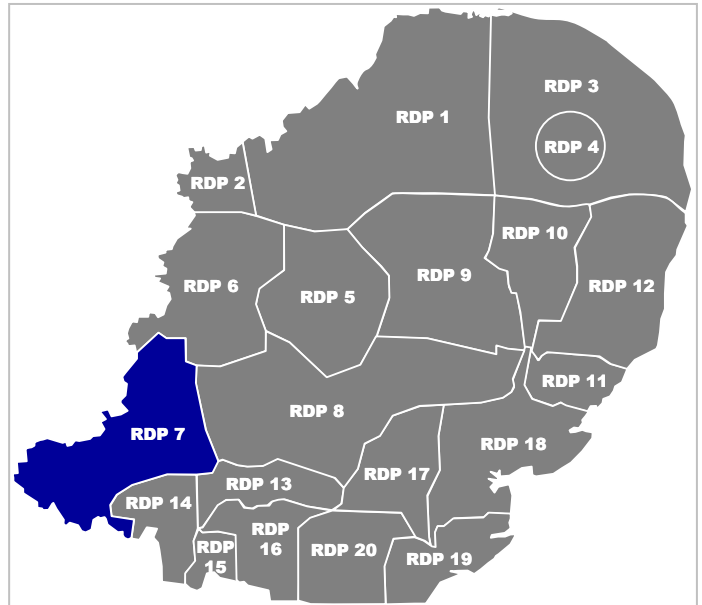


Figure 1 – Area covered by the RDP

Amersham and Sundon GSP

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Aylesbury town and its surrounding area is supplied by Aylesbury East Grid with its 132kV connection at Sundon Grid via 30 km of tower line. The load on the grid and 132kV circuits has run near firm capacity since the mid 90's and therefore local authority ambitions to expand Aylesbury by approximately 50% posed major challenges to the network.

As Ilmer Grid is to be used to support load growth in Aylesbury the recommended strategy is to provide incremental steps in capacity to meet that growth. This builds on previous investment to refurbish and increase conductor size on the 132kV tower line from Amersham to Ilmer Grid. With a new 33kV switch house, Bishopstone, now established on the south west perimeter of Aylesbury, new connections driven growth will require reinforcement of Ilmer Grid and additional 33kV interconnection between Ilmer Grid and Bishopstone. Bishopstone will then provide the point of connection for further network development in Aylesbury. This strategy has evolved following extensive discussions with developers, Aylesbury Vale District Council and Aylesbury Advantage since 2000.

Sundon

With major reinforcement and Asset Replacement having recently taken place the Sundon network is well placed to meet identified load growth during the review period

With extensive asset replacement and reinforcement having recently taken place on the Sundon network, the emphasis will be on asset replacement, primarily at Sundon Grid. The proposed asset replacement will also provide capacity for the proposed development areas of Houghton Regis and Luton.

Investment Profile

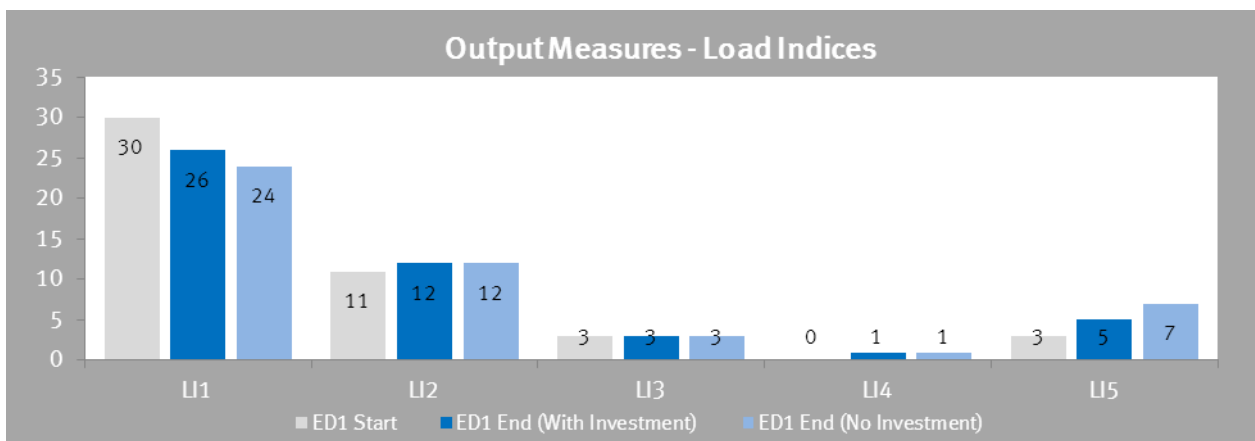
Table 1 provides the projected expenditure profile for reinforcement and asset replacement projects (LRE and NLRE) in this RDP for both DCPR5 and ED1. This information is taken from the 19th February 2014 NAMP version.

IDP	DPCR5 2013-15	2015 /2016	2016 /2017	2017 /2018	2018 /2019	2019 /2020	2020 /2021	2021 /2022	2022 /2023	RIIO-ED1 Total
LRE	£3.2m	£0.4m	£1.1m	£0.9m	£0.3m	£1.3m	£2.4m	£0.5m	£0.0m	£6.9m
NLRE	£8.0m	£5.2m	£3.8m	£4.3m	£8.1m	£4.6m	£2.0m	£1.3m	£3.3m	£32.6m
TOTAL	£11.1m	£5.6m	£5.0m	£5.2m	£8.4m	£5.9m	£4.4m	£1.8m	£3.3m	£39.5m

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.

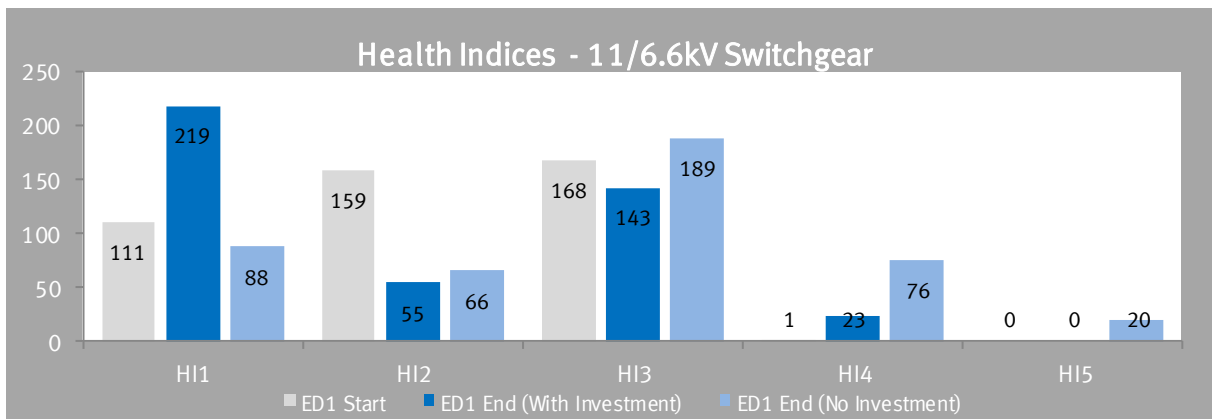
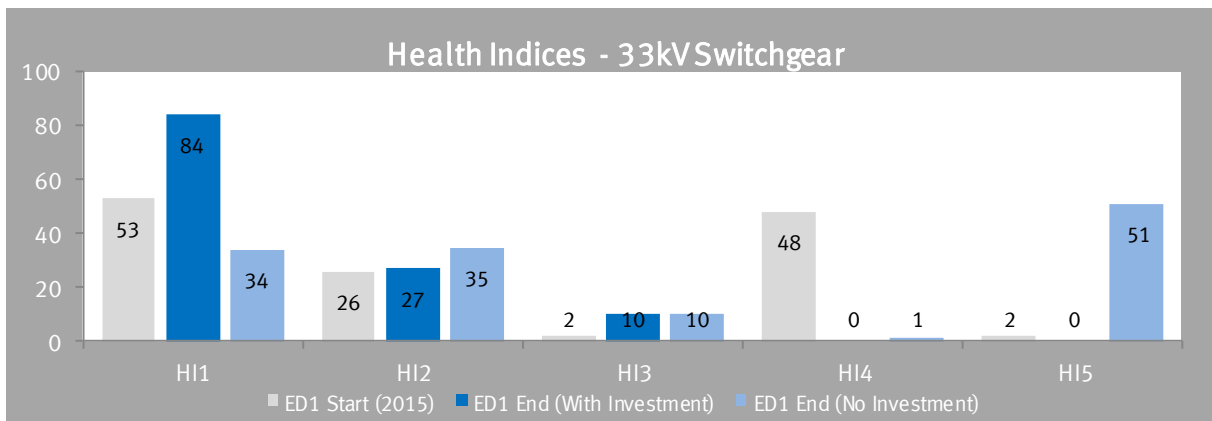
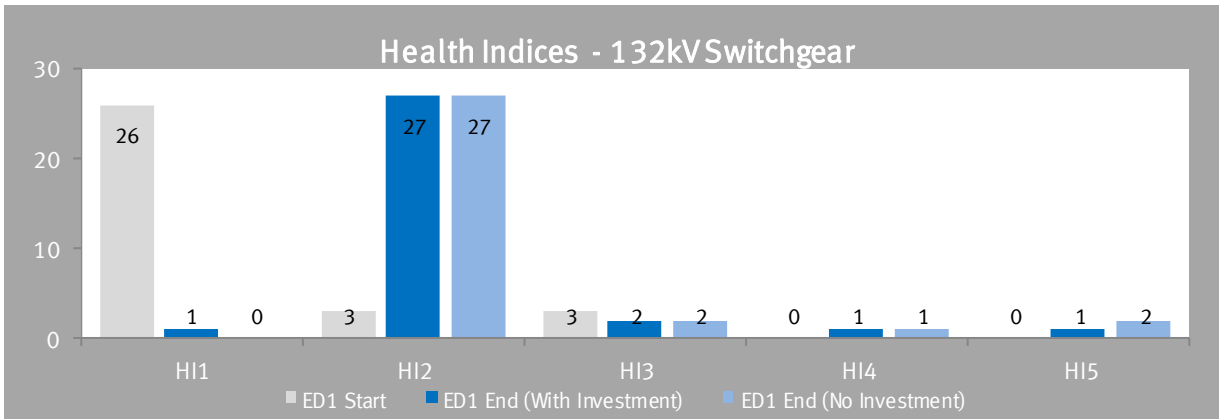


Amersham and Sundon GSP

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Figure 2. Load Indices (LI)

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



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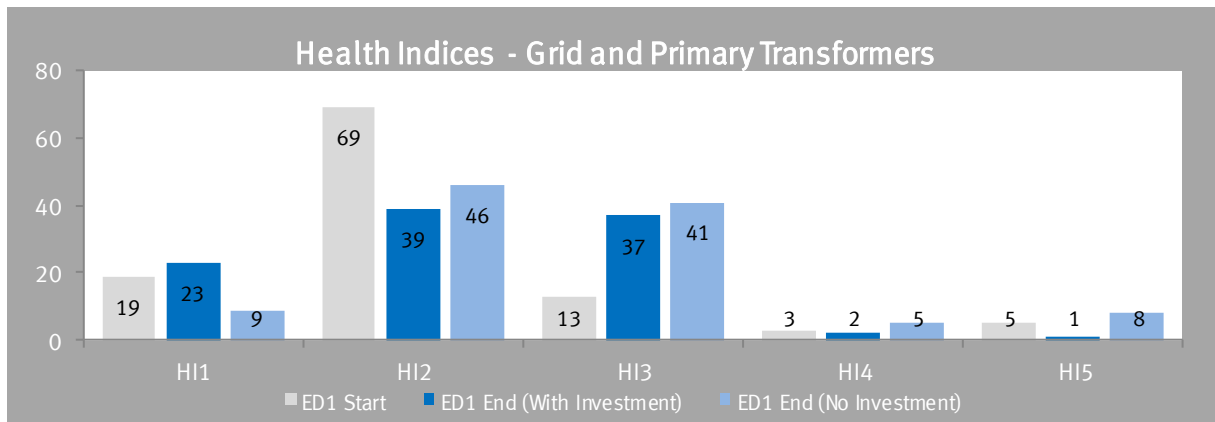


Figure 3. Health Indices by asset category

Scenarios Considered

- Demand growth from Planning Load Estimates (PLEs) up to 2023.
- Major Generation sites disconnected.
- Compliance with P2/6 Standard for Security of Supply and operational flexibility of the 132kV network.

RDP Dependencies and Interactions

Data centres have in the past made applications for capacity up to 100 MVA. Loads of this magnitude would require 132kV solutions from Amersham and consequent reinforcement of Amersham Supergrid by NG. As these are speculative enquiries which have been dormant for some years, no provision has been made to cater for this in the Recommended Strategy.

2 Network configuration

2.1 Existing Network

The two NGC exit points in this region are Amersham and Sundon. From Amersham there are only two 132kV circuits supplying UKPN network. These two overhead circuits supply Ilmer Grid which distributes power via 6 primary substations in a predominantly rural area of Buckinghamshire. Sundon Supergrid provides the major exit point in this region supplying Bedfordshire, Buckinghamshire and north Hertfordshire. 132,000-Volt distribution at Sundon provides connections to 7 Grid substations across the area which supports 29 primary substations. The two networks are interconnected at 33kV between Ilmer Grid and Aylesbury East Grid.

2.2 Network changes in progress

Amersham

The first stage of implementing the recommended network strategy is the establishment of a 33kV bar on the 33kV interconnectors between Ilmer Grid and Aylesbury East Grid. The location of this busbar at Bishopstone on the southwest edge of Aylesbury provides a point of connection for a new Primary Substation to supply the MDA of Berryfields and allows the permanent transfer of Wendover Primary from Aylesbury East Grid to Ilmer Grid.

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The transfer of load from Aylesbury East is designed to maintain P2/6 compliance of the Grid and facilitate load growth on the east side of Aylesbury.

The 33kV switchroom now being constructed at Bishopstone is fully funded jointly by a consortium of developers for the Berryfields MDA and by Arla Dairies who have a customer Primary Substation under construction at their new processing and distribution plant at Aston Clinton, east of Aylesbury. The 33kV point of connection for Arla Dairies is Aylesbury East Grid.

The Primary Substation to supply the Berryfields MDA will be located at Telford Close in the industrial area on the western edge of Aylesbury. This is a strategically chosen site intended to not only supply Berryfields but also to transfer load at 11kV from Exchange Street Primary in the centre of Aylesbury. This Primary Substation (designated Coldharbour Farm) is fully customer funded. In this case the Berryfields MDA consortium has elected to follow the ICP route and build the network to their minimum requirements. This will limit the medium term scope for 11kV load transfer from Exchange Street and there will be a future requirement to increase the system transformer capacity at this site. The minimum standard 33kV cable size will allow future transformers up to 11/18/24 MVA rating.

3 Summary of Issues

3.1 Development areas

Aylesbury

Aylesbury is the only significant development area in Buckinghamshire which is within the UKPN footprint. Its supply point is Aylesbury East Grid. Aylesbury is located at the western extremity of the network requiring a 132kV connection from Sundon Grid some 30km away. This factor together with the already heavily loaded state of Aylesbury East Grid has presented a challenge in developing a solution to accommodate a load growth of approximately 45% by 2031. The housing target for Aylesbury and its environs is approximately 10,000. The strategy developed for reinforcing the network to supply Aylesbury will provide an additional 50 MVA

Proposed development around Aylesbury East Grid will require the diversion and undergrounding of the incoming 132kV tower line as well as the 33kV tower lines to Exchange St Primary and Tring Primary. 33kV wood pole construction circuits to Buckingham Road Primary and North Drive Primary are also affected.

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Figure 2: Suggested Spatial Strategy for Aylesbury

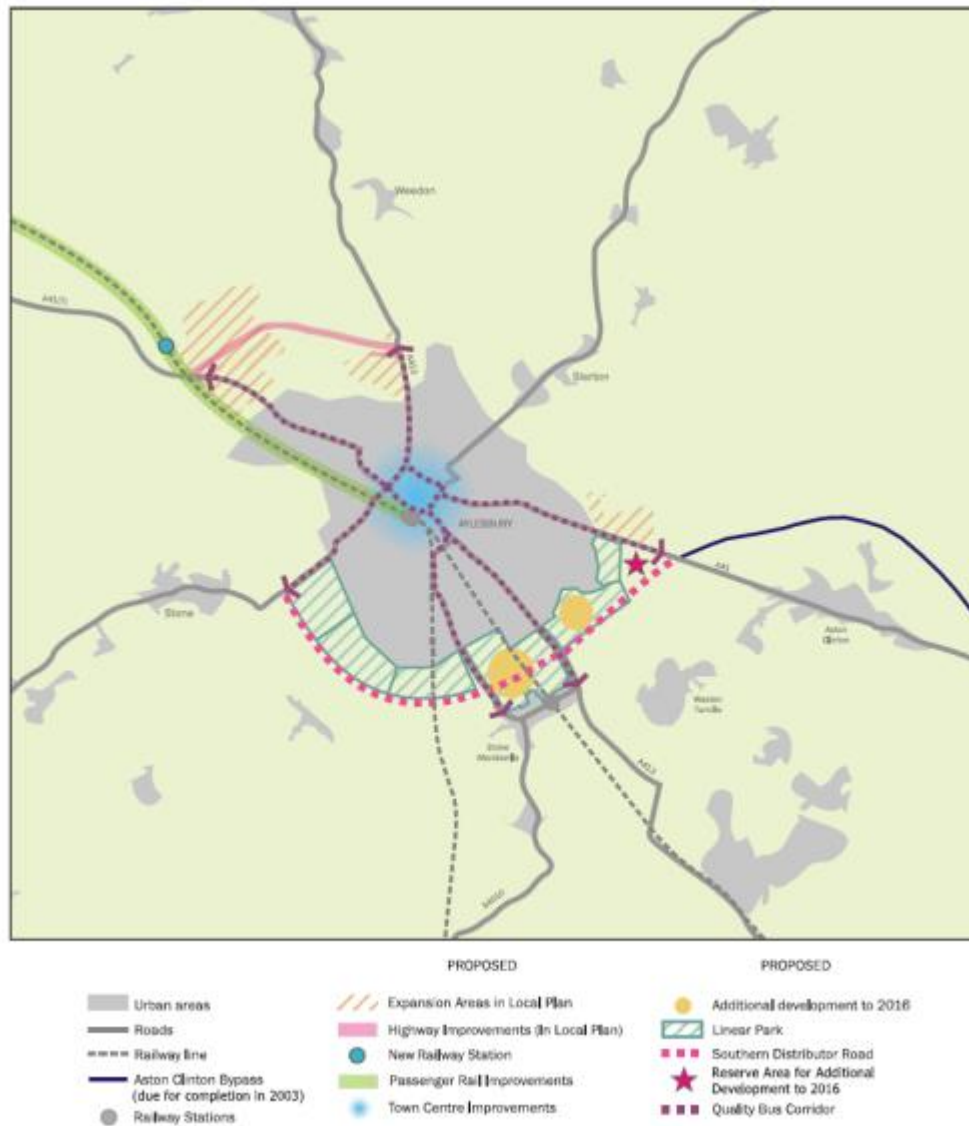


Figure 4. Aylesbury Strategic Development areas

Existing commitments at March 2012	5,150		
Additional homes to 2031	3,250	Total	8,400

Wendover

Existing commitments	180		
Additional	30	Total	210

Haddenham

Existing commitments	155		
Additional	100	Total	255

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Remainder of Aylesbury sub market and villages in southern Vale

Existing commitments	415		
Additional	960	Total	1.375

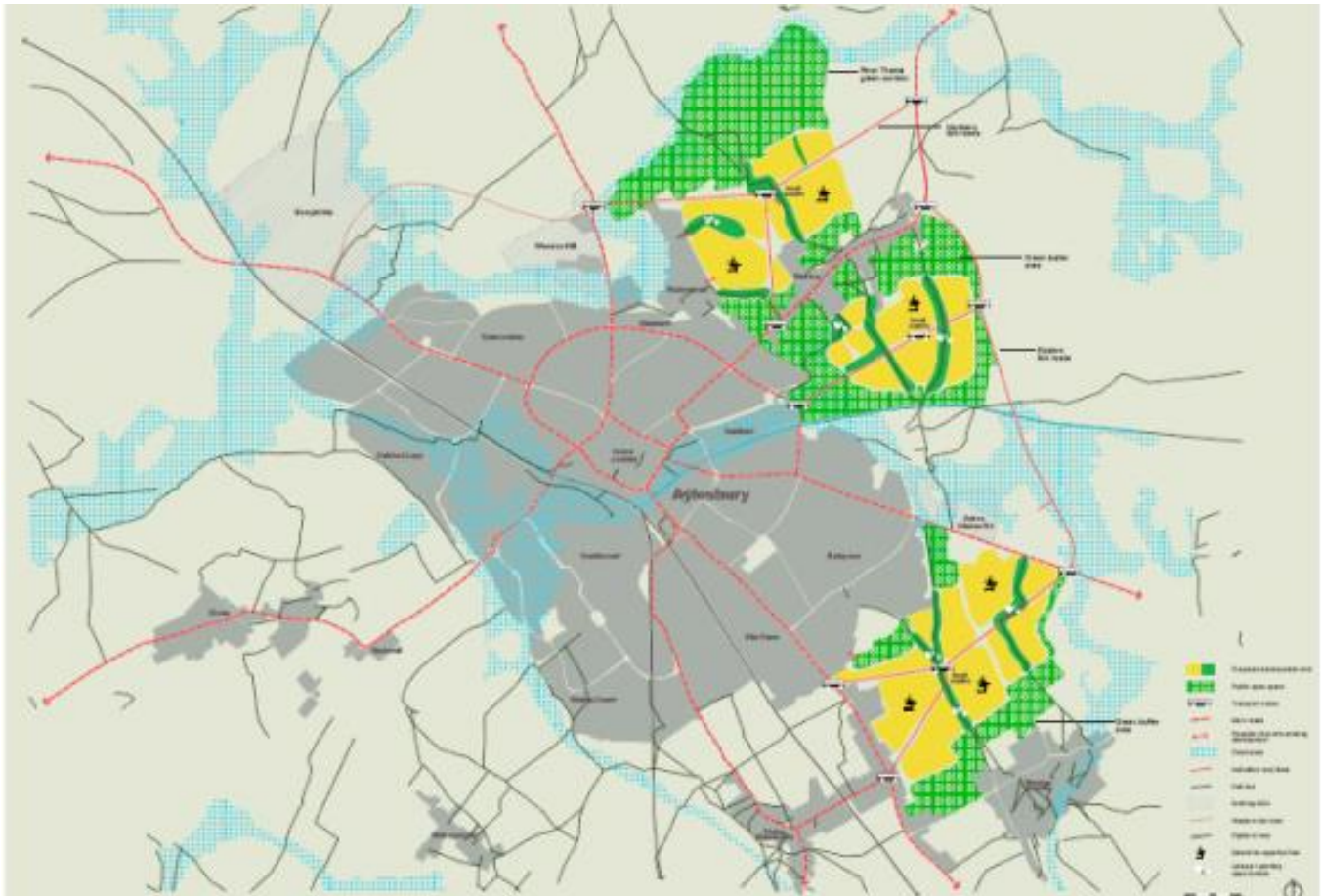


Figure 5. Aylesbury Expansion

Leighton Buzzard

Expansion of Leighton Buzzard forms a significant part of Central Bedfordshire’s development plan for delivering housing. The major part of this expansion is on the eastern side of the town. The anticipated load for this development is approximately 8 MVA which would require reinforcement in either the form of a new Primary Substation or reinforcement of the existing Primary in the centre of Leighton Buzzard. This is a speculative development within the definition of the UKPN publication Statement of Basis and Methodology of Charges for Connection to the Electricity Distribution System.

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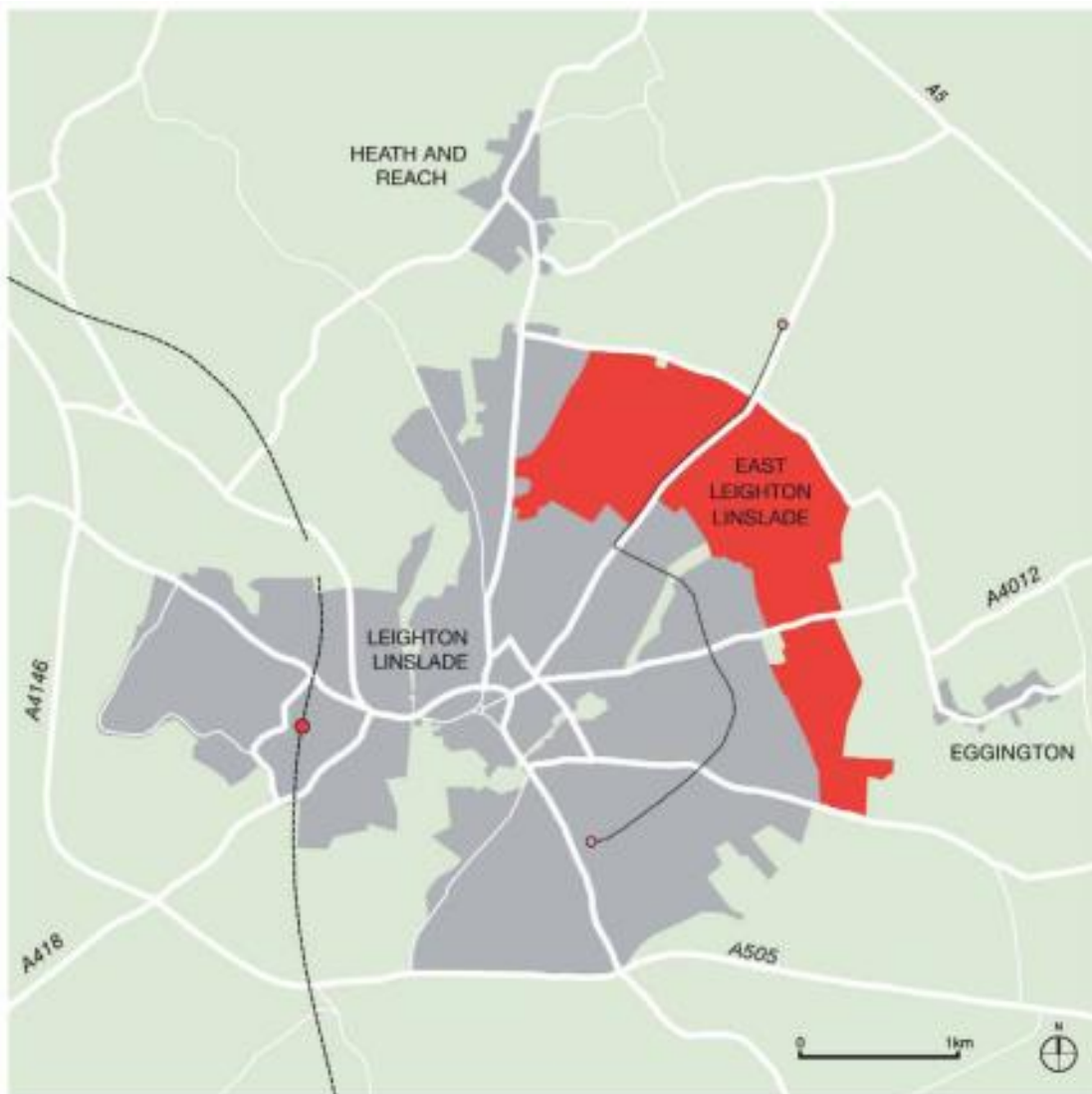


Figure 6. East Leighton Linsdale Development at Leighton Buzzard

Luton Borough Council

The main driver for development within the Luton Borough Council area is employment with a target of approximately 10,000 jobs. The areas identified for this are Napier Park (former Vauxhall Motors site), Century Park, adjacent to Luton Airport, Power Court in the town centre and land at Junction 10a of the M1. There is adequate capacity at 132kV level to accommodate the anticipated load from these developments, likely to be in the region of 30 to 40 MVA.

Amersham and Sundon GSP

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	Housing	Employment
Power Court	600	1,000
Napier Park	600	2,000
Century Park	-	6,000
Bidwells (Jct 10a)	-	540

Houghton Regis/A5-M1 link

The proposed A5-M1 link from the A5 at Houghton Regis to a new junction on the M1 (J11a) will release a large area for development across the north of Houghton Regis and the east side of the M1 between Junction 11 and the new Junction 11a. The aim of this development is to provide 5,150 homes, 1 million sq ft of distribution and 175,000 sq ft of retail and leisure development, together with associated open space, schools and community facilities. The likely power requirement for this development area is approximately 20MVA up to 2031.



Figure 7. Houghton Regis Expansion

Biggleswade

This town remains a principal growth area identified by Central Bedfordshire Council. Up to now the growth level has been accommodated on the network by transferring load to adjacent 11kV networks and by reduced demand in the older industrial areas of Biggleswade. However, the development of land in the ownership of the former Bedfordshire County Council could trigger major network reinforcement from Little Barford Grid or Letchworth Grid

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3.2 Asset Replacement

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

Sundon/Lewsey 33kV Tower Line (PFD) - 33kV Tower Line Refurbishment

The condition assessment of the Sundon/Lewsey 33kV Tower Line (PFD) has shown that the probability of failure due to degradation will become unacceptable. Completion of the project will see 7 km of 33kV Tower Line refurbished.

The 33kV OHL circuit may be subject to diversion to allow for the proposed A5-M1 Link road and potential housing development to the East of Houghton Regis

Aylesbury East/Exchange Street 33kV Tower Line (PDF) - 33kV Tower Line Refurbishment

The condition assessment of the Aylesbury East/Exchange Street 33kV Tower Line (PDF) has shown that the probability of failure due to degradation will become unacceptable. Completion of the project will see 3 km of 33kV Tower Line refurbished. The 33kV OHL forms part of ED1 reinforcement strategy for Exchange Street Primary ITC.

Aylesbury East Grid\Exchange St 33kV Tower Line (PEF 2/4) - 33kV Tower Line Refurbishment

The condition assessment of the Aylesbury East Grid\Exchange St 33kV Tower Line (PEF 2/4) has shown that the probability of failure due to degradation will become unacceptable. Completion of the project will see 6 km of 33kV Tower Line refurbished.

Aylesbury East Grid/Luton South Grid 33kV Tower Line (PDG) - 33kV Tower Line Refurbishment

The condition assessment of the Aylesbury East Grid/Luton South Grid 33kV Tower Line (PDG) has shown that the probability of failure due to degradation will become unacceptable. Completion of the project will see 88 km of 33kV Tower Line refurbished.

Sundon/Luton North 132kV Tower Line (PRB) - 132kV Tower Line Refurbishment

The condition assessment of the Sundon/Luton North 132kV Tower Line (PRB) has shown that the probability of failure due to degradation will become unacceptable. Completion of the project will see 10 km of 132kV Tower Line refurbished.

ARA/RAE 132kV Tower Line (PW) - 132kV Tower Line Refurbishment

The condition assessment of the ARA/RAE 132kV Tower Line (PW) has shown that the probability of failure due to degradation will become unacceptable. Completion of the project will see 15 km of 132kV Tower Line refurbished.

Buckingham Rd local/Waddesdon 33kV OHL circuit - 33kV wood pole OHL replacement

The condition assessment of the Buckingham Rd local/Waddesdon 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.

Sundon 132/33kV Grid Substation - Replace 33kV switchgear

The asset condition of the 33kV switchgear has been assessed as very poor with the report recommending its replacement as soon as is practicable. The costs are based on replacing the hybrid indoor/outdoor double bus bar board with a three section single busbar indoor board. Previously banked circuits have been separated to have their own CB. One ex-Westoning circuit for future interconnection to Westoning Grid has been retained and provision made for an additional Leighton Buzzard circuit for the reinforcement of Leighton Buzzard Primary. The cost of the latter breaker may be ultimately borne by the speculative development of Leighton Linslade.

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Final configuration of the new 33kV board needs to be assessed on the basis of associated Grid transformer replacement, fault rating, P2/6 compliance and future load growth.

Aylesbury East 132/33kV Grid Substation - Replace 33kV Switchgear

The condition assessment of the 1958/61 CPA OE5 outdoor oil insulated switchgear installed at Aylesbury East 132/33kV Grid 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.

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

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

Houghton Regis 132/33kV Grid Substation - Replace 33kV Switchgear

The condition assessment of the 1966 SWS ET indoor oil insulated switchgear installed at Houghton Regis 132/33kV Grid 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.

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

The condition assessment of the 1965 CPA ULC1 indoor oil insulated switchgear installed at Brogborough 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.

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

The condition assessment of the 1966 AEI BVRP1 indoor oil insulated switchgear installed at Caddington 33/11kV Primary Substation has shown that the probability of failure due to degradation will become unacceptable. Completion of the project will see 9 circuit breakers replaced with 9 new circuit breakers.

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

The condition assessment of the 1978 GEC BVAC indoor VAC switchgear installed at Cheddington 33/11kV Primary Substation has shown that the probability of failure due to degradation will become unacceptable. Completion of the project will see 7 circuit breakers replaced with 7 new circuit breakers.

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

The condition assessment of the 1968 AEI BVRP1 indoor oil insulated switchgear installed at Chinnor 33/11kV Primary Substation has shown that the probability of failure due to degradation will become unacceptable. Completion of the project will see 9 circuit breakers replaced with 9 new circuit breakers.

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

The condition assessment of the 1983 GEC VMX indoor resin insulated switchgear installed at Dunstable 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.

Houghton Regis 33/11kV Primary Substation - Replace 11kV Switchgear

The condition assessment of the 1965/66 AEI BVRP1/7 indoor oil insulated switchgear installed at Houghton Regis 33/11kV Primary Substation has shown that the probability of failure due to degradation will become unacceptable. Completion of the project will see 14 circuit breakers replaced with 14 new circuit breakers.

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

The condition assessment of the 1966 AEI BVRP17 indoor oil insulated switchgear installed at Kensworth 33/11kV Primary Substation has shown that the probability of failure due to degradation will become unacceptable. Completion of the project will see 6 circuit breakers replaced with 6 new circuit breakers.

Luton North 132/11kV Grid Substation - Replace 11kV Switchgear

The condition assessment of the 1974 AEI JB43 indoor oil insulated switchgear installed at Luton North 132/11kV Grid Substation has shown that the probability of failure due to degradation will become unacceptable. Completion of the project will see 20 circuit breakers replaced with 20 new circuit breakers.

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

The condition assessment of the 1961 CPA ALA1 indoor oil insulated switchgear installed at Saunderton 33/11kV Primary Substation has shown that the probability of failure due to degradation will become unacceptable. Completion of the project will see 8 circuit breakers replaced with 8 new circuit breakers.

East Harpenden 33/11kV Primary Substation - Replace 11kV Switchgear

The condition assessment of the 1965 AEI JB921 indoor oil insulated switchgear installed at East Harpenden 33/11kV Primary Substation has shown that the probability of failure due to degradation will become unacceptable. Completion of the project will see 6 circuit breakers replaced with 6 new circuit breakers.

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

The condition assessment of the 1958 BTH JB821 indoor oil insulated switchgear installed at Stewartby 33/11kV Primary Substation has shown that the probability of failure due to degradation will become unacceptable. Completion of the project will see 3 circuit breakers retrofitted.

Sundon 33/11kV Grid Substation - Replace 11kV Switchgear

The condition assessment of the 1964 REY LM23T indoor oil insulated switchgear installed at Sundon 33/11kV Grid Substation has shown that the probability of failure due to degradation will become unacceptable. Completion of the project will see 9 circuit breakers replaced with 9 new circuit breakers.

Sundon 132/33kV Grid Substation - Replace Grid Transformers (GT1, GT2, GT3)

The condition assessment of the 1954/60 FUL Grid Transformer installed at Sundon 132/33kV Grid Substation has shown that the probability of failure due to degradation will become unacceptable. Completion of the project will see 3 Grid Transformers replaced with 3 new Grid Transformers.

Edison Road 132/11kV Grid Substation - Replace Grid Transformers (GT2)

The condition assessment of the 1963 BLO Grid Transformer installed at Edison Road 132/11kV 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 1 Grid Transformer replaced with 1 new Grid Transformer.

North Drive 33/11kV Primary S/S - Replace 33/11kV Transformer T4

Load growth on this Primary Substation dictates that T4 will be replaced in the reinforcement project for North Drive in 2013/14

Chaul End 33/11kV Primary Substation - Replace Primary Transformers (T1)

The condition assessment of the 1967 YET Primary Transformer installed at Chaul End 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 1 Primary Transformer replaced with 1 new Primary Transformer. The 33/11kV Primary Transformers form part of ED1 reinforcement strategy.

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

The condition assessment of the 1967 BRU Grid Transformer installed at Ilmer 33/11kV Primary Substation has shown that the probability of failure due to degradation will become unacceptable. Completion of the project will see 2 Primary Transformers replaced with 2 new Primary Transformers.

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

The condition assessment of the 1961 ECC Primary Transformer installed at Kensworth 33/11kV Primary Substation has shown that the probability of failure due to degradation will become unacceptable. Completion of the project will see 2 Primary Transformers replaced with 2 new Primary Transformers.

Wendover 33/11kV Primary Substation - Replace Primary Transformers (T2)

The condition assessment of the 1964 AEI Primary Transformer installed at Wendover 33/11kV Primary Substation has shown that the probability of failure due to degradation will become unacceptable. Completion of the project will see 1 Primary Transformer replaced with 1 new Primary Transformer.

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

The condition assessment of the 1988 HSP Primary Transformer installed at Dunstable 33/11kV Primary Substation has shown that the probability of failure due to degradation will become unacceptable. Completion of the project will see 2 Primary Transformers refurbished.

Stopsley 33/11kV Primary Substation - Refurbish Primary Transformers (T3)

The condition assessment of the 1974 PAR Primary Transformer installed at Stopsley 33/11kV Primary Substation has shown that the probability of failure due to degradation will become unacceptable. Completion of the project will see 1 Primary Transformer refurbished.

3.3 Security of Supply Analysis

Information can be found in the Appendices.

3.4 Operational and technical constraints

Pinch Points: None Known

Diamond Crossings: PVA Line – likely to be eliminated by undergrounding of this circuit from M1 to Houghton Regis Grid

3.5 National Grid

No significant works by National Grid are underway for Sundon.

4 Recommended strategy

4.1 Description

Austin Canons 33/11kV Local Primary Substation - ITC (2 x 18/30/40MVA)

This 33/11kV Substation is one of the potential supplies to the proposed Elstow Village and will therefore require an ITC. Currently Austin Canons is P2/6 compliant. Whilst it is predicted that the load will start to increase with building activity commenced, the ITC will be co-ordinated with the transformer risk calculations. The current risk is as indicated in the transformers at risk table.

Manton Lane 33/11kV Primary Substation - ITC (2 x 18/30/40) & switchboard

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The predicted load at Manton Lane Primary Substation will exceed the existing firm capacity, including the transfer capacity to Edison Road and Austin Cannon Substations. 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 fully rated for the larger units.

Chaul End 33/11kV Primary Substation - ITC (T3: 11/18/23MVA)

The predicted load at Chaul End S/S will exceed the existing firm capacity, including the transfer capacity to Luton St Marys and SKF S/Ss. It is therefore proposed to replace the existing transformers with larger units. The existing switchgear is fully rated for this increased load. The existing circuits supplying the transformers are fully rated for the larger units.

Luton North Grid Local 33/11kV Substation - ITC (new 3rd 18/30/40MVA), 33kV circuit breaker and 11kV switchboard extension

The predicted load at Luton North Substation will exceed the existing firm capacity, including the transfer capacity to Stopsley and Chaul End Substations. It is therefore proposed to augment the existing transformers with a third unit. The existing switchgear is fully rated for this increased load but will require 2 new circuit breakers. The supply for the third transformer will be from the local 33kV bus bar via a new 33kV circuit breaker.

Completion of this project will see the 2 existing transformers augmented by new transformers, the existing 11kV switchboard augmented by two new circuit breakers and a new 33kV circuit breaker.

North Drive 33/11kV Primary Substation - ITC (T1: 12/18/24MVA) & Switchgear

The predicted load at North Drive will exceed the existing firm capacity, including the transfer capacity to Exchange Street and Wendover Primaries. It is therefore proposed to replace the existing transformers with larger units. The existing switchgear is not rated for this increased load. It is therefore proposed to replace this switchgear.

Icknield Way Proposed 33kV Switching Station

The predicted combined load at Pitstone, Cheddington and Caddington Substations will exceed the existing firm capacity, including transfer capacity to Luton South Substations. It is not possible to lower the load level without compromising operational and planning requirements. It is therefore proposed to add a new switching installation called Icknield Way. This proposed Substation will be supplied from the Houghton Regis to tee point circuits.

Completion of this project will see the establishment of a new site with 11 circuit breakers and new 3km underground circuits.

Innovation: Battery Storage at Leighton Buzzard

Leighton Buzzard Primary has been identified in EPN as a suitable site to demonstrate a large-scale network storage device where there is the opportunity to use the storage capacity to mitigate significant reinforcement. In the last few years, there have been a number of deviations above firm capacity of 35MVA at Leighton Buzzard during the winter months, with around 15MWh currently at risk. Reinforcement to accommodate these peaks would currently require a third 11km 33kV circuit from Sundon Grid and the installation of a third 33/11kV transformer – all conservatively estimated at a cost of around £8m.

Installation of storage capacity at this site, on a plot of adjacent land owned by UKPN will:

- a) Provide network support to reduce peak demands, deferring significant reinforcement required to maintain P2/6 compliance and facilitating increased capacity for the connection of low-carbon technologies;
- b) Provide power factor and power quality support, improving the load factor and facilitating further increased capacity for the connection of low-carbon technologies; and
- c) Lead the industry in exploring and testing the commercial and regulatory framework changes necessary to maximise the value from electrical energy storage – progressing the development of storage as a cost-effective alternative to reinforcement for customers.

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

Innovation: Increased Overhead Line Capacity

In 2011 a IFI project was initiated to bring together a quantity of Overhead Line research projects to assess whether or how they could be applied within UKPN. This project investigated the following key areas:

- In the case of 33kV lines, examine whether a combination of using a novel conductor, larger traditional conductor, different design temperature and/or greater sag than previously assumed possible can relieve the constraint for lower cost.
- In the case of 132kV lines, examine whether re-rating the lines with individual day-time, night-time, Spring/Summer/Autumn/Winter ratings and increasing the overhead line capacity by running the conductors at a higher running temperature and resolving ESQC issues where identified.
- In the case of 132kV lines in areas of large wind generation penetration, examine the use of Dynamic Line Ratings to enable deferral.

Two circuits were identified as case studies:

- 33kV OHL between Sundon Grid and Leighton Buzzard Primary (RDP 07)
- 132kV OHL between Pelham and Wymondley GSP (RDP 08)

During the course of this investigation the profile of both overhead line circuits were confirmed with a LiDAR (Light Detection And Ranging) survey and assessed in PLS-CADD (Power Line Systems – Computer Aided Design and Drafting). This identified some existing ESQCR infringements when running the conductors higher than the design temperature.

4.2 Financial Appraisal and Benefits

Information regarding Load Indices and Health Indices as part of the output measures is available in the Appendices.

The financial expenditure is shown in the Appendices.

5 Scenarios considered

No alternative scenarios have been identified.

6 References

References	Description
Reference 1	Planning Load Estimates EPN Area 2011 - 2023
Reference 2	132kV Network HV Schematic Operating Diagrams East of England (2012)
Reference 3	33kV Network HV Schematic Operating Diagrams East of England (2012)
Reference 4	Council Masterplans, etc...

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

6.1 Appendices

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

6.2 Document History

Version	Date of Issue	Author	Details
0.4	01/02/2013	Jim Whiteley	Initial draft
1.0	24/06/2013	Jim Whiteley	Final version

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:

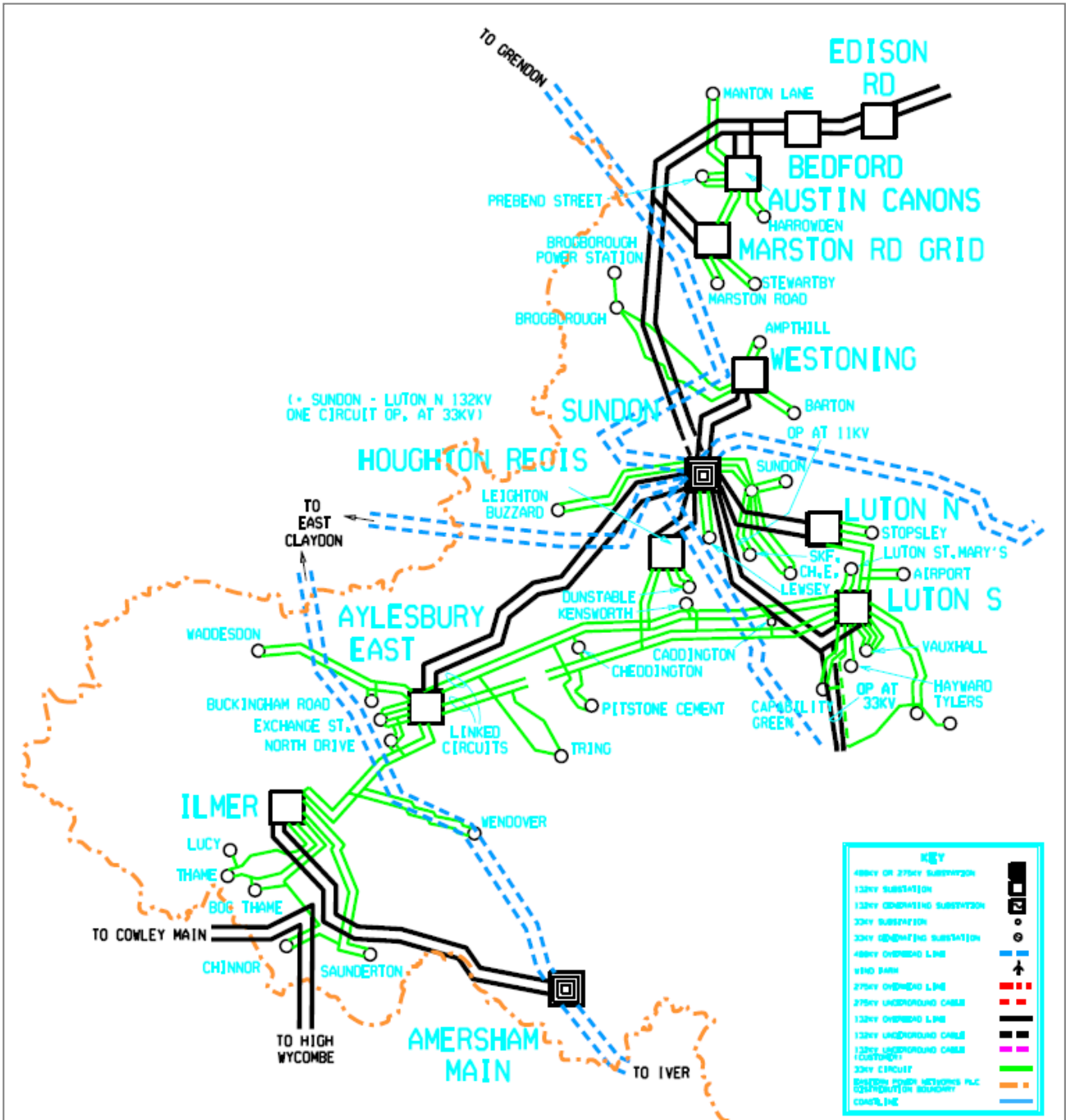
Name	Role	Signature	Date
Jim Whiteley	Infrastructure Planner		20/03/14
Nuno Da Fonseca	Infrastructure Planning Manager (EPN)		

Approval by:

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

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

APPENDIX A: GEOGRAPHICAL DIAGRAM

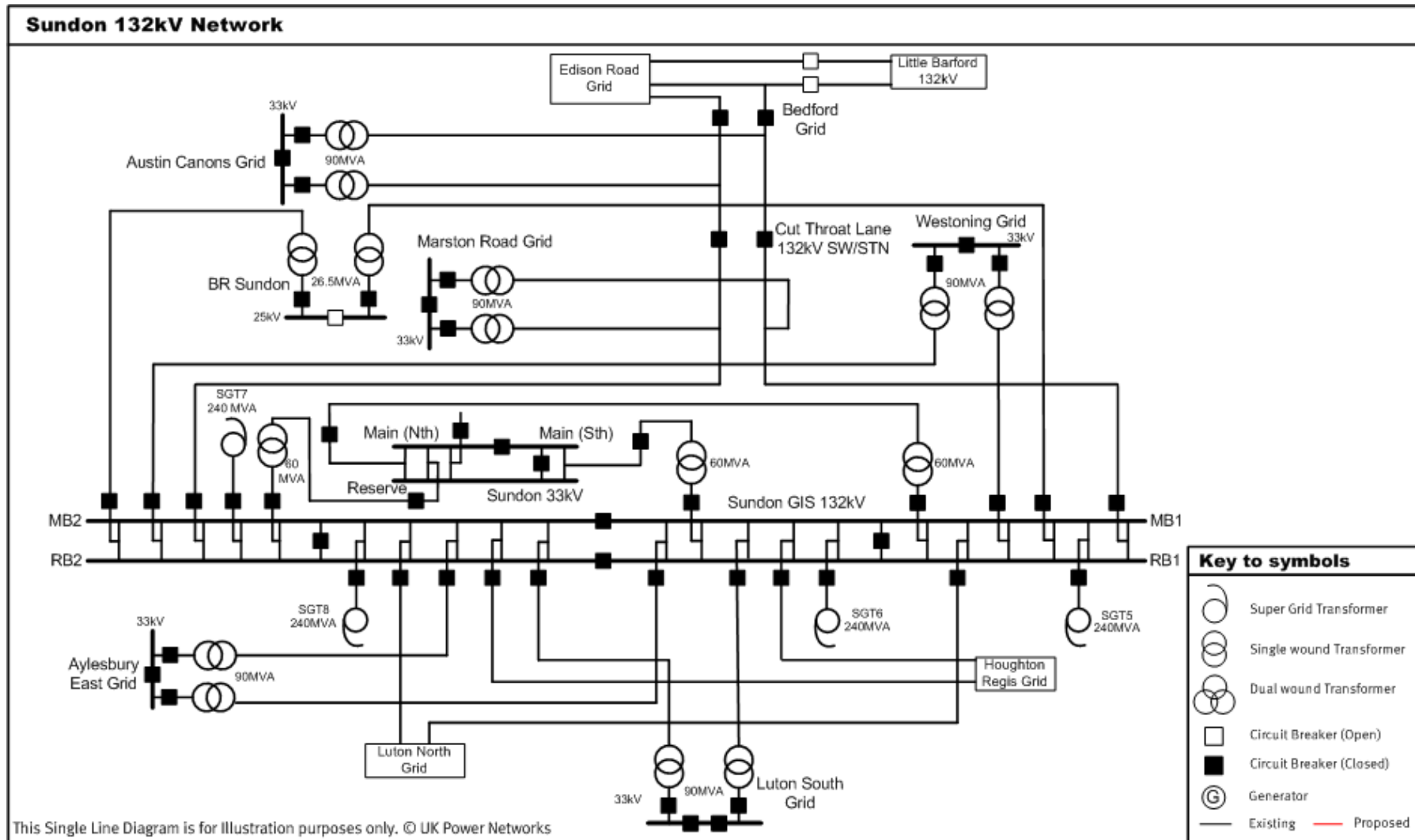


Showing Amersham/Ilmer 132kV network and 33kV surrounding circuits including 33kV interconnection to the Aylesbury East network

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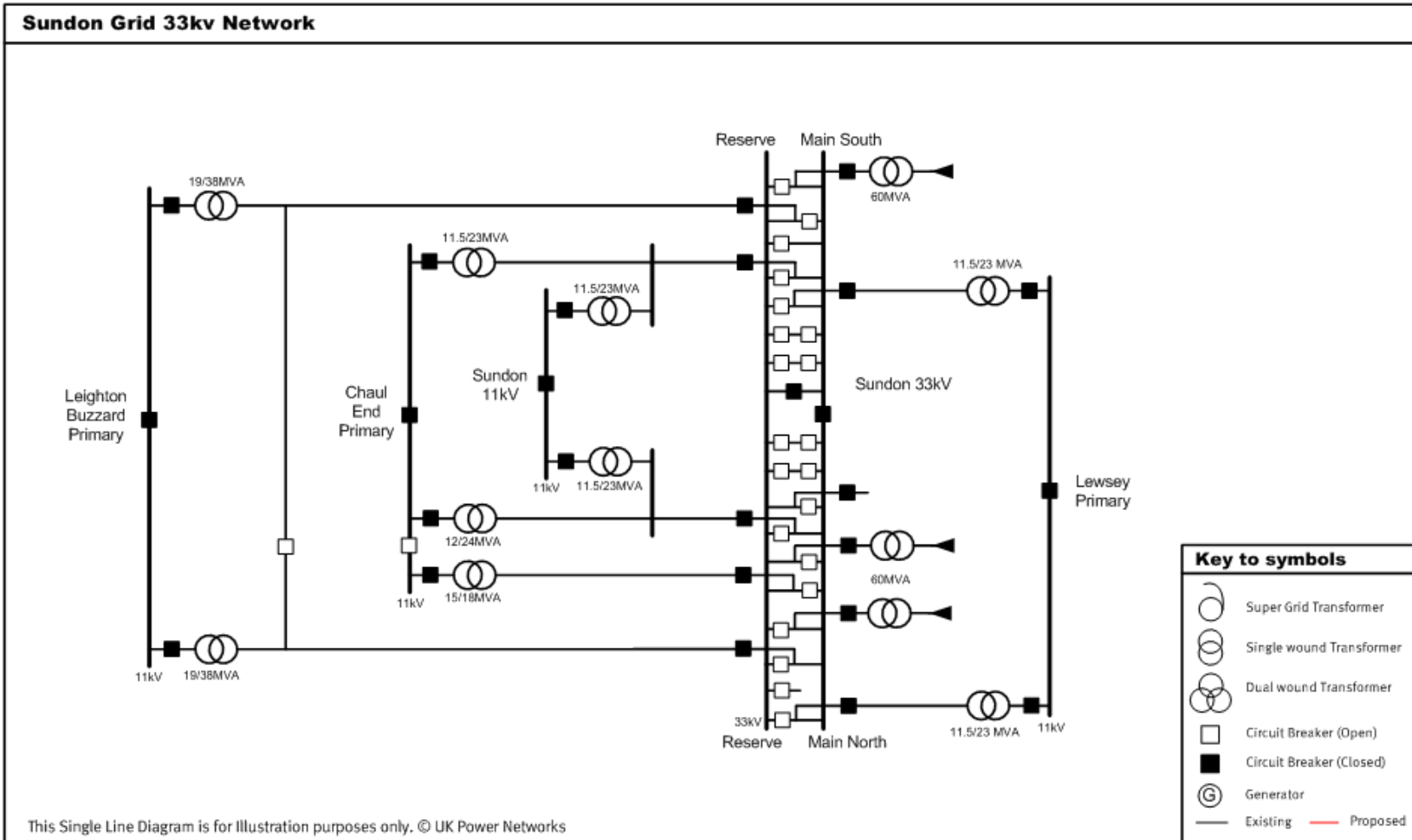
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APPENDIX B: SINGLE LINE DIAGRAM – EXISTING NETWORK



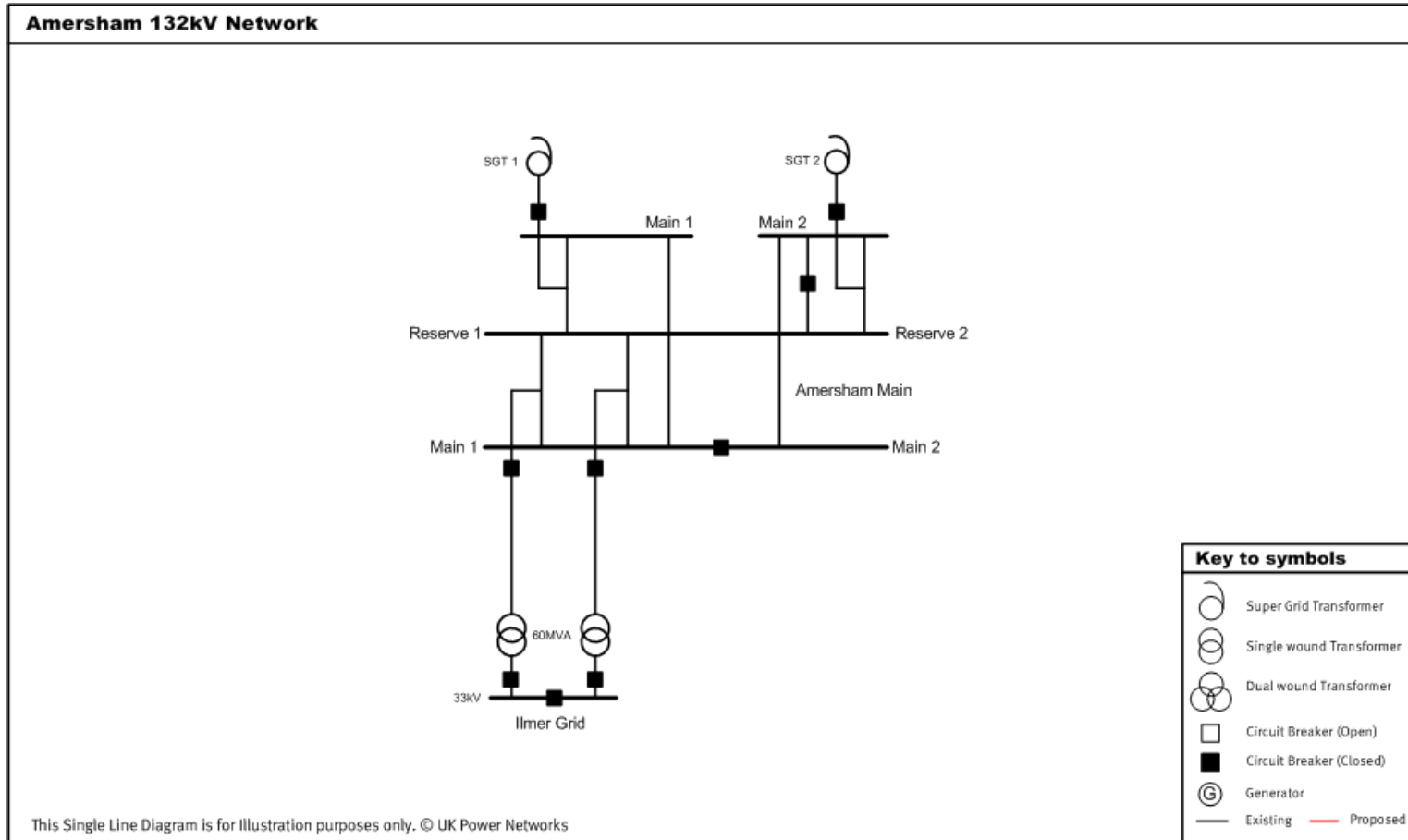
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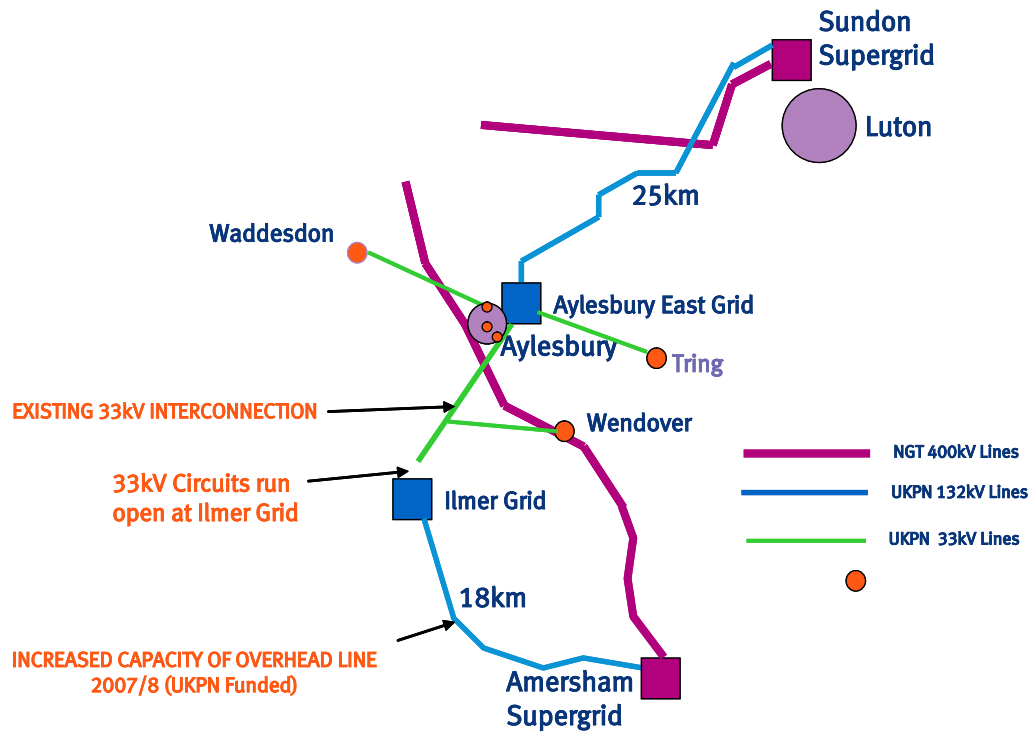
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APPENDIX C: SINGLE LINE DIAGRAM – RECOMMENDED STRATEGY

Amersham – Ilmer Network

Existing Network

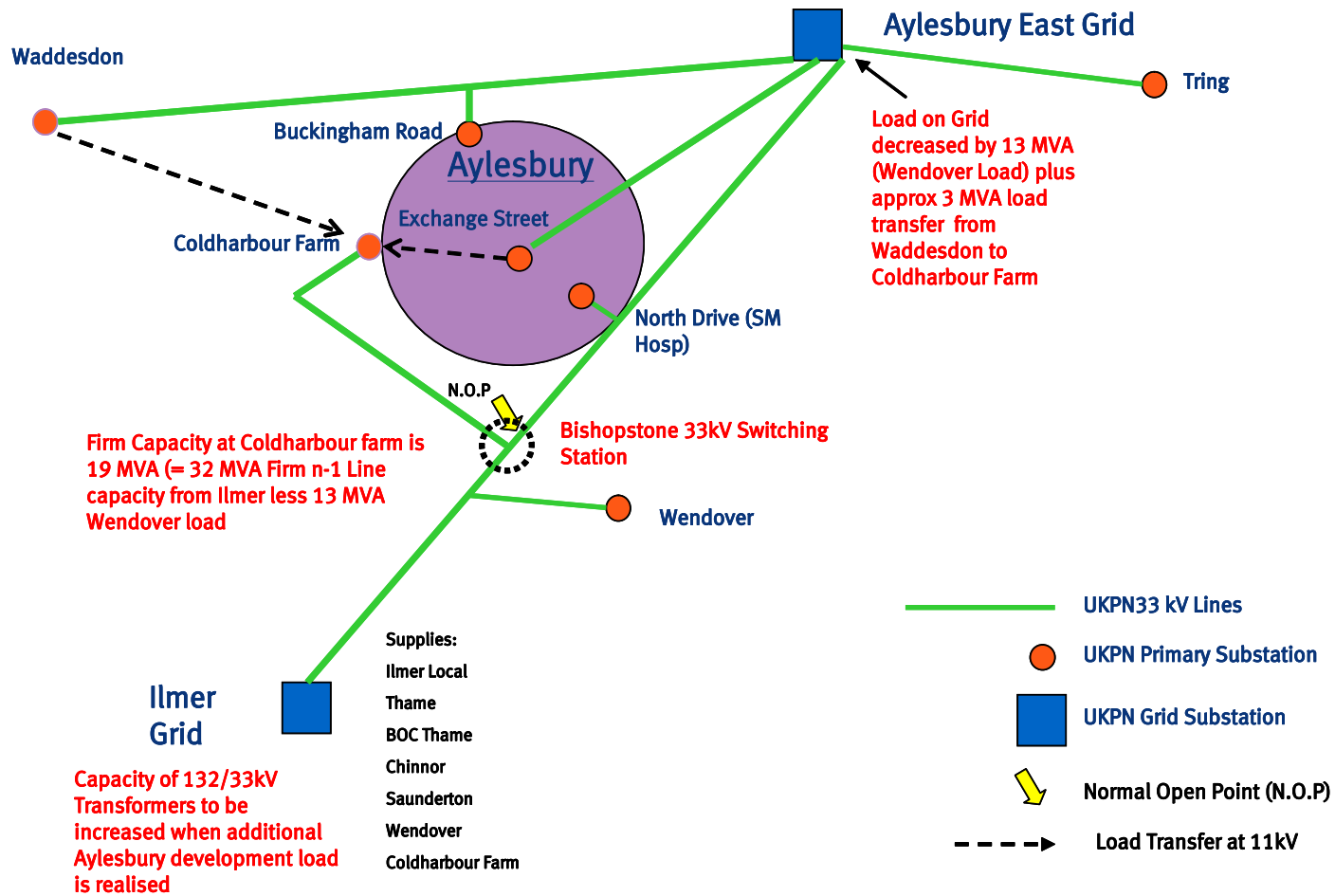


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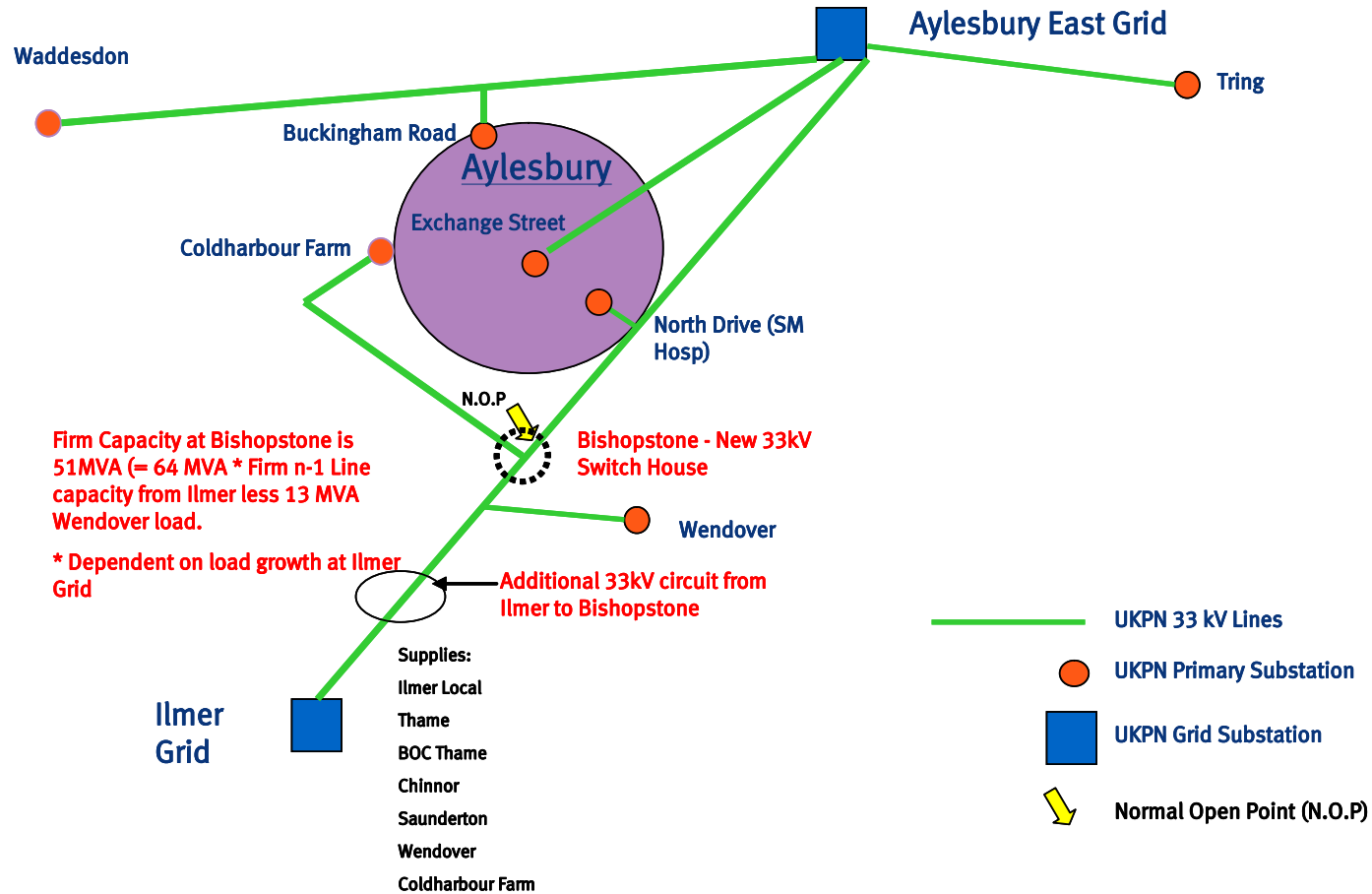
Phase 1 Network development to provide point of connection for Coldharbour Farm Primary (Berryfields development) and to create headroom at Aylesbury East Grid.



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Phase 2 Network Development to provide additional capacity at Bishopstone 33kV bars for future load connections



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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	1.02.02	4025	PFD - Sundon/Lewsey - Conductor Replacement				105,357	316,070					
A	1.02.02	4045	PDF - Aylesbury East/Exchange Street - Conductor Replacement			45,072	135,215						
A	1.02.02	7534	PEF - Aylesbury East Grid - Exchange St - Conductor Replacement						92,722	278,166			
A	1.02.02	7535	PDG - Aylesbury East Grid/Luton South Grid - Conductor Replacement					600,000	3,500,000	1,339,714			
A	1.02.03	7537	PRB - Sundon - Luton North - Conductor Replacement									154,537	463,612
A	1.02.03	7552	PW - ARA/RAE - Conductor Replacement						231,806	695,418			
A	1.02.05	5808	PX Grendon-RAE/ARA Feasibility work	409,539	91,220								
A	1.09.01	7578	3F20C - Aylesbury East Waddesdon/Buckinghamshire Rd 1 - 33kV Wood Pole OHL Replacement							261,476	625,967		
A	1.48.02	5782	Sundon 132/33kV Grid Substation - Replace 33kV Switchgear	19,499	823,852	1,487,116							
A	1.48.06	7600	Grendon 132kV Grid Supply Point - Replace 132kV Switchgear (NG*)					242,026	564,758				
A	1.48.11	7606	Aylesbury East 132/33kV Grid Substation - Replace 33kV Switchgear									342,487	884,095
A	1.48.11	7609	Ilmer 132/33kV Grid Substation - Replace 33kV Switchgear					331,992	845,789	263,472			
A	1.48.11	7626	Houghton Regis 132/33kV Grid Substation - Replace 33kV Switchgear		95,147	1,370,111	291,233						
A	1.50.01	7633	Brogborough 33/11kV Primary Substation - Replace 11kV Switchgear									39,111	823,146
A	1.50.01	7635	Caddington 33/11kV Primary Substation - Replace 11kV Switchgear										234,836
A	1.50.01	7637	Cheddington 33/11kV Primary Substation - Replace 11kV Switchgear								232,605	509,141	
A	1.50.01	7639	Chinnor 33/11kV Primary Substation - Replace 11kV Switchgear										234,836
A	1.50.01	7640	Dunstable 33/11kV Primary Substation - Replace 11kV Switchgear										39,111

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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	7643	Godmanchester 33/11kV Primary Substation - Replace 11kV Switchgear										232,605
A	1.50.01	7649	Houghton Regis 33/11kV Primary Substation - Replace 11kV Switchgear				279,043	673,398					
A	1.50.01	7651	Kensworth 33/11kV Primary Substation - Replace 11kV Switchgear										196,093
A	1.50.01	7656	Luton North 132/11kV Grid Substation - Replace 11kV Switchgear					476,178	1,182,993				
A	1.50.01	7661	Saunderton 33/11kV Primary Substation - Replace 11kV Switchgear							234,119	539,771		
A	1.50.01	7682	East Harpenden 33/11kV Primary Substation - Replace 11kV Switchgear						215,341	525,653			
A	1.50.01	7705	Stewartby 33/11kV Primary Substation - Retrofit 11kV Switchgear							48,979			
A	1.50.01	7708	Sundon 33/11kV Grid Substation - Replace 11kV Switchgear							234,836	555,096		
A	1.51.01	7720	Sundon 132/33kV Grid Substation - Replace Grid Transformers (GT1, GT2, GT3)			908,122	2,715,015	816,749					
A	1.51.01	7722	Edison Road 132/11kV Grid Substation - Replace Grid Transformers (GT2)					404,961	1,074,999				
A	1.51.03	5839	North Drive 33/11kV Primary S/S - Replace 33/11kV Transformer T4	51,020	251,273	294,641							
A	1.51.03	7747	Chaul End 33/11kV Primary Substation - Replace Primary Transformers (T1)				174,618	396,583					
A	1.51.03	7762	Ilmer 33/11kV Primary Substation - Replace Primary Transformers (T1, T2)						394,039	748,365			
A	1.51.03	7763	Kensworth 33/11kV Primary Substation - Replace Primary Transformers (T1, T2)		41,576	1,100,827							
A	1.51.03	7773	Wendover 33/11kV Primary Substation - Replace Primary Transformers (T2)										174,619
A	1.51.11	7728	Dunstable 33/11kV Primary Substation - Refurbish Primary Transformers (T1, T2)								51,020	250,814	
A	1.51.11	7738	Stopsley 33/11kV Primary Substation - Refurbish Primary Transformers (T3)			25,510	125,407						
A	1.55.02	5752	Grendon 132kV FMVG CT/VT Replacement	31,400									
H	1.29.01	2798	Sundon/Chaul End 33kV FFC Circuits - Replace Faulty Cables	1,587,250	4,565,750								

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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
R	1.33.01	4408	Manton Lane 33/11kV Primary Substation - ITC (2 x 18/30/40) & Switchboard						233,382	940,995	515,307		
R	1.33.01	4409	Chaul End 33/11kV Primary Substation - ITC (T3: 11/18/23MVA)				144,027	417,818					
R	1.33.01	5009	Luton North Grid Local 33/11kV Substation - ITC (new 3rd 18/30/40MVA), 33kV Circuit Breaker and 11kV Switchboard Extension			215,349	508,314						
R	1.33.01	5812	North Drive 33/11kV Primary Substation - ITC (2x 12/18/24MVA) & Switchgear			152,353	483,792	487,104					
R	1.33.07	4009	Icknield Way Proposed 33kV Switching Station						37,874	335,561	1,911,106	507,507	
R	1.33.14	8472	Leighton Buzzard 33/11kV Primary Substation - Smarter Network Storage	3,152,000									

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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)	DPCR 5 Intervention		RIIO-ED1 without intervention				RIIO-ED1 with Intervention			P/6 at End ED1	
				NAMP	FC ED1 Start (MVA)	2014 (S) 14/15 (w)	2022 (S) 22/23 (W)	2014 (S) 14/15 (w)	2022 (S) 22/23 (W)	NAMP	FC ED1 end (MVA)	2022 (S) 22/23 (W)	P2/6 Class	Comply
Amersham 11	W	Circuit Rating	21.8		21.8	15.5	16.6	LI1	LI1		21.8	LI1	C	Yes
Ampthill	S	Transformer	15.0		15.0	12.8	13.9	LI2	LI2		15.0	LI2	C	Yes
Austin Cannons Grid 33.	W	Switchgear	114.3		114.3	92.0	99.0	LI2	LI2		114.3	LI2	D	Yes
Austin Cannons Primary.	W	Aux equipment	22.8		22.8	19.2	20.8	LI2	LI2		22.8	LI2	C	Yes
Aylesbury East Grid 33	W	Transformer	117.0		117.0	114.9	122.2	LI3	LI5		117.0	LI5	D	Yes
Barton	W	Transformer	23.0		23.0	7.6	8.6	LI1	LI1		23.0	LI1	B	Yes
Brogborough	S	Transformer	15.0		15.0	11.6	12.5	LI1	LI2		15.0	LI2	C	Yes
Buckingham Road	W	Transformer	19.5		19.5	15.3	16.7	LI1	LI2		19.5	LI2	C	Yes
Caddington	W	Transformer	18.0		18.0	9.6	10.5	LI1	LI1		18.0	LI1	B	Yes
Capability Green	S	Transformer	18.0		18.0	7.5	7.9	LI1	LI1		18.0	LI1	B	Yes
Central Harpenden	W	Transformer	18.0		18.0	19.5	21.2	LI5	LI5		18.0	LI5	C	Yes
Chaul End	S	Transformer	33.0		33.0	32.7	35.5	LI3	LI5	4409	36.0	LI3	C	Yes
Cheddington	W	Transformer	9.0		9.0	7.7	8.5	LI2	LI2		9.0	LI2	B	Yes
Chinnor	W	Transformer	15.0		15.0	4.9	5.8	LI1	LI1		15.0	LI1	B	Yes
Dunstable	W	Transformer	24.0		24.0	19.1	21.1	LI1	LI2		24.0	LI2	C	Yes
East Harpenden	W	Backfeed	24.1		24.1	8.3	9.4	LI1	LI1		24.1	LI1	B	Yes

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Substation	Season	First Limitation	FC NOW (MVA)	DPCR 5 Intervention		RIIO-ED1 without intervention				RIIO-ED1 with Intervention			P/6 at End ED1	
				NAMP	FC ED1 Start (MVA)	2014 (S) 14/15 (w)	2022 (S) 22/23 (W)	2014 (S) 14/15 (w)	2022 (S) 22/23 (W)	NAMP	FC ED1 end (MVA)	2022 (S) 22/23 (W)	P2/6 Class	Comply
Exchange Street	W	Transformer	45.4		45.4	34.7	36.0	LI1	LI1		45.4	LI1	C	Yes
Harrowden.	W	Aux equipment	22.9		22.8	16.7	18.0	LI1	LI1		22.8	LI1	C	Yes
Houghton Regis Grid 33	W	Switchgear	114.3		195.0	65.7	106.5	LI1	LI1		195.0	LI1	D	Yes
Houghton Regis Primary	S	Aux equipment	25.7		25.7	16.9	18.0	LI1	LI1		25.7	LI1	C	Yes
Ilmer 11	W	Transformer	13.0		13.0	9.8	10.9	LI1	LI2		13.0	LI2	B	Yes
Ilmer Grid 33	W	Switchgear	68.6		68.6	50.3	54.4	LI1	LI1	7609	78.0	LI1	C	Yes
Kensworth	W	Transformer	6.0		6.0	6.6	6.9	LI5	LI5		6.0	LI5	B	Yes
Leighton Buzzard	W	Circuit Rating	35.0	8472	35.0	34.4	37.8	LI3	LI5		35.0	LI5	C	Yes
Lewsey	W	Circuit Rating	20.1		20.1	18.7	20.2	LI2	LI4		20.1	LI4	C	Yes
Luton Airport	W	Switchgear	23.9		23.9	19.3	19.7	LI2	LI2		23.9	LI1	C	Yes
Luton South Grid	S	Transformer	90.0		90.0	63.8	66.9	LI1	LI1		90.0	LI1	D	Yes
Luton St Marys	S	Transformer	15.0		15.0	14.0	14.9	LI2	LI3		15.0	LI3	C	Yes
Manton Lane.	W	Aux equipment	22.8		22.8	21.4	23.5	LI2	LI5	4408	40.0	LI1	C	Yes
Marston Road	W	Transformer	13.0		13.0	11.3	12.5	LI2	LI3		13.0	LI3	C	Yes
North Drive	W	Transformer	13.0		13.0	13.5	14.4	LI5	LI5	5812	24.0	LI1	C	Yes
Pitstone	W	Transformer	24.0		24.0	4.6	4.7	LI1	LI1		24.0	LI1	B	Yes
Prebend Street.	W	Aux equipment	45.8		45.8	34.8	36.9	LI1	LI2		45.8	LI2	C	Yes
Saunderton	W	Switchgear	15.2		15.2	8.8	10.0	LI1	LI1		15.2	LI1	B	Yes
Stopsley	W	Transformer	40.0		40.0	14.1	14.7	LI1	LI1		40.0	LI1	C	Yes

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Substation	Season	First Limitation	FC NOW (MVA)	DPCR 5 Intervention		RIIO-ED1 without intervention				RIIO-ED1 with Intervention			P/6 at End ED1	
				NAMP	FC ED1 Start (MVA)	2014 (S) 14/15 (w)	2022 (S) 22/23 (W)	2014 (S) 14/15 (w)	2022 (S) 22/23 (W)	NAMP	FC ED1 end (MVA)	2022 (S) 22/23 (W)	P2/6 Class	Comply
Sundon 11	S	Transformer	17.3		17.3	11.3	12.0	LI1	LI1		17.3	LI1	B	Yes
Sundon 33	W	Transformer	144.0		144.0	97.4	106.0	LI1	LI1		144.0	LI1	D	Yes
Thame	W	Transformer	18.0		18.0	16.0	17.2	LI2	LI3		18.0	LI3	C	Yes
Tring	W	Transformer	24.0		24.0	15.7	17.1	LI1	LI1		24.0	LI1	C	Yes
Waddesdon	W	Transformer	13.0		13.0	9.6	10.8	LI1	LI2		13.0	LI2	B	Yes
Wendover	W	Transformer	18.0		18.0	13.1	14.1	LI1	LI1		18.0	LI1	C	Yes
Westoning Grid	W	Switchgear	114.3		130.7	45.8	50.2	LI1	LI1		130.7	LI1	C	Yes
Westoning Local	W	Transformer	24.0		24.0	12.8	14.2	LI1	LI1		24.0	LI1	C	Yes
Marston Grid 33	S	Transformer	90.0		96.1	34.5	39.0	LI1	LI1		96.1	LI1	C	Yes
Luton North Grid	W	Switchgear	38.1		38.1	37.6	41.0	LI3	LI5	5009	76.3	LI1	C	Yes
Luton North 33kV	W	Switchgear	114.3		114.3	51.6	55.6	LI1	LI1		114.3	LI1	C	Yes
Stewartby	S	Transformer	7.5		7.5	1.6	1.6	LI1	LI1		7.5	LI1	B	Yes

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
AMERSHAM MAIN			2						1	1			1	1	
BEDFORD GRID		2						2					2		
CUT THROAT LANE 132KV SW/STN	2						2						2		
GRENDON GRID			1							1		1			
SUNDON GIS 132KV	24	1					25						25		
TOTAL	26	3	3			27	2	1	2		1	27	2	1	1

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OUTPUT MEASURES - HEALTH INDICES (HI)

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
AUSTIN CANONS GRID		10						10					10		
AYLESBURY EAST GRID			1	12						13	13				
BISHOPSTONE SW/STN	7					7					7				
BOC THAME PRIMARY	2					2									
BROGBOROUGH GENERATOR STN	7						7								
BROGBOROUGH PRIMARY	1	1					2					2			
CAPABILITY GREEN PRIMARY		1					1					1			
HOUGHTON REGIS GRID				13						13	13				
ILMER GRID				10	2					12	12				
LUTON NORTH GRID	11					11					12				
LUTON SOUTH GRID		13					13					13			
MARSTON ROAD GRID	14					14					14				
RAE GRID			1						1						
S & M POWER STATION		1					1								
SUNDON 33KV				13						13	13				
WESTONING GRID	11					11					11				
TOTAL	53	26	2	48	2	34	35	10	1	51	84	27	10		

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
AMPTHILL PRIMARY		8	6					13	1				13	1	
ARA GRID			1					1					1		
ARLA DAIRIES PRIMARY															
AUSTIN CANONS PRIMARY		9	4					12	1				12	1	
BARTON PRIMARY		6	3					9					9		
BROGBOROUGH PRIMARY		3	7					7	3		10				
BUCKINGHAM RD PRIMARY		4	6				1	9				1	9		
CADDINGTON PRIMARY		3	6					4	5		9				
CAPABILITY GREEN PRIMARY	7						7					7			
CENTRAL HARPENDEN PRIMARY	13					13					13				
CHAUL END PRIMARY		19					5	14				5	14		
CHEDDINGTON PRIMARY			7						7		7				
CHINNOR PRIMARY		3	6					3	6		9				

Amersham and Sundon GSP

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
COLDHARBOUR FARM PRIMARY															
DUNSTABLE PRIMARY		2	8					2	3	5	10				
EAST HARPENDEN PRIMARY			5	1					4	2	6				
EXCHANGE ST PRIMARY		13	13				6	7	13		6	7	13		
HARROWDEN PRIMARY	15					15					15				
HOUGHTON REGIS PRIMARY		5	9					6	4	4	14				
ILMER PRIMARY		8						8				8			
KENSWORTH PRIMARY		1	5					3	3			3	3		
LEIGHTON BUZZARD PRIMARY		11	4				1	13	1		1	13	1		
LEWSEY PRIMARY		1	10					11				11			
LUTON AIRPORT PRIMARY	2	9				2	9				2	9			
LUTON NORTH GRID		6	14					6	11	3	26				
LUTON ST MARYS PRIMARY		3	8					9	2			9	2		
MANTON LANE PRIMARY		3	11					14			14				
MARSTON RD PRIMARY		8	5					12	1			12	1		
NORTH DR PRIMARY		6	3				5	2	2		9				
PITSTONE PRIMARY	9					2	7				2	7			
PREBEND ST PRIMARY	25					25					25				
RAE GRID			1						1						
SAUNDERTON PRIMARY			8					3	5		8				
STEWARTBY PRIMARY			3							3		3			
STOPSLEY PRIMARY	15					15					15				
SUNDON 11KV		2	7				2	2	2	3	9				
THAME PRIMARY		2	6					8				8			
TRING PRIMARY		10					10				10				
VAUXHALL LUTON		4					4								
WADDESDON PRIMARY	9					9					9				
WENDOVER PRIMARY		10	2					11	1			11	1		
WEST BEDFORD PRIMARY	7					7					7				
WESTONING PRIMARY	9						9				9				
TOTAL	111	159	168	1		88	66	189	76	20	219	55	143	23	

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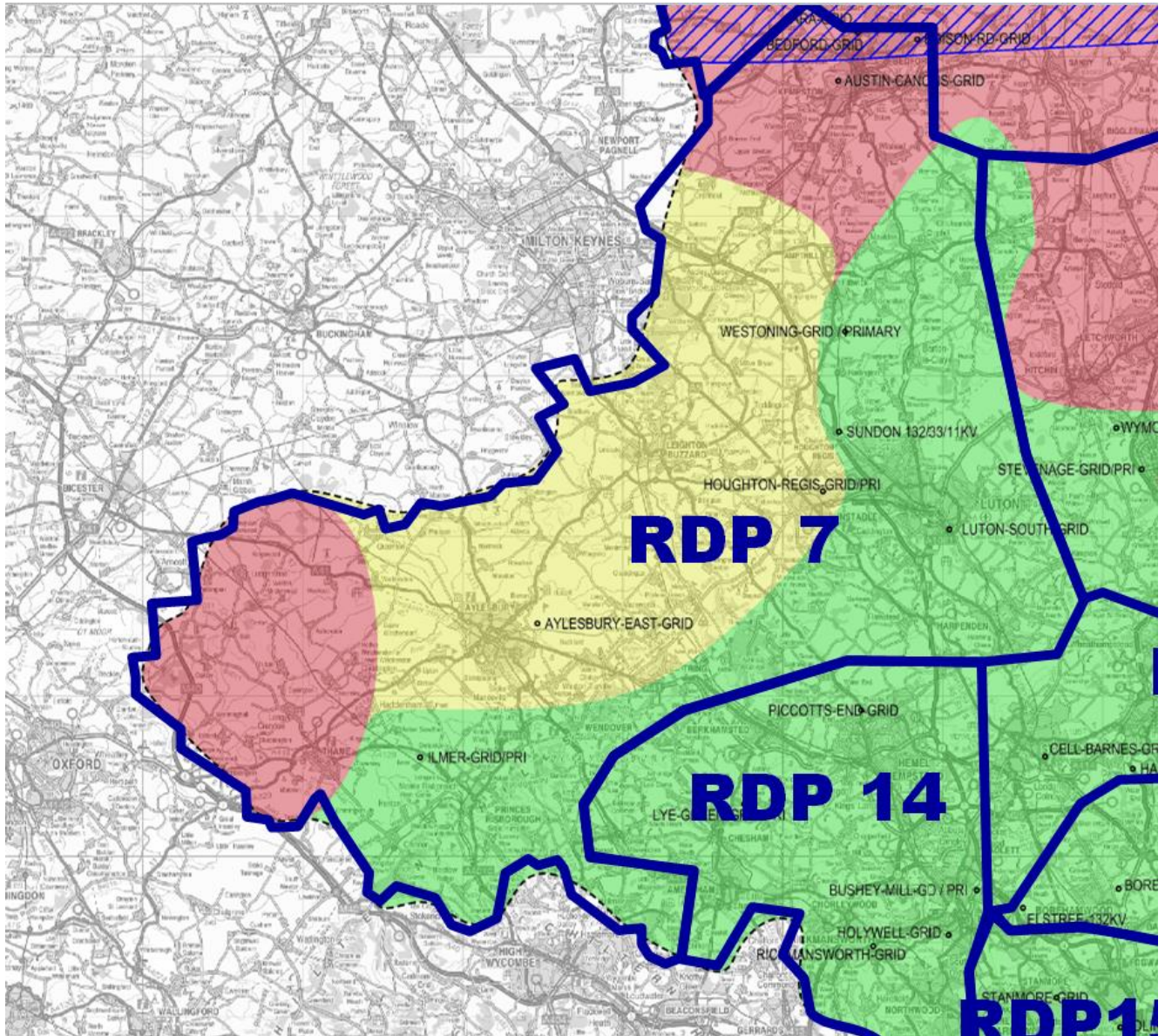
OUTPUT MEASURES - HEALTH INDICES (HI)

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
AMPTHILL PRIMARY		2						2					2		
ARA GRID		1						1					1		
ARLA DAIRIES PRIMARY	2					2					2				
AUSTIN CANONS GRID		2						2					2		
AUSTIN CANONS PRIMARY		2					2					2			
AYLESBURY EAST GRID		2					2					2			
BARTON PRIMARY		2					2					2			
BR SUNDON		2					2					2			
BROGBOROUGH PRIMARY		1	1					2					2		
BUCKINGHAM RD PRIMARY		1	1					2					2		
CADDINGTON PRIMARY		2						2					2		
CAPABILITY GREEN PRIMARY	1	1					2					2			
CENTRAL HARPENDEN PRIMARY		1	1					2					2		
CHAUL END PRIMARY		2			1		2			1	2	1			
CHEDDINGTON PRIMARY		2					1	1				1	1		
CHINNOR PRIMARY		2						2					2		
COLDHARBOUR FARM PRIMARY															
DUNSTABLE PRIMARY		1	1					1	1				2		
EAST HARPENDEN PRIMARY			1					1					1		
EXCHANGE ST PRIMARY		4					1	3				1	3		
HARROWDEN PRIMARY	2					2					2				
HOUGHTON REGIS GRID		2					2					2			
HOUGHTON REGIS PRIMARY	2						2					2			
ILMER GRID		2						2					2		
ILMER PRIMARY				2						2	2				
KENSWORTH PRIMARY					2					2	2				
LEIGHTON BUZZARD PRIMARY		2						2					2		
LEWSEY PRIMARY		1	1				1		1			1		1	
LUTON AIRPORT PRIMARY	2						2					2			
LUTON NORTH GRID	2	2					3		1		1	3		1	
LUTON SOUTH GRID		2					1	1				1	1		
LUTON ST MARYS PRIMARY		1	1					2					2		
MANTON LANE PRIMARY		2					2				2				
MARSTON RD PRIMARY		2					1	1				1	1		
MARSTON ROAD GRID	1	1					1	1				1	1		

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NORTH DR PRIMARY	1	1				1	1			2					
PITSTONE PRIMARY	2					2				2					
PREBEND ST PRIMARY	3					2	1			2	1				
RAE GRID		1					1				1				
SAUNDERTON PRIMARY	2					2				2					
STEWARTBY PRIMARY	1	1				1			1	1	1		1		
STOPSLEY PRIMARY	1	1		1		1		1	1	1	1	2			
SUNDON 11KV	2					2				2					
SUNDON GIS 132KV	1	2					1	2		3					
THAME PRIMARY	2						2				2				
TRING PRIMARY	2					2				2					
VAUXHALL LUTON	4					4				4					
WADDESDON PRIMARY		2					2				2				
WENDOVER PRIMARY	1	1					2				2				
WEST BEDFORD PRIMARY	2					2				2					
WESTONING GRID	1	1					2				2				
WESTONING PRIMARY		2					1	1			1	1			
TOTAL	19	69	13	3	5	9	46	41	5	8	23	39	37	2	1

Amersham and Sundon GSP APPENDIX G: GENERATION HEAT MAP



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