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Newcastle Upon Tyne
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17 October 2014

Dear Chris

NORTHERN POWERGRID SUBMISSION FOR A COMPANY SPECIFIC ADJUSTMENT

Further to our telephone conversation of 13 October, I am writing to set out our case for a company specific adjustment that would reflect the unavoidable additional costs that we incur because of our uniquely high concentration of unusual network voltages.

The simple fact is that both of our licence areas have, for historical reasons, network configurations which drive significant additional ongoing cost into our business.

- In the Northeast a 20kV high voltage network was used during the electrification of coal mines and associated inland industrial sites across widespread otherwise rural areas. This was the economically rational choice given the distribution of load at these sites. During the subsequent mass roll-out of electricity to urban centres, the (by then industry standard) 11kV voltage was used, leading to two entirely separate HV networks which do not support one another.[1] 66kV was also chosen as that next voltage step up in certain areas, rather than 33kV, again due to the pattern of industry across the region.[2]
- In Yorkshire the coalfield to the east of Sheffield was electrified using a 66/11kV combination, again since 33kV would not have been economically rational given the distribution of load on the system.

Many of the original customers are now gone. 20kV and 66kV assets are significantly more expensive than 11/33kV assets, and the higher voltages are no longer needed to serve customer requirements. So in the hypothetical case where we were starting again, on a 'greenfield' site, we would install 11/33kV systems. But of course that is not our starting point, and it is economically rational choice to manage the existing asset, despite its high cost, except in rare cases where wholesale replacement is needed of entire sections of network.

[1] This is the only special factor we are aware of which has been recognised by law – the unique difficulties associated with restoring customers on the 20kV network was recognised in the Electricity (Standards of Performance) Regulations 1991, which entered into force on 1 July 1991, and all subsequent revisions of those regulation

[2] Our GSP which bears the title 'Hawthorne Pit' in East Durham, supplying 66kV assets and the local 20kV network, but no 11kV or 33kV network, is a good example of all these factors combined

These voltage level issues affect Northern Powergrid far more than any other DNO. The 20kV voltage in Northeast is unique in the country. And we estimate that Northern Powergrid has 62% of the 66kV network in the country (despite only accounting for around 12% of all MPANs). Ultimately this means we bear higher costs for delivering a given level of outputs to our customer base than any other DNO would.

To illustrate the issue we face, the table below sets out typical unit costs for various voltage levels, based on our market-tested rates with suppliers.

	Cost using industry standard voltage (11/33kV)	Cost using Northern Powergrid voltage (20/66kV)	Northern Powergrid unit cost premium (%)
Kilometre of HV cable	£73.5k	£81.5k	11.0%
Kilometre of HV OHL	£24.9k	£25.8k	3.6%
HV PM Transformer	£3.8k	£4.0k	6.7%
HV GM Transformer	£11.7k	£12.0k	2.8%
HV RMU	£11.7k	£12.5k	6.7%
Bay of HV switchgear in a primary	£44.3k	£59.9k	35.2%
Kilometre of EHV cable	£346.2k	£506.0k	46.1%
Kilometre of EHV OHL	£70.2k	£71.0k	1.2%
EHV Transformer	£331.8k**	£510.0k**	53.7%
Bay of EHV switchgear (66kV outdoor –v- 33kV indoor)	£54.9k*	£175.0k*	21.7%

Unit costs based on actual volumes of NPgN and NPgY replacement
*Ofgem data used for this comparison as we do not have a comparable 33kV CB replacement figure
**Ofgem data used for this comparison as it implicitly includes the generally larger transformer sizes at 66kV

This being the case, every time we need to replace an item of kit on our 20/66kV networks, we have a unit cost penalty which will affect our performance in both Ofgem's disaggregated and totex regression analysis. Other DNOs do not face the same headwind.

The decision to allow a company specific adjustment for SP Manweb's interconnected network indicated to us that that adjustments for company specific network design features are to be taken into account, whereas we had previously believed that Ofgem's policy would preclude them. In the light of the approach set out in the draft determination we are now making our own submission for equivalent treatment of our unique and higher cost networks.

This letter and associated appendices makes our case, in conjunction with our March 2014 business plan submission (which contained detailed evidence on the network assets to which our case relates).

Northern Powergrid's business plan commentary was developed to support qualitative adjustments to the findings of the disaggregated benchmarking model. These requests for adjustments in the disaggregated model therefore require no further explanation, though technically if translated to a company specific adjustment they would require an adjustment to our costs prior to running the disaggregated model, rather than an over-ride to the findings of that model based on unadjusted costs. We believe we have provided the necessary evidence to make such an adjustment, either to unit costs (where relevant) or volumes.

However, our commentary and our justifications were not developed to support a company specific adjustment, which would also affect the findings of Ofgem's totex model (since the 'company specific' costs would be deducted from totex prior to running regressions). The following justification bridges between the submissions we made, and the tests Ofgem appears to be applying in deciding whether to allow company specific adjustments into both the disaggregated and the totex modelling.

Northern Powergrid (Northeast) Ltd

We propose a company specific adjustment of £39m for Northern Powergrid (Northeast) Ltd (Northeast) for totex (along with adjustments for disaggregated modelling in line with the qualitative adjustments relating to 20/66kV already proposed). Below we set out a narrative supporting the need for the higher costs (with appendices to this letter setting out estimates of the additional cost incurred).

Northeast has two unusual types of network. One is the 20kV network which is unique to Northeast amongst licensees. The other is the 66kV network, of which Northeast has 37% of the national total, whereas most other licensees have little or none (with the exception of Northern Powergrid (Yorkshire) plc).[3]

This pattern of network was developed as a least cost solution to the pattern of industry seen across the Northeast when electricity was first made available to industrial sites (which occurred well before mass electrification in the 1960s and 1970s).

- During the late nineteenth and first half of the twentieth century, County Durham and Northumberland were characterised by regular pockets of energy intensive industry – in particular this arose because the entire area was a heavily exploited coal field (with the associated pit heads) and also supported other industry in response to the abundant coal (such as early, inland, steel works).
- The presence of this industry led to the early development of an electricity network serving an extensive area.
- Given the pattern and requirements of industry at the time, the economical choice was to install a 20kV network later backed up by 66kV. Use of these intermediate voltages was (and still would be) the rational response to the sparse distribution of small pockets of load intensive activity at the levels historically seen.
- When mass electrification later took place, the logical choice (to serve the more evenly spread, lower load requirements of the population centres as opposed to industry) was to use the industry standard 11kV for the HV network.

[3] Percentage of the nation's 66kV system as measured by switchgear and transformers (Ofgem July 2014 civil model): NPgN 37%, NPgY 25%, LPN 14%, WMID 11%, SSES 8%, SWALES 6%, ENWL 0%, EMID 0%, SWEST 0%, SPN 0%, EPN 0%, SPD 0%, SPMW 0%, SSEH 0%,

Although the industrial activity which necessitated it has now vanished, the 20kV and 66kV systems remain. This has left the Northeast with two distinct HV networks, one running at 11kV and another running at 20kV, and significant amounts of 66kV.

Networks running at 66/20kV carry significantly higher costs than 33/11kV to install and maintain, (though they can sustain higher loading).[4] But the original rural industry which required a higher specification network has now disappeared (with the demise of the pits and heavy industry from these areas) and, if we did not have the legacy of the position that developed to serve the pits and heavy industry, the preferred network design to serve the remaining town and village population centres would be to use 11kV.

Had industrial development in the Northeast been similar to that typically seen in other DNO regions (with South Yorkshire being the notable exception), a 33/11kV network would have been installed at the outset and the cost to maintain and replace the network would be lower. However, since extensive parts of the system were designed and developed to run at 66kV and 20kV, the least cost solution is now to maintain and replace that system – at a higher cost to the one every other DNO would face for a similar pattern of customers.

As well as the higher unit costs, the two distinct HV systems in the Northeast also suffer from the disadvantage that they cannot easily be used to support each other without the extensive use of expensive interbus transformers.[5] This means that the networks effectively have lower levels of interconnection than might be expected in a similarly dense network running a single HV system. Such networks are therefore:

- more difficult to restore post-fault, particularly where there are multiple faults as experienced during adverse weather, due to lower levels of interconnection; or
- built slightly stronger than would be expected with more robust overhead lines, and additional interconnection to bring these networks closer to normal flexibility expectations (e.g. Wandy Law firm busbar) in order to cope with abnormal weather conditions in the absence of interconnection.

The separate systems, with lower levels of interconnection, also mean that reinforcement costs are higher.

Northern Powergrid (Yorkshire) plc

We propose a company specific adjustment of £21m for Northern Powergrid (Yorkshire) plc (Yorkshire) for totex (along with adjustments for disaggregated modelling in line with the qualitative adjustments relating to 20/66kV already proposed). Below we set out a narrative supporting the need for the higher costs (with appendices to this letter setting out estimates of the additional cost incurred).

Yorkshire has one unusual type of network. This is the 66kV network, of which Yorkshire has 25% of the national total, whereas most other licensees have little or none (with the notable

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[4] Most DNOs have some 6kV network, again for historical reasons. The characteristics and cost of this network are similar to 11kV. The 20kV network, however, is distinct from 11kV and carries significantly higher costs. Hence 6kV networks do not provide a reason for a company specific adjustment, while 20kV networks do.

[5] This is not an issue with regards to the two EHV systems as they generally run as n-1 redundant systems and therefore are self-supporting in post-fault conditions.

exception of Northeast). This pattern of network was developed as a least cost solution to an unusually dense pattern of electricity demands which made the normal 132/33/11kV arrangements impractical.

- In Sheffield, where heavy industry (steelworks, forges etc.) was densest the response was the 275/33kV ring, with a high density of associated 33/11kV substations.
- On the periphery of this area the network drops a voltage, but retains the double step using 132/11kV infeeds to meet the higher than average historical power density requirements.
- Moving away from Sheffield into the mining areas to the east, the power density was still significantly higher than might be expected in an otherwise rural area across a widespread area.

This distribution of demand in otherwise rural areas would either have led to an increased number of 132/33kV infeeds or highly stretched 33kV feeders. The rational response from both an economic and engineering point of view was to install a 66kV system.[6] Since the decline of mining in Yorkshire through the 1980s and 1990s, the load on the 66kV network has reduced and the 66kV network no longer retains a total cost advantage over a ‘green-field’ 33kV network. Indeed, in the pockets where we need to strengthen the network significantly (our Doncaster reinforcement high value project being a good example) we would always consider whether it is technically feasible to use 33kV to do so, since this is cheaper.

However we are left with the legacy of a 66kV network where the most efficient available option is generally to renew with 66kV network rather than replace it with 33kV assets. The 66kV network assets are significantly more expensive than 33kV network assets (as they are more akin to 132kV), and the network architecture requires substation layouts that significantly increase civil costs.

Had industrial development in South Yorkshire been similar to that seen in all other DNO regions (with the exception of the extensive Durham and Northumberland coal field network which Northeast maintains), a 33kV network would have been installed (rather than the 66kV network) and the cost to maintain and replace the network would now be lower. However, given extensive parts of the system were designed and developed to run at 66kV, the least cost solution is now to maintain and replace that system – at a higher cost to the one every other DNO faces today for a similar pattern of customers.

Additional information

Beyond these high level points, we would refer you to the detailed information provided in our business plan submission as referenced at appendix 1. The bulk of the references relate to our business plan annex on major plant (switchgear and transformers) which is included for ease of reference as associated document 1 to this submission.

We also refer you to a narrative in appendix 2 describing the cost information we have used to estimate the size of the required company specific adjustment.

[6] Unlike the earlier Northeast network, 11kV had been settled as the HV distribution voltage by the time these mining areas were electrified, although mine-owners ran a small amount of 3.3kV distribution in some villages.

At appendix 3 we include network maps which highlight the extensive use of both 66kV and 20kV voltage assets across our distribution services areas.

At appendix 4 we set out details of the 20kV and 66kV assets on the register of Northern Powergrid and other DNOs (in the case of 66kV).

At appendix 5 we set out tables showing our estimated premia by asset line items.

I think it is likely that you will have some questions about our submission, so I suggest that we should meet to discuss this at your earliest convenience. If there is any additional information that would help you to assess our application, please contact Mark Drye and he will provide it as soon as is practicable.

It is important that you consider our submission on the same basis as the cases made by other companies; if the underlying argument and evidence base is equally persuasive, it follows that it merits the same treatment.

Yours sincerely

John France
Regulation Director

Appendix 1 – references to relevant content in our business plan

Appendix 1 – references to relevant content in our business plan

In this appendix we summarise the evidence of additional costs put forward in our business and in our additional justification. The location of the material is shown in italicised text.

General comment on 66kV and 20kV systems

As we have made clear in our submissions, "We are an industry outlier with the volume of 20kV and 66kV network that we operate. This does not create any additional risk to our outputs but does impact on the costs that we incur." - *1.26 Additional justification for our major plant (switchgear and transformers) asset replacement forecast for 2015-23, page 6.*

66kV and 20kV equipment costs

66kV equipment today is significantly more expensive than 33kV, in some cases (particularly cable and switchgear) approaching the more commonly used 132kV equivalents.

- *1.26 Additional justification for our major plant (switchgear and transformers) asset replacement forecast for 2015-23,*
    - *section 2.7 Efficient Unit Costs (switchgear) and*
    - *section 3.6 Efficient Unit Costs (transfomers).*

20kV equipment today is significantly more expensive than 11kV. This has been allowed for in the disaggregated models but no allowance has been made in the totex model.

- *Ofgem cost models, Asset replacement supporting file-20140717-1_1*
- *1.26 Additional justification for our major plant (switchgear and transformers) asset replacement forecast for 2015-23,*
    - *section 2.7 Efficient Unit Costs (switchgear) and*
    - *section 3.6 Efficient Unit Costs (transfomers).*

Civil works – unit cost issues and volume issues

The assets are generally air insulated as at 132kV, not metal-clad as at 33kV and this increases the footprint of substations significantly and with that the size and complexity of civil works. This leads to higher volumes of civil works, that the model does not normalise out as it assumes a homogeneous EHV substation population, and disproportionately more expensive civil works as the footprint of the substation increases for 66kV installations.

- 1*.26 Additional justification for our major plant (switchgear and transformers) asset replacement forecast for 2015-23, section 4 Civil works driven by major substation asset replacement*,]

Network architecture and implications on costs

The 66kV network is more complex than typical 33kV networks as it is an interconnected grid, requiring more equipment to operate it. Network architecture on 66kV interconnected systems leads to a need for higher numbers of circuit breakers; specifically whereas the overwhelming

majority of 33kV circuit breakers are found at 132/33KV or 275/33kV sites, around half the circuit breakers on a 66kV system are found at the 66/20kV or 66/11kV substations.
The individual replacement scheme breakdowns we have provided demonstrate the level of additional complexity experienced at 66kV network substations.

- *1.26 Additional justification for our major plant (switchgear and transformers) asset replacement forecast for 2015-23, section 2 HV EHV and 132kV switchgear,*

The assets used on 20kV systems are generally run in similar configurations to other HV systems; while there are areas of interconnected network to improve CI and CML in rural areas these are few enough to have no overall impact.

Appendix 2 – narrative supporting estimates of company specific adjustments

Appendix 2 – narrative supporting estimates of company specific adjustments

This appendix first gives an overview of the implications of our proposal for the totex and disaggregated analysis, before providing a fuller narrative on how adjustments have been calculated for individual line items. This narrative is supported by Appendix 3, the accompanying spreadsheet which sets out our calculations.

Overview of implications for disaggregated and totex analysis

All sums calculated in the analysis below affect our position in the totex models; however some do not affect our position in the disaggregated models because either:

- Ofgem has already allowed for the difference in unit costs (e.g. 20kV equipment), or
- The issue normalises out in the disaggregated model (e.g. additional switchgear volumes due to network architecture).

We have indicated both the totex and disaggregated impacts in each area.

Area		Include in Disagg	Include in totex	Cost Assessment Bilateral Reference	Justification
Equipment costs	£25.5M for Northeast and £9.7M for Yorkshire	£16.1	£35.2m	A4.3	66kV switchgear (unit cost) - Activity dominated by NPg, benchmarked against de minimis activity in other DNOs. Allocation of consequential costs varies significantly dependent upon specific substation solutions
		£4.1m		A4.4	EHV and 132kV transformers (unit cost) - No recognition of significant legitimate difference in DNO costs due to: specifications, approach to losses and allocation of consequential costs
	£3.1M Northeast	£0m	£3.1m	-	No further adjustment needed to disaggregated model since allowance already made
Network architecture and implications on costs	£6.6M for Northeast and £5.7M for Yorkshire	£0m	12.3	-	Additional breakers will be normalised in the disaggregated model
Civil works	£2m in Northeast and £3m in Yorkshire	£5m	£5m	A1.1	Civil works - major substation asset replacements (unit cost and volumes) - Plant replacement volumes accepted but associated civils volumes reduced dramatically. No consideration of physical & cost difference between 66kV & 33kV substation civils
	£1.8m in Northeast and £2.1m in Yorkshire	£3.9m	£3.9m		

66kV and 20kV equipment costs

Multiplying the marginal cost of 66kV equipment as opposed to 33kV equipment by the volume of 66kV asset replacement in our RIIO-ED1 business plan submission indicates a cost of £25.5M for Northeast and £9.7M for Yorkshire. We have not included any additional reinforcement, refurbishment or connections driven costs as these are not regarded as significant.

Multiplying the marginal cost of 20kV equipment as opposed to 11kV equipment by the volume of 66kV asset replacement in our RIIO-ED1 business plan submission indicates a cost of £3.1M for Northeast. We note that in the 20kV case, costs have been allowed for in the disaggregated models but no allowance has been made in the totex model.

Network architecture and implications on costs

As explained in appendix 1, network architecture requirements associated with the 66kV network mean we need many additional circuit breakers. We have multiplied the unit costs of 66kV circuit breakers by the numbers of such circuit breakers proposed for replacement in our RIIO-ED1 business plan submission which are at 66/11kV or 66/20kV substations. This excludes the 275/66kV or 132/66kV circuit breakers which will be similar in number to the 33kV circuit breakers for an equivalent 33kV type network. This indicates a cost of £6.6M for Northeast and £5.7M for Yorkshire.

Civil works – unit cost issues and volume issues

The assets are generally air insulated as at 132kV, not metal-clad as at 33kV, and this increases the footprint of substations significantly and with that the size and complexity of civil works.

Ofgem's disaggregated modelling has indicated a disallowance of £26m for EHV plinths and groundworks costs. Some of this is associated with the larger sites associated with 66kV substations, while some will be due to the different practices and data interpretations by the different DNOs. Noting that the costs of groundworks in particular rise disproportionately as larger substation sites are required (since larger sites are less likely to be flat, so will require more preparation), we believe in the order of 20% of the disallowance will be associated with the 66kV sites being renewed in the RIIO-ED1 period; this is around of £2m in Northeast and £3m in Yorkshire. In practice, the proportion may be much higher (we have very few 33kV substation renewals), but site variability and lack of comparable benchmarks for EHV civil works makes precise estimates difficult; this is a problem Ofgem is also experiencing in assessing this area of activity.

The volume of asset driven civils is also affected by the higher number of 66kV circuit breakers driven by the network architecture, since Ofgem assumes a homogeneous population of assets as the volume driver for civils. Ofgem has indicated a benchmarked cost which is lower than our submission by £1.8m in Northeast and £2.1m in Yorkshire; the reduced volumes assumed in Ofgem's modelling due to its failure to recognise the unique features and unavoidably higher costs of the 66kV network accounts for all of this. We have therefore used this as our estimate of the additional cost due to this issue, since it is the best available external benchmark for 33kV volumes relative to 66kV volumes.

Distinct HV systems

We have not quantified this. There will be an additional cost to our business (such as additional reinforcement costs) but we have not included it in our estimation due to the lack of a meaningful manner of calculating it.

Appendix 3 – network maps

Appendix 3 – network maps

Key to maps:

Blue lines = 66kV network

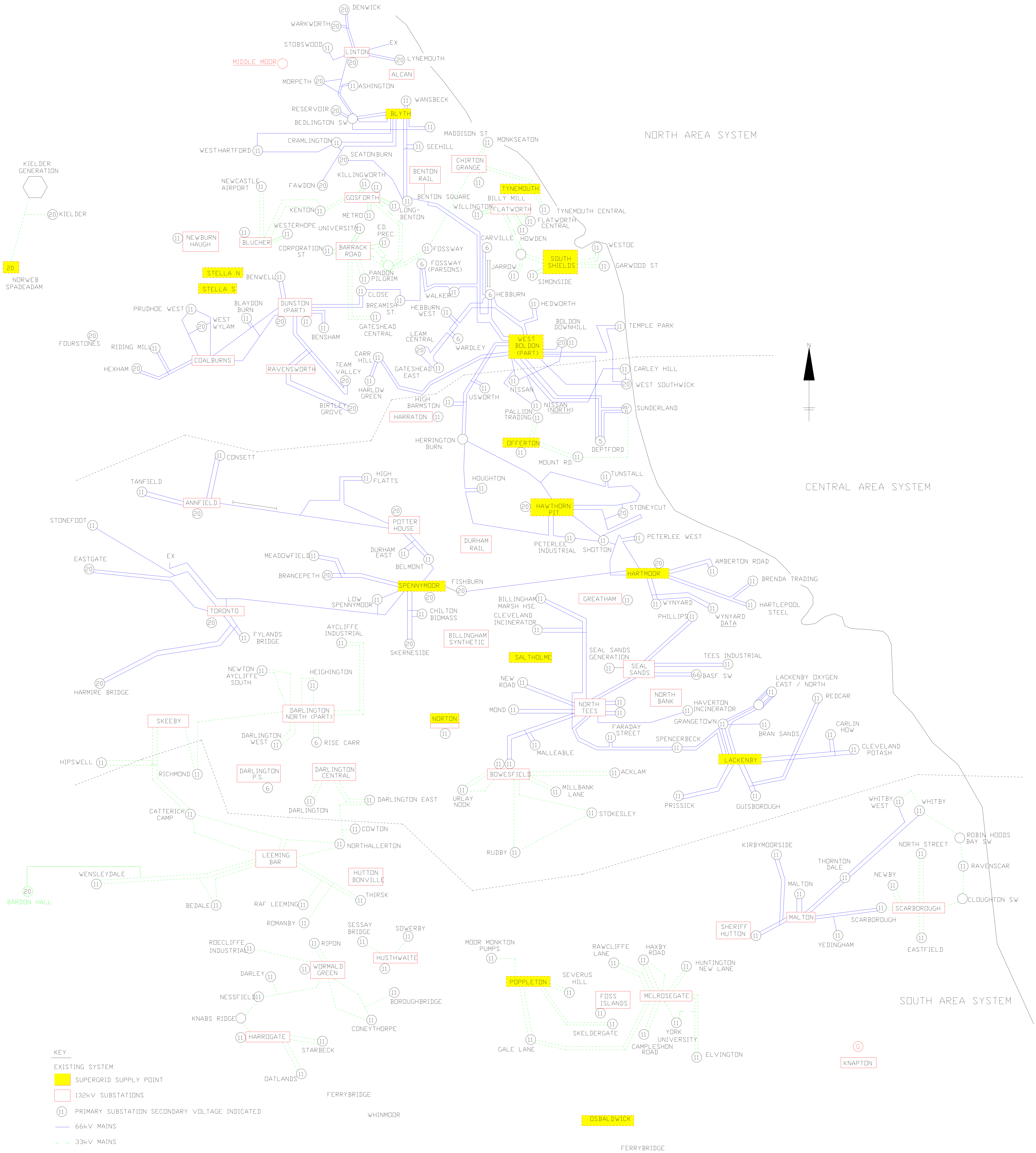
Green lines = 33kV network

Circles containing numbers = busbar, with number indicating voltage

Additional notes to interpreting maps:

20kV assets are not shown, but 20kV busbars (described in key) indicate links to the 20kV network

Not all 33kV assets are shown, where system density precludes this. This particularly applies to the dense 33kV network around Sheffield



NORTH AREA SYSTEM
CENTRAL AREA SYSTEM
SOUTH AREA SYSTEM
N
DENWICK
WARKWORTH
STOBSWOOD
LINTON
EX
LYNEMOUTH
MIDDLE MOOR
ALCAN
MORPETH
ASHINGTON
WANSBECK
RESERVOIR
BLYTH
BEDLINGTON SW
MADDISON ST
MONKSEATON
CRAMLINGTON
WESTHARTFORD
SEEHILL
SEATON BURN
CHIRTON GRANGE
BENTON RAIL
KIELDER GENERATION
KIELDER
NEWCASTLE AIRPORT
FAWDON
KILLINGWORTH
GOSFORTH
TYNEMOUTH
BENTON SQUARE
BILLY MILL
WILLINGTON
FLATWORTH
TYNEMOUTH CENTRAL
KENTON
LONG-BENTON
METRO
FLATWORTH CENTRAL
WESTERHOPE
UNIVERSITY
ED. PREC.
NEWBURN HAUGH
BLUCHER
CORPORATION ST
BARRACK ROAD
CARVILLE
HOWDEN
WESTOE
FOSSWAY
SOUTH SHIELDS
GARWOOD ST
NORWEB SPADEADAM
STELLA N
BENWELL
PANDON
PILGRIM
FOSSWAY (PARSONS)
JARROW
SIMONSIDE
STELLA S
CLOSE
WALKER
HEBBURN
BLAYDON BURN
DUNSTON (PART)
BREAMISH ST.
HEBBURN WEST
HEDWORTH
PRUDHOE WEST
WEST WYLAM
BENSHAM
GATESHEAD CENTRAL
BOLDON DOWNHILL
TEMPLE PARK
FOURSTONES
LEAM CENTRAL
WARDLEY
WEST BOLDON (PART)
RIDING MILL
CARR HILL
HEXHAM
COALBURNS
RAVENSWORTH
TEAM VALLEY
GATESHEAD EAST
CARLEY HILL
WEST SOUTHWICK
HARLOW GREEN
NISSAN
HIGH BARMSTON
USWORTH
NISSAN (NORTH)
SUNDERLAND
BIRTLEY GROVE
HARRATON
PALLION TRADING
HERRINGTON BURN
OFFERTON
DEPTFORD
MOUNT RD.
CONSETT
TUNSTALL
TANFIELD
HIGH FLATTS
HOUGHTON
ANNFIELD
HAWTHORN PIT
STONEYCUT
STONEFOOT
POTTER HOUSE
DURHAM RAIL
PETERLEE INDUSTRIAL
SHOTTON
PETERLEE WEST
EASTGATE
EX
MEADOWFIELD
DURHAM EAST
BELMONT
AMBERTON ROAD
BRANCEPETH
SPENNYMOOR
FISHBURN
HARTMOOR
BRENDA TRADING
LOW SPENNYMOOR
BILLINGHAM MARSH HSE.
GREATHAM
WYNYARD
HARTLEPOOL STEEL
TORONTO
CHILTON BIOMASS
CLEVELAND INCINERATOR
PHILLIPS
WYNYARD DATA
FYLANDS BRIDGE
AYCLIFFE INDUSTRIAL
SKERNESIDE
BILLINGHAM SYNTHETIC
SALTHOLME
SEAL SANDS GENERATION
TEES INDUSTRIAL
NEWTON AYCLIFFE SOUTH
HEIGHINGTON
SEAL SANDS
BASF SW
HARMIRE BRIDGE
NEW ROAD
NORTH BANK
LACKENBY OXYGEN EAST / NORTH
DARLINGTON NORTH (PART)
MOND
NORTH TEES
HAVERTON INCINERATOR
REDCAR
SKEEBY
NORTON
GRANGETOWN
FARADAY STREET
BRAN SANDS
CARLIN HOW
DARLINGTON WEST
RISE CARR
SPENCERBECK
CLEVELAND POTASH
HIPSWELL
MALLEABLE
LACKENBY
RICHMOND
DARLINGTON P.S.
DARLINGTON CENTRAL
BOWESFIELD
ACKLAM
MILLBANK LANE
URLAY NOOK
PRISSICK
GUISBOROUGH
DARLINGTON EAST
WHITBY WEST
WHITBY
CATTERICK CAMP
DARLINGTON
STOKESLEY
COWTON
ROBIN HOODS BAY SW
NORTHALLERTON
KIRBYMOORSIDE
NORTH STREET
LEEMING BAR
RUDBY
THORNTON DALE
RAVENSCAR
WENSLEYDALE
HUTTON BONVILLE
MALTON
NEWBY
BARDON HALL
THIRSK
CLOUGHTON SW
BEDALE
RAF LEEMING
SCARBOROUGH
SCARBOROUGH
ROMANBY
SESSAY BRIDGE
SOWERBY
SHERIFF HUTTON
YEDINGHAM
EASTFIELD
ROECLIFFE INDUSTRIAL
RIPON
MOOR MONKTON PUMPS
RAWCLIFFE LANE
HAXBY ROAD
HUSTHWAITE
HUNTINGTON NEW LANE
WORMALD GREEN
DARLEY
SEVERUS HILL
POPPLETON
NESSFIELD
FOSS ISLANDS
MELROSEGATE
BOROUGHBRIDGE
KNABS RIDGE
CONEYTHORPE
SKELDERGATE
YORK UNIVERSITY
HARROGATE
STARBECK
GALE LANE
CAMPLESHON ROAD
ELVINGTON
KNAPTON
DATLANDS
FERRYBRIDGE
WHINMOOR
OSBALDWICK
FERRYBRIDGE
KEY
EXISTING SYSTEM
SUPERGRID SUPPLY POINT
132kV SUBSTATIONS
PRIMARY SUBSTATION SECONDARY VOLTAGE INDICATED
66kV MAINS
33kV MAINS

KEY

NGC GRID SUPPLY POINT

GENERATING STATION

SUPPLY POINT

PRIMARY SUBSTATION

33 KV

66 KV

Appendix 4 – DNO 20kV and 66kV asset bases

Appendix 4 – 20kV - Network data: total assets on asset register as at 2023 (1 year snap shot)

Source: Ofgem consolidation of BPDT V1

Asset	Name	Units	ENWL	NPGN	NPGY	WMID	EMID	SWALES	SWEST	LPN	SPN	EPN	SPD	SPMW	SSEH	SSES
Cable	20kV UG Cable	km	0	1,720	0	0	0	0	0	2	0	0	0	0	0	0
	Percentage of DNO Total		**0%**	**100%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**
Overhead Pole Line	20kV OHL (Conventional Conductor)	km	0	5,093	0	0	0	0	0	2	0	0	0	0	0	0
	20kV OHL (BLX or similar Conductor)	Each	0	28	0	0	0	0	0	2	0	0	0	0	0	0
	20kV Poles		0	63,694	0	0	0	0	0	2	0	0	0	0	0	0
	Total		**0**	**68,815**	**0**	**0**	**0**	**0**	**0**	**2**	**0**	**0**	**0**	**0**	**0**	**0**
	Percentage of DNO Total		**0%**	**100%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**
Switchgear	20kV CB (PM)	Each	0	564	0	0	0	0	0	2	0	0	0	0	0	0
	20kV CB (GM) Primary	Each	0	399	0	0	0	0	0	2	0	0	0	0	0	0
	20kV CB (GM) Secondary	Each	0	678	0	0	0	0	0	2	0	0	0	0	0	0
	20kV Switch (PM)		0	231	0	0	0	0	0	2	0	0	0	0	0	0
	20kV Switchgear - Other (PM)		0	6,418	0	0	0	0	0	2	0	0	0	0	0	0
	20kV Switch (GM)		0	151	0	0	0	0	0	2	0	0	0	0	0	0
	20kV RMU	Each	0	1,214	0	0	0	0	0	2	0	0	0	0	0	0
	Total		**0**	**9,655**	**0**	**0**	**0**	**0**	**0**	**2**	**0**	**0**	**0**	**0**	**0**	**0**
	Percentage of DNO Total		**0%**	**100%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**
Transformer	20kV Transformer (PM)	Each	0	7,314	0	0	0	0	0	2	0	0	0	0	0	0
	20kV Transformer (GM)		0	1,676	0	0	0	0	0	2	0	0	0	0	0	0
	Total		**0**	**8,990**	**0**	**0**	**0**	**0**	**0**	**2**	**0**	**0**	**0**	**0**	**0**	**0**
	Percentage of DNO Total		**0%**	**100%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**

Appendix 4 – 66kV - Network data: total assets on asset register as at 2023 (1 year snap shot)

Source: Ofgem consolidation of BPDT V1

Asset	Name	Units	ENWL	NPGN	NPGY	WMID	EMID	SWALES	SWEST	LPN	SPN	EPN	SPD	SPMW	SSEH	SSES
Cable	66kV UG Cable (Gas)	km	0	0	0	0	0	0	0	2	0	0	0	0	0	0
	66kV UG Cable (Non Pressurised)	km	0	273	140	90	0	7	0	187	0	0	0	0	0	149
	66kV UG Cable (Oil)	km	0	299	4	6	0	2	0	245	0	0	0	0	0	58
	EHV Sub Cable	km	2	0	0	0	0	2	66	0	0	0	2	5	317	14
	Total		**2**	**571**	**144**	**96**	**0**	**11**	**66**	**434**	**0**	**0**	**2**	**5**	**317**	**221**
	Percentage of DNO Total		**0.12%**	**30.55%**	**7.72%**	**5.16%**	**0.00%**	**0.57%**	**3.53%**	**23.22%**	**0.00%**	**0.00%**	**0.11%**	**0.25%**	**16.95%**	**11.82%**
Overhead Pole Line	66kV OHL (Pole Line) Conductor	km	0	403	835	717	0	319	0	0	0	0	0	0	15	7
	66kV Pole	Each	0	5,830	11,448	9,173	0	4,679	0	0	0	0	0	0	0	60
	66kV Fittings		0	2,538	167	1,242	0	338	0	56	0	0	0	0	0	0
	66kV OHL (Tower Line) Conductor	km	0	543	15	67	0	41	0	15	0	0	0	0	0	0
	66kV Tower	Each	0	1,291	84	621	0	124	0	28	0	0	0	0	0	0
	Total		**0**	**10,605**	**12,549**	**11,820**	**0**	**5,501**	**0**	**99**	**0**	**0**	**0**	**0**	**15**	**67**
	Percentage of DNO Total		**0.00%**	**26.08%**	**30.87%**	**29.07%**	**0.00%**	**13.53%**	**0.00%**	**0.24%**	**0.00%**	**0.00%**	**0.00%**	**0.00%**	**0.04%**	**0.16%**
Switchgear	66kV CB (Air Insulated Busbars)(OD) (GM)	Each	0	387	279	70	0	59	0	24	0	0	0	0	0	0
	66kV CB (Gas Insulated Busbars)(ID) (GM)	Each	0	14	0	0	0	0	0	37	0	0	0	0	0	71
	66kV CB (Gas Insulated Busbars)(OD) (GM)	Each	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	66kV CB (Air Insulated Busbars)(ID) (GM)	Each	0	0	0	14	0	1	0	68	0	0	0	0	0	0
	Total		**0**	**401**	**279**	**84**	**0**	**60**	**0**	**129**	**0**	**0**	**0**	**0**	**0**	**71**
	Percentage of DNO Total		**0.00%**	**39.16%**	**27.25%**	**8.20%**	**0.00%**	**5.86%**	**0.00%**	**12.60%**	**0.00%**	**0.00%**	**0.00%**	**0.00%**	**0.00%**	**6.93%**
Transformer	66kV Transformer	Each	0	198	125	86	0	29	0	95	0	0	0	0	0	56
	Percentage of DNO Total		**0.00%**	**33.62%**	**21.22%**	**14.60%**	**0.00%**	**4.92%**	**0.00%**	**16.13%**	**0.00%**	**0.00%**	**0.00%**	**0.00%**	**0.00%**	**9.51%**

Appendix 5 – 66kV and 20kV premium estimates

Appendix 5 - NPgN 66 & 20kV Premium

Price base (2012/13)	Units	Npg RIIO-ED1 Volumes	NPg RIIO-ED1 Unit Cost	Ofgem Adjusted Unit Cost	Unit Cost Differential (66-v-33, 20-v-11)		Included in 66/20kV Premium Calculation		66 / 20kV Premium
Activity			**2016-2023**	**Option 6**	**NPg unit costs**	**Ofgem unit costs**	**MPg Costs**	**Ofgem Costs**	
		#	**£k/unit**		**£k**	**£k**			**£k**
6.6/11kV OHL (Conventional Conductor)	km	**132**	24.87	19.47					**0.00**
6.6/11kV OHL (BLX or similar Conductor)	km	**0**	0	30.64					**0.00**
20kV OHL (Conventional Conductor)	km	**128**	25.77	25.21	0.90	5.74	yes		**115.48**
20kV OHL (BLX or similar Conductor)	km	**0**	0	38.90	0.00	8.26			**0.00**
6.6/11kV Poles	Each	**6,077**	2.18	1.94					**0.00**
20kV Poles	Each	**6,179**	2.27	2.33	0.09	0.39	yes		**554.08**
6.6/11kV UG Cable	km	**183**	73.46	100.00					**0.00**
20kV UG Cable	km	**43**	81.57	110.00	8.11	10.00	yes		**349.77**
HV Sub Cable	km	**0**	0	302.98					**0.00**
6.6/11kV CB (PM)	Each	**128**	5.16	8.18					**0.00**
6.6/11kV CB (GM) Primary	Each	**204**	44.31	28.70					**0.00**
6.6/11kV CB (GM) Secondary	Each	**0**	0	8.55					**0.00**
6.6/11kV Switch (PM)	Each	**0**	0	6.08					**0.00**
6.6/11kV Switchgear - Other (PM)	Each	**585**	3.05	1.33					**0.00**
6.6/11kV Switch (GM)	Each	**0**	0	6.47					**0.00**
6.6/11kV RMU	Each	**555**	11.74	12.09					**0.00**
6.6/11kV X-type RMU	Each	**0**	0	16.36					**0.00**
20kV CB (PM)	Each	**120**	5.35	9.55	0.19	1.37	yes		**22.82**
20kV CB (GM) Primary	Each	**112**	59.89	35.96	15.58	7.26	yes		**1744.91**
20kV CB (GM) Secondary	Each	**0**	0	8.86	0	0.31			**0.00**
20kV Switch (PM)	Each	**0**	0	4.69	0	-1.40			**0.00**
20kV Switchgear - Other (PM)	Each	**504**	3.38	1.18	0.33	-0.15	yes		**167.36**
20kV Switch (GM)	Each	**0**	0	7.50	0	1.03			**0.00**
20kV RMU	Each	**92**	12.53	12.31	0.79	0.23	yes		**72.99**
6.6/11kV Transformer (PM)	Each	**119**	3.75	3.34					**0.00**
6.6/11kV Transformer (GM)	Each	**585**	11.71	11.42					**0.00**
20kV Transformer (PM)	Each	**94**	4.00	4.30	0.25	0.96	yes		**23.57**
20kV Transformer (GM)	Each	**117**	12.04	13.01	0.34	1.58	yes		**39.22**
Batteries at GM HV Substations	Each	**320**	0.54	1.57					**0.00**
33kV OHL (Pole Line) Conductor	km	**0**	0	29.96					**0.00**
33kV Pole	Each	**182**	4.71	2.50					**0.00**
66kV OHL (Pole Line) Conductor	km	**0**	0	35.00	0.00	5.04			**0.00**
66kV Pole	Each	**201**	3.74	3.77	-0.97	1.27		yes	**255.39**
33kV OHL (Tower line) Conductor	km	**0**	0	42.93					**0.00**
33kV Tower	Each	**0**	0	43.09					**0.00**
33kV Fittings	Each	**0**	0	1.13					**0.00**
66kV OHL Conductor	km	**120**	27.38	56.94	27.38	14.01		yes	**1684.82**
66kV Tower	Each	**2**	82.56	80.74	82.56	37.6		yes	**75.30**
66kV Fittings	Each	**1,086**	4.20	1.45	4.20	0.32	yes		**4561.06**
33kV UG Cable (Non Pressurised)	km	**22**	357.26	357.26					**0.00**
33kV UG Cable (Oil)	km	**0**	0	263.40					**0.00**
33kV UG Cable (Gas)	km	**0**	0	263.40					**0.00**
66kV UG Cable (Non Pressurised)	km	**57**	503.59	532.91	146.3	175.65	yes		**8369.72**
66kV UG Cable (Oil)	km	**0**	0	532.91	0	269.5			**0.00**
66kV UG Cable (Gas)	km	**0**	0	532.91	0	269.51			**0.00**
EHV Sub Cable	km	**0**	0	475.00					**0.00**
33kV CB (Air Insulated Busbars)(ID) (GM)	Each	**0**	0	54.91					**0.00**
33kV CB (Air Insulated Busbars)(OD) (GM)	Each	**0**	0	67.61					**0.00**
33kV CB (Gas Insulated Busbars)(ID) (GM)	Each	**0**	0	83.18					**0.00**
33kV CB (Gas Insulated Busbars)(OD) (GM)	Each	**0**	0	83.18					**0.00**
33kV Switch (GM)	Each	**0**	0	38.81					**0.00**
33kV Switchgear - Other	Each	**0**	0	6.78					**0.00**
33kV Switch (PM)	Each	**0**	0	3.93					**0.00**
33kV RMU	Each	**0**	0	95.90					**0.00**
66kV CB (Air Insulated Busbars)(ID) (GM)	Each	**0**	0	109.46					**0.00**
66kV CB (Air Insulated Busbars)(OD) (GM)	Each	**76**	287.31	175.00	0.00	113.74		yes	**8644.09**
66kV CB (Gas Insulated Busbars)(ID) (GM)	Each	**0**	0	197.41					**0.00**
66kV CB (Gas Insulated Busbars)(OD) (GM)	Each	**0**	0	197.41					**0.00**
66kV Switchgear - Other	Each	**3**	101.70	7.39	101.7	0.61		yes	**1.83**
33kV Transformer (PM)	Each	**0**	0	2.84					**0.00**
33kV Transformer (GM)	Each	**17**	536.73	331.82					**0.00**
66kV Transformer	Each	**11**	544.18	510.01	7.45	178.2		yes	**1960.18**
Batteries at 33kV Substations	Each	**67**	12.06	6.60					**0.00**
Batteries at 66kV Substations	Each	**56**	11.22	6.60					**0.00**
Total									**28,643**

Appendix 5 - NPgY 66kV Premium

Price base (2012/13)	Units	Npg RIIO-ED1 Volumes	NPg RIIO-ED1 Unit Cost	Ofgem Adjusted Unit Cost	Unit Cost Differential (66-v-33, 20-v-11)		Included in 66/20kV Premium Calculation		66 / 20kV Premium
Activity			2016-2023	Option 6	NPg unit costs	Ofgem unit costs	MPg Costs	Ofgem Costs	
		#	£k/unit		£k	£k			£k
33kV OHL (Pole Line) Conductor	km	122	70.16	29.96					**0.00**
33kV Pole	Each	2,513	5.44	2.50					**0.00**
66kV OHL (Pole Line) Conductor	km	68	71.00	35.00	0.84	5.04	yes		**56.69**
66kV Pole	Each	1,855	5.66	3.77	0.22	1.27	yes		**410.82**
33kV OHL (Tower line) Conductor	km	5	22.84	42.93					**0.00**
33kV Tower	Each	0	0	43.09					**0.00**
33kV Fittings	Each	46	1.75	1.13					**0.00**
66kV OHL Conductor	km	0	0	56.94	-22.84	14.01			**0.00**
66kV Tower	Each	0	0	80.74	0	37.65			**0.00**
66kV Fittings	Each	80	4.49	1.45	2.73	0.32	yes		**218.65**
33kV UG Cable (Non Pressurised)	km	55	341.84	341.84					**0.00**
33kV UG Cable (Oil)	km	0	0	263.40					**0.00**
33kV UG Cable (Gas)	km	0	0	263.40					**0.00**
66kV UG Cable (Non Pressurised)	km	4	544.29	532.91	202.45	191.07	yes		**728.81**
66kV UG Cable (Oil)	km	0	0	532.91					**0.00**
66kV UG Cable (Gas)	km	0	0	532.91					**0.00**
EHV Sub Cable	km	0	0	475.00					**0.00**
33kV CB (Air Insulated Busbars)(ID) (GM)	Each	0	0	54.91					**0.00**
33kV CB (Air Insulated Busbars)(OD) (GM)	Each	6	218.93	67.61					**0.00**
33kV CB (Gas Insulated Busbars)(ID) (GM)	Each	0	0	83.18					**0.00**
33kV CB (Gas Insulated Busbars)(OD) (GM)	Each	0	0	83.18					**0.00**
33kV Switch (GM)	Each	0	0	38.81					**0.00**
33kV Switchgear - Other	Each	0	0	6.78					**0.00**
33kV Switch (PM)	Each	0	0	3.93					**0.00**
33kV RMU	Each	0	0	95.90					**0.00**
66kV CB (Air Insulated Busbars)(ID) (GM)	Each	0	0	109.46					**0.00**
66kV CB (Air Insulated Busbars)(OD) (GM)	Each	54	297.84	175.00	78.92	113.74		yes	**6141.86**
66kV CB (Gas Insulated Busbars)(ID) (GM)	Each	0	0	197.41					**0.00**
66kV CB (Gas Insulated Busbars)(OD) (GM)	Each	0	0	197.41					**0.00**
66kV Switchgear - Other	Each	0	0	7.39					**0.00**
33kV Transformer (PM)	Each	0	0	2.84					**0.00**
33kV Transformer (GM)	Each	27	542.40	331.82					**0.00**
66kV Transformer	Each	12	592.69	510.01	50.29	178.20		yes	**2138.38**
Batteries at 33kV Substations	Each	43	0.50	6.60					**0.00**
Batteries at 66kV Substations	Each	33	0.51	6.60					**0.00**
Total									**9,695**