TRANSMISSION COMPANY OF NIGERIA

INDEPENDENT SYSTEM OPERATOR (ISO)

Part 5

Transmission Adequacy Report

Outlook for 2017-2027

By

Market Operator

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Contact: Engr. Musa Musa Gumel
Ag. Managing Director Independent System Operator (ISO)
No. 14 Zambezi Crescent, Maitama, Abuja, Nigeria

Contact: Engr. Moshood Saleeman
Ag. Managing Director Market Operator (MO)
No. 14 Zambezi Crescent, Maitama, Abuja, Nigeria

Author:
Peter Lilje, Ph.D.
Dr.-Ing. Markus Pöller
Moeller & Poeller Engineering (M.P.E.) GmbH
Europaplatz 5, 72076 Tübingen, Germany
Tel.: +49 7071 13879-0
Email: info@moellerpoeller.de

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No 2 Dr. Clement Isong street, Asokoro, Abuja/Nigeria
Contact: Ina Hommers (ina.hommers@giz.de)
T 00234 (0)8057601986

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Contents

Definitions of Terms and Acronyms

The acronyms, as well as terms that are used in the performance indices, are defined below.

Availability	MTTF / (MTTF + MTTR)
DC	Double circuit
DISCO	Distribution company
Effective Substation Capacity	Sum of transformer ratings at the DISCO interfaces, considering (n-1)-security
Failure Rate	Number of failures per year
Mixed network	Network that is partially secure and partially not, e.g. 132kV ring supplied from two nodes having substations along the ring, with a radial line supplied from one such substation.
MTTF	Mean time to fail
MTTR	Mean time to repair
MV	Medium voltage
MYTO	Multi-year tariff order
Non-Secure capability	Network capability under (n-0) operating conditions
Non-Secure network	Network supplied from just one node and having non-redundant components, e.g. radial single-circuit network
SC	Single circuit
Secure capability	Network capability under (n-1) operating conditions
Secure network	Network supplied from at least two nodes and/or consisting of redundant components
Total Substation Capacity	Sum of transformer ratings at the DISCO interfaces

1. Introduction

The transmission adequacy during the year 2015 was analysed by assessing the ability of the transmission system to reliably transmit electrical power from the generation stations to the DISCOs and to the neighbouring countries.

Chapter 2 provides an overview of the transmission system, including its topology, the main assets and its installed capacity.

Chapter 3 explains how the capability of the transmission system and the maximum short-circuit levels were calculated.

Chapter 4 summarises the generation and transmission expansion projects in tables. Changes to the transmission lines are also shown graphically.

Chapters 5, 6 and 7 contain the results. Separate subsections are provided for the 330kV and the 132kV networks, as well as for the years 2017, 2018 and 2019-2027.

Finally, Chapter 8 summarises the results.

2. Transmission Installed Capacity

Figure 1 provides a graphical representation of the high voltage transmission lines at the end of 2016, where the 330kV lines are shown in blue and 132kV lines are shown in green.

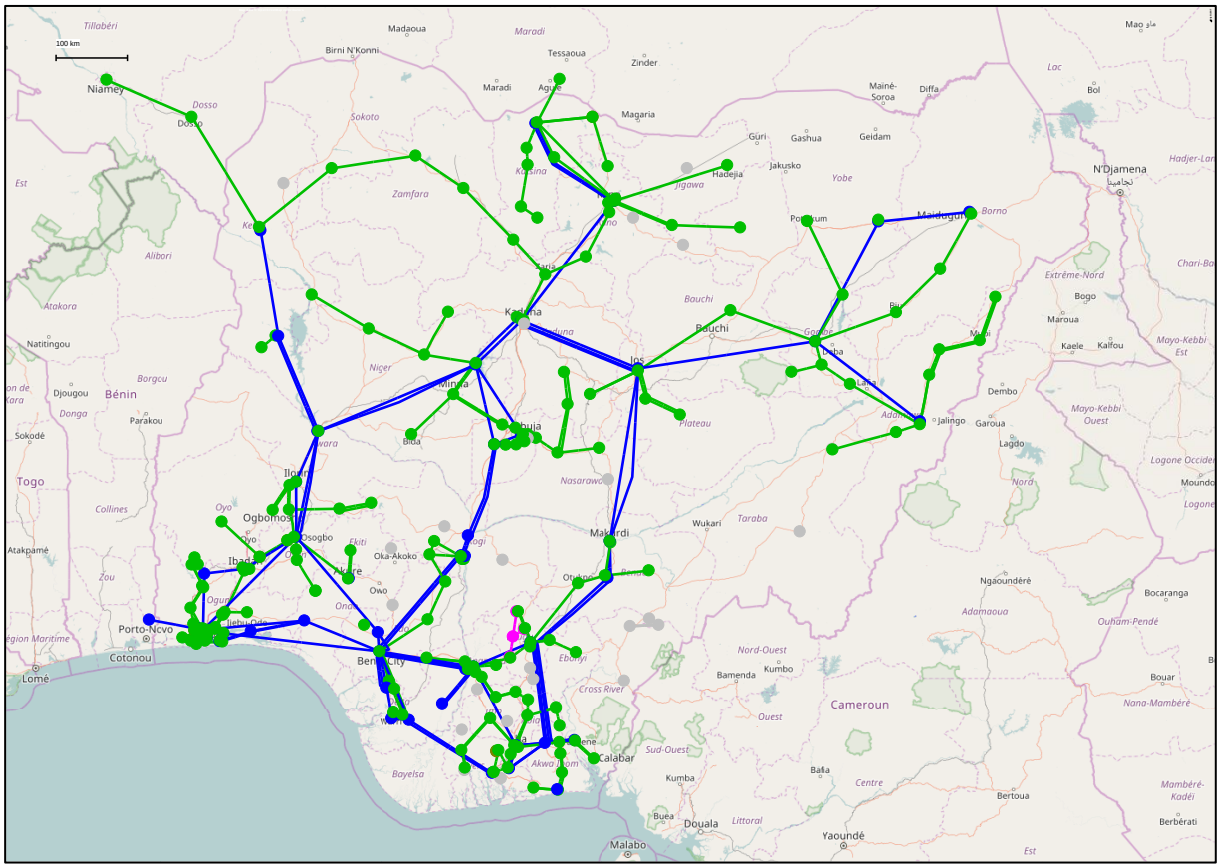

Figure 1: Map of transmission system at the end of 2016 showing voltage levels 330kV (blue), 132kV (green) and 66kV (yellow[1])

The transmission system supplies power to 11 DISCOs as well as two neighbouring countries (Benin and Niger). Figure 2 shows the high-voltage supplies to the DISCOs and to the neighbouring countries. All such supplies are at 132kV level.

[1] *The map shows lines that have been commissioned by the end of 2015.*

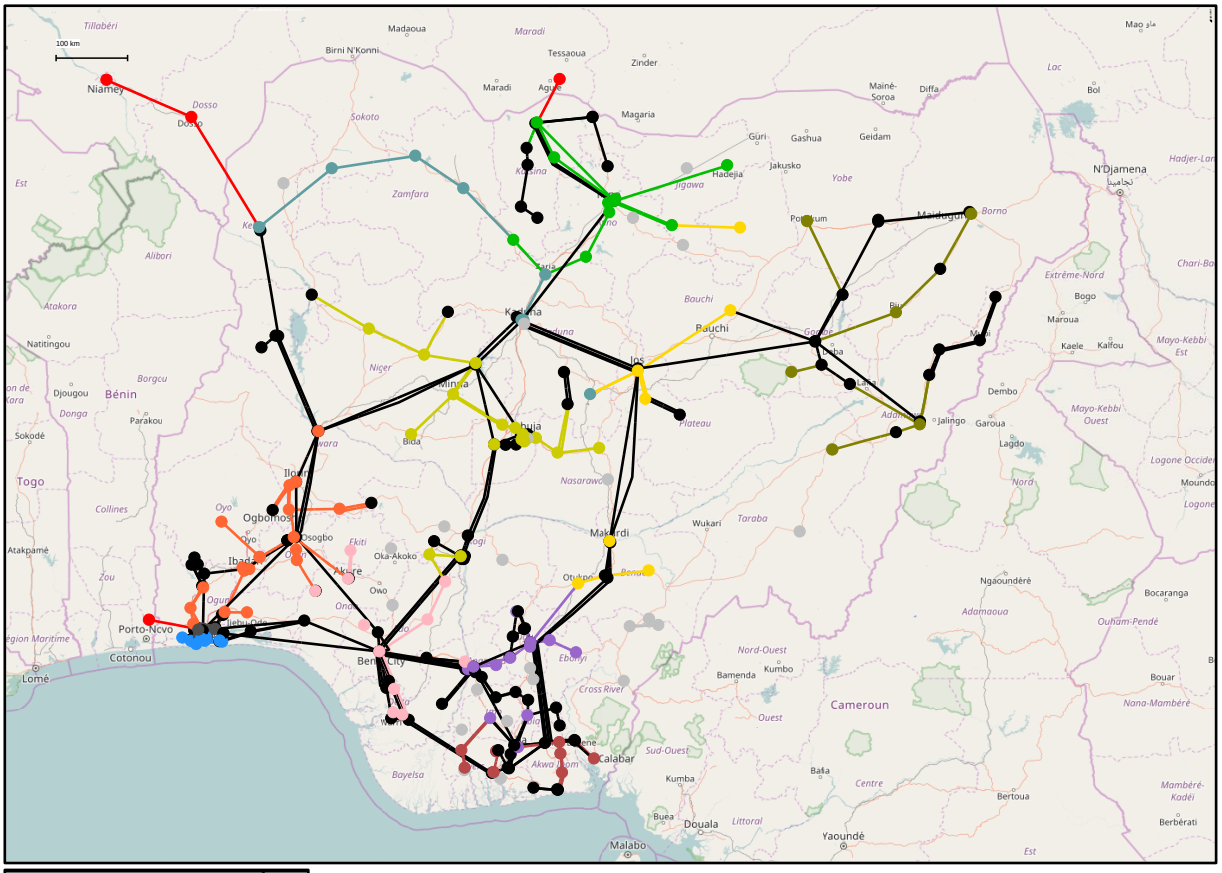

Figure 2: Map of transmission system at the end of 2016 showing HV supplies to the DISCOs

Table 1 provides a summary of the transmission assets at the end of 2016. A summary of an asset register, consisting of lists of transmission lines, transformers and shunts, is included in Annex 1.

The capacities of the substations supplying the DISCOs were obtained from the ratings of the transformers that supply the DISCOs. The effective capacities exclude the redundant transformer capacities. Whether a transformer was redundant was based on engineering judgement[2], by looking at the ratings of the transformers. The total capacities and effective capacities are shown in Table 2. Additional information is included in Annex 1.4.

[2] *A detailed analysis of each substation design could be executed in the future for increased accuracy.*

Table 1: Summary of transmission assets as at end 2016 (power components)

Type of asset, description	Number	Value
Number and total length of transmission lines (multiple-circuit / single-circuit)		
330kV	80	7724 km
132kV	201	8539 km
66kV	2	20 km
Number of substations	156	
Transformer capacity		
330/132kV	84	12476 MVA
132/66kV	1	30 MVA
132/MV	306	13550 MVA
66/33kV	2	15 MVA
Reactive compensation		
Inductive shunts	22	1420 Mvar
Capacitive shunts	32	700 Mvar
Dynamic compensation (e.g. SVC, STATCOM)	0	0 Mvar

Table 2: Substation capacities at transmission interface, end 2016

DISCO	Total Substation Capacity [MVA]	Effective Substation Capacity [MVA]
Abuja	1592.5	1002.5
Benin	1165	785
Eko	1470	865
Enugu	1202.5	797.5
Ibadan	1495	985
Ikeja	1590	1025
Jos	555	425
Kaduna	975	635
Kano	827.5	550
Port Harcourt	1055	775
Yola	375	270
Total capacity (local)	**12302.5**	**8115**

3. Methodology

3.1. General

The capability of the transmission system over a ten-year period was derived using a model of the power system.

The transmission capability is limited mainly by thermal considerations and by voltage stability. The capabilities of the 330kV and the 132kV networks are determined separately.

The generation and transmission expansion plans were considered in the analysis. Since the final plans were not available at the time of writing this report, preliminary information was used. The expected changes to generation stations were derived from the Preliminary Transmission Expansion Plan [1] and the changes to the transmission system were obtained from the On-going Transmission Projects List [2]. The details are discussed in the following chapter.

In addition to the transmission capability, the maximum short-circuit levels (both currents and powers) at all 330kV and 132kV busbars were calculated for December 2017 and December 2018.

3.2. Transmission Capability of 330kV Network

The thermal capability of the 330kV network was studied by means of "DC" load flow calculations. Such calculations allow the network to be studied under high load conditions, even if this would lead to voltage instability in the underlying 132kV networks.

The transmission capability is reported at generation level, the maximum power generation at the interfaces to the transmission network. Therefore, transmission losses are excluded.

The calculated transmission capability depends on the distribution of the load. The distribution could be according to:

1. A fixed allocation rule, when there is insufficient generation.
2. The forecasted demand of the individual DISCOs, when there is sufficient generation.

The Generation Adequacy Report: Outlook for 2017-2027 shows that generation will be insufficient for the next ten years. Therefore, only point (1) above applies in this report.

The load allocation to the DISCOs and the neighbouring countries was assumed to be in accordance with the percentages given in Table 3. These percentages were applied in the past.

Table 3: Percentage load allocation to DISCOs and exports to neighbouring countries

DISCO / Export	MYTO	Allocation [%]	Example [MW]
Abuja	11.5%	10.7%	449
Benin	9.0%	8.4%	351
Eko	11.0%	10.2%	430
Enugu	9.0%	8.4%	351
Export_Benin	-	4.8%	200
Export_Niger	-	2.3%	95
Ibadan	13.0%	12.1%	508
Ikeja	15.0%	13.9%	586
Jos	5.5%	5.1%	215
Kaduna	8.0%	7.4%	312
Kano	8.0%	7.4%	312
PHDC	6.5%	6.0%	254
Yola	3.5%	3.3%	137
Total	**100.0%**	**100.0%**	**4200**

The capability of the 330kV network was studied under (n-0)-conditions, i.e. intact, as well as under (n-1)-conditions, i.e. with one 330kV line out of service. Such contingencies were only considered for the secure part of the 330kV network, i.e. double-circuit lines of a meshed network. Contingencies of radial 330kV lines were not considered, since these simply lead to power outages. Lists of Non-Secure network components (330kV lines and transformers) were compiled for the years 2017 and 2018.

All values were calculated for the case with all installed conventional generators in service. Variations in the capability will occur from day to day, depending on the generation dispatch and the availability of transmission equipment. Such variations are studied separately by the system operator and are not the subject of this report.

In addition to the thermal capability, the voltage stability-constrained capability was calculated. This was done by finding the maximum power at which the boundary flows, which are permissible from a voltage stability perspective, would be reached. Again, DC load flow calculations were used. However, the permissible boundary flows were obtained from a Separate Voltage Stability Study [3], in which AC load flow calculations were used.

Figure 3 shows the boundaries that were considered and Table 4 sows the permissible boundary flows, all at 330kV level. The permissible boundary flows apply if all hydro generators are in service - see [3] for details.

Ultimately, the capability of the 330kV network was obtained as the minimum of the thermal limits and the voltage stability-constrained limits.

Table 4: Voltage stability constraints used in the calculations (maximum power flows in MW)

Boundary	Jan_2017		Jun_2017		Dec_2017		Nov 18		2019		2025	
	n-0	n-1	n-0	n-1	n-0	n-1	n-0	n-1	n-0	n-1	n-0	n-1
Lagos	2350	1125	2800	1750	3300	2000	3300	2000	3500	2200	3070	1850
Kaduna	1000	820	1000	790	850	600	1300	950	1400	1000	1400	1000
Jos	790	420	790	420	1050	850	1550	1350	1650	1400	1650	1400
Gombe	275		275		406		424		450		450	
Maiduquri	95		95		170		155		180		180	
Yola	110		110		200		200		225		225	
Birnin_Kabbi	300		300		300		300		330		330	

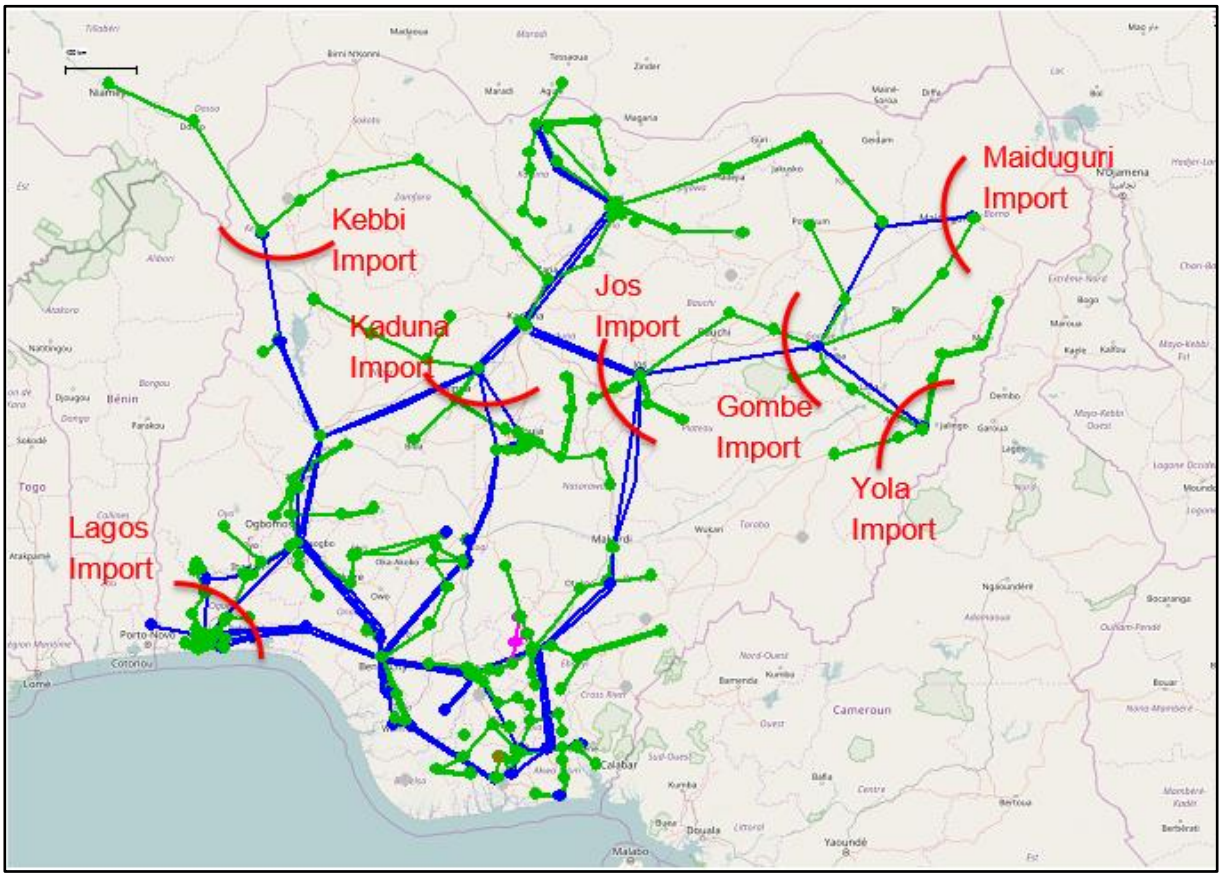

Figure 3: 330kV boundaries at which voltage stability constraints were considered

3.3. Transmission Capability of 132kV Networks

In addition to the above, the capabilities of the individual 132kV networks were calculated for 2017 and 2018. The 132kV networks are defined according to their connections to the 330kV network, i.e. they end at the 132kV terminals of the 330/132kV transmission transformers. To illustrate this, Figure 4 shows the 132kV networks in December 2017 (the dark blue lines represent secure 330kV lines, the light blue lines represent single-circuit radial 330kV networks and the remaining colours represent the 132kV networks).

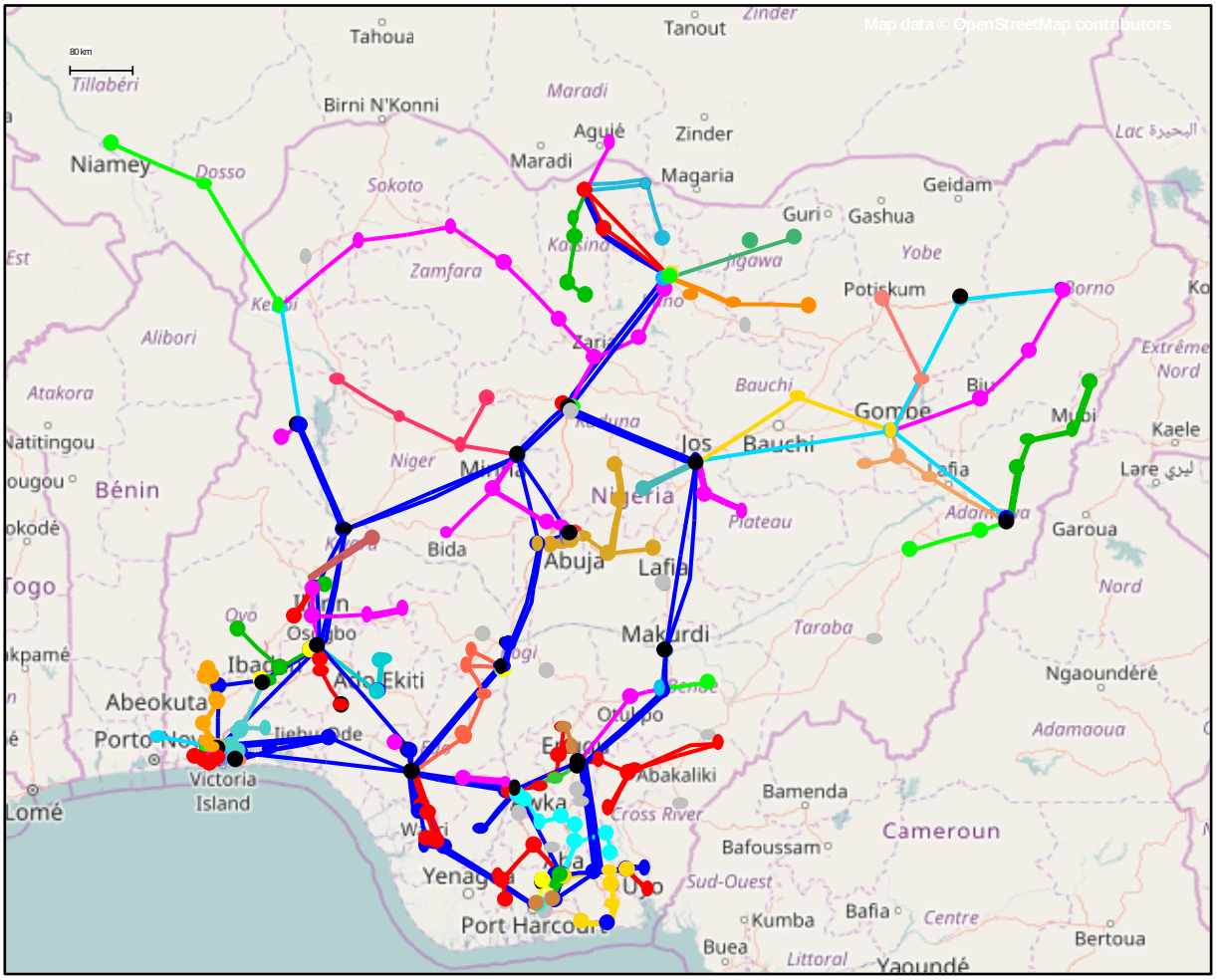

Figure 4: Map of the transmission system at the end of 2017 showing 132kV networks in different colours (dark blue and light blue lines represent 330kV networks).

The following operating conditions were considered:

a. Maximum load of all 132kV networks
b. Maximum load of “Secure” and “Mixed” 132kV networks under (n-1)-operating conditions.

A secure network is one that is either supplied from more than one node, or it is supplied by redundant transmission lines (e.g. double-circuit lines). Radial networks with single circuit lines are not (n-1)-secure. Mixed networks are partially secure, but contain at least one node whose supply is not (n-1)-secure. Examples of secure networks and Non-Secure networks are shown below.

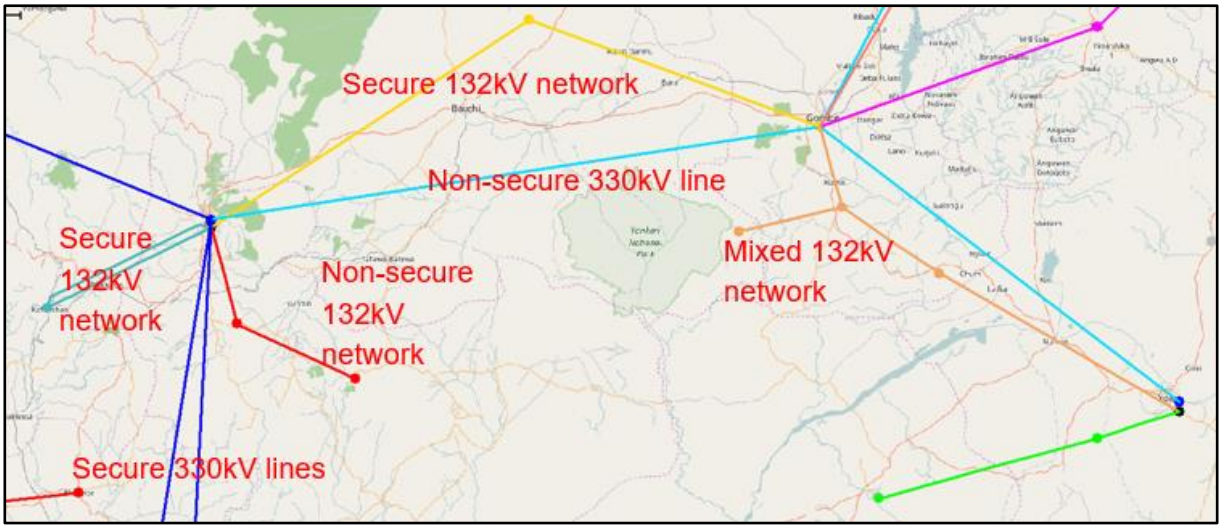

Figure 5: Examples of meshed, radial and Mixed 132kV networks

The transmission networks were further categorised into ones that include transmission lines and others, which consist of substations located at 330/132lV substations. The capabilities of the former category were derived as discussed below. The capabilities of the latter were assessed from the rating of the 132kV/MV transformers. The installed transformer capacity represents the non-secure capability, and the effective capacity represents the non-secure capability.

The transmission capability is reported at load level, i.e.at the MV interfaces to the DISCOs and at the 132kV interfaces to the loads of neighbouring countries. Therefore, transmission losses are included.

The capabilities of the 132kV networks were determined using "AC" load flow calculations. In this way, it is determined whether the capabilities are limited thermally or due to voltage stability.

Wherever the capability was limited by voltage stability, additional "DC" load flows were executed to determine the thermal limits. The latter represent the limits that could be achieved if the voltage problems in these networks were resolved. The results were adjusted to consider the losses in the 132kV lines and the 132kV/MV transformers (estimated at 2% in total), since these are neglected in the DC load flow calculation.

3.4. Maximum Short-Circuit Levels

The maximum short-circuit currents and short-circuit powers were calculated according to IEC 60909-2016. The information can be used in the future to verify the adequacy of the substation short-circuit ratings.

4. Network Expansion

4.1. Generation Projects

Details about the changes to the power plants are contained in the generation adequacy outlook. That report lists the numerous possible scenarios. The changes that are considered most likely are contained in a Base Case. These are summarised in Table 5, where positive values indicate additions (commissioning of new plants) and negative values indicate reductions (decommissioning of old plants).

Table 5: Summary of changes to installed generation capacity 2017-2027

Power plant	Change in power plant installed capacities [MW]										
	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
Aba							549				
Aba_IPP							134				
Afam	-450	260									
Alaoji		275									
Alscon									340		
Anambra									500		
Asip					500						
Azikel_IPP				467							
Azura			440								
Bresson			343								
Century_IPP					480						
Delta		143			-615						
Egbema		360									
Egbin			220					-220	-1100		
Egbin_Aes					144						
Eleme		20									
Gbarain		240									
Hudson				144							
Ibom		174						360	120		
Ics_IPP					600						
Lafarage			47		207						
Mabon					39						
Olorunsogo_NIPP		120									
Oma_Power			240		120		103				
Omoku_NIPP		240									
Paras				60							
Quatpower_Aba							360				
Rivers		160									
Sapele		280	-70	-210	-140						
Sapele_NIPP											
Shiroro				290							
Zungeru				290							
Total	**-450**	**2272**	**1220**	**1041**	**1335**	**0**	**1146**	**140**	**-140**	**0**	**0**

4.2. Transmission Projects

4.2.1. Overview

A summary of the transmission projects is shown in Table 6. Additional information is provided thereafter.

Table 6: Summary of changes in the transmission system 2017-2027

Year	330kV circuits		132kV circuits		330/132kV Trf		132kV/MV Trf	
	#	km	#	km	#	MVA	#	MVA
2017	13	1909	59	2986	11	1650	94	5118
2018	3	500	10	594	0	0	2	120
2022	0	0	8	980	0	0	22	1400

4.2.2. 2017

Figure 6 shows the modifications to the transmission lines in 2017. A detailed list of changes to the transmission system is provided in Table 28, Annex 2.

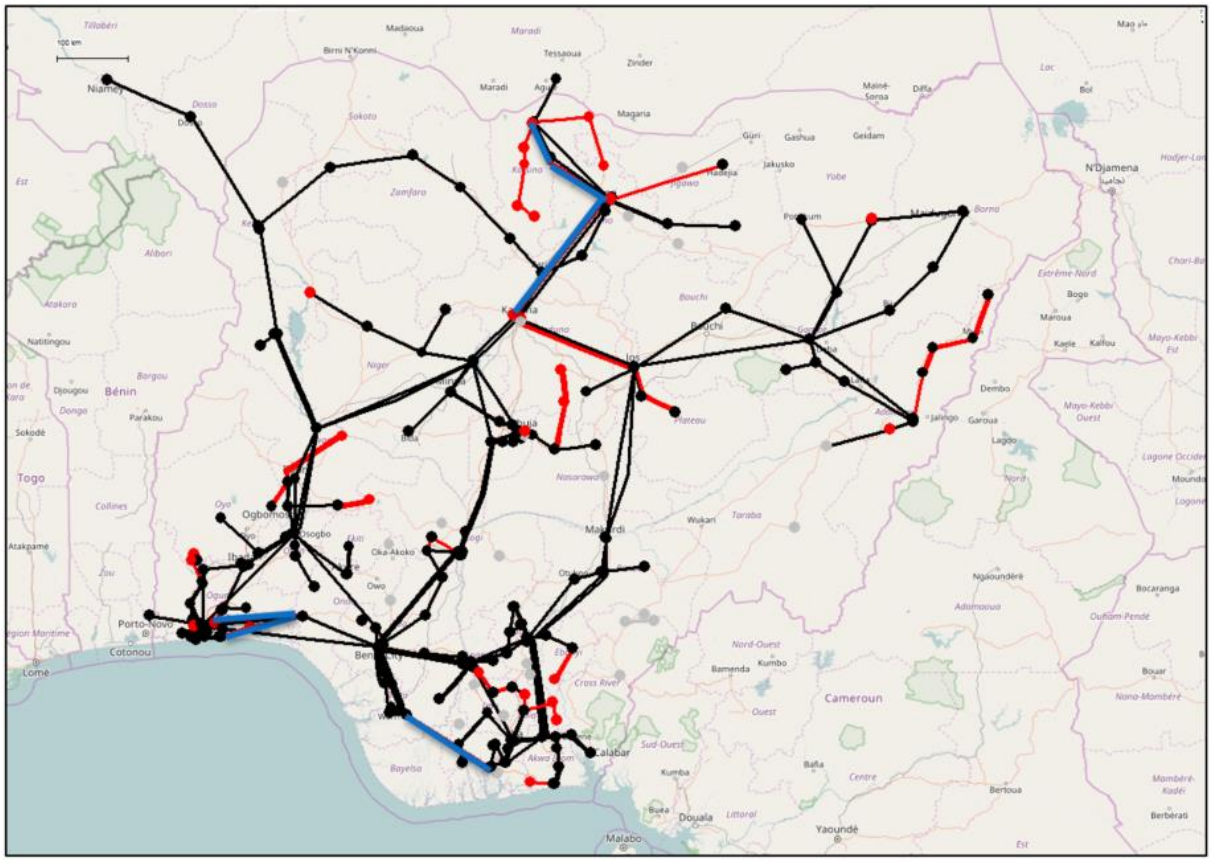

Figure 6:OHL modifications in 2017 (blue for 330kV, red for 132kV)

4.2.3. 2018

Figure 7 shows the modifications to the transmission lines in 2018. A detailed list of changes to the transmission system is provided in Table 29, Annex 2.

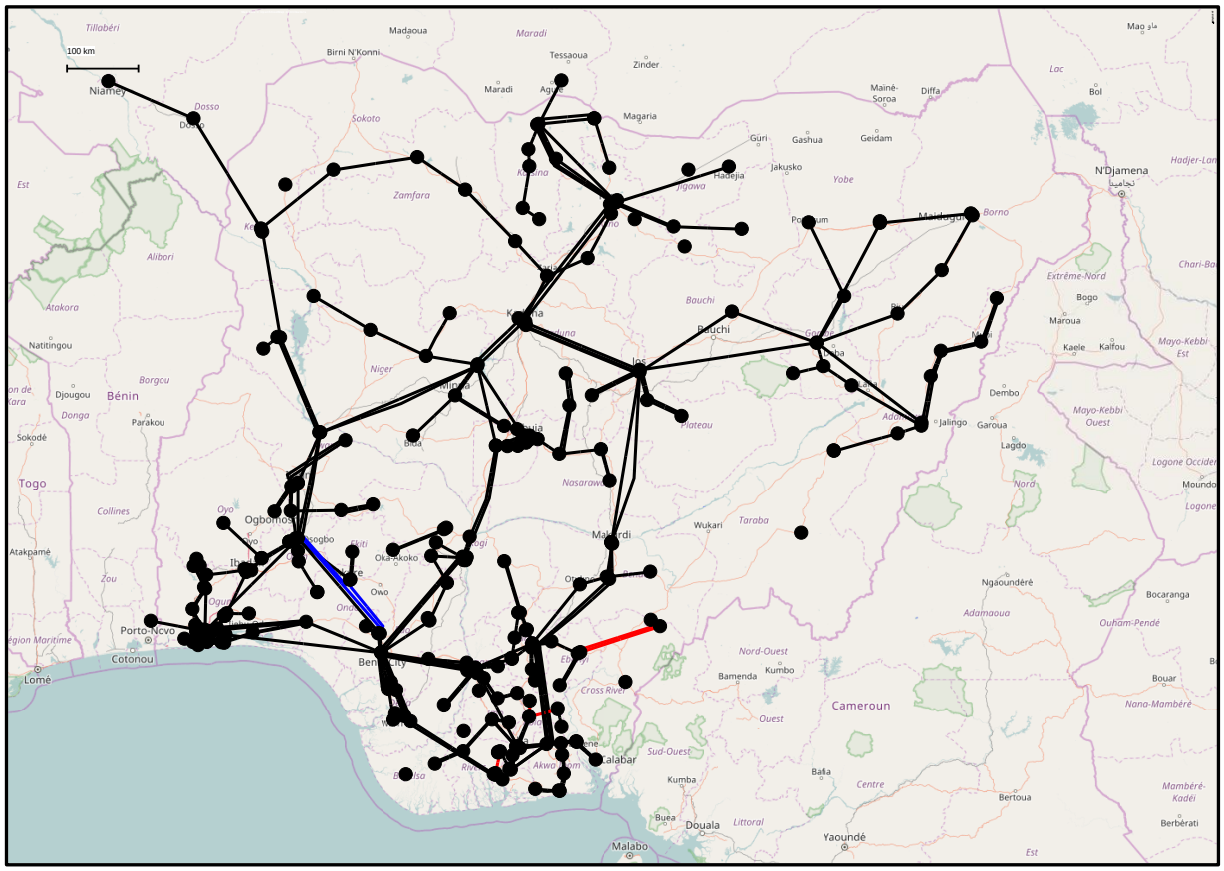

Figure 7:OHL modifications in 2018 (blue for 330kV, red for 132kV)

4.2.4. 2019-2027

Figure 8 shows the modifications to the transmission lines after 2018. A detailed list of changes to the transmission system is provided in Table 30, Annex 2.

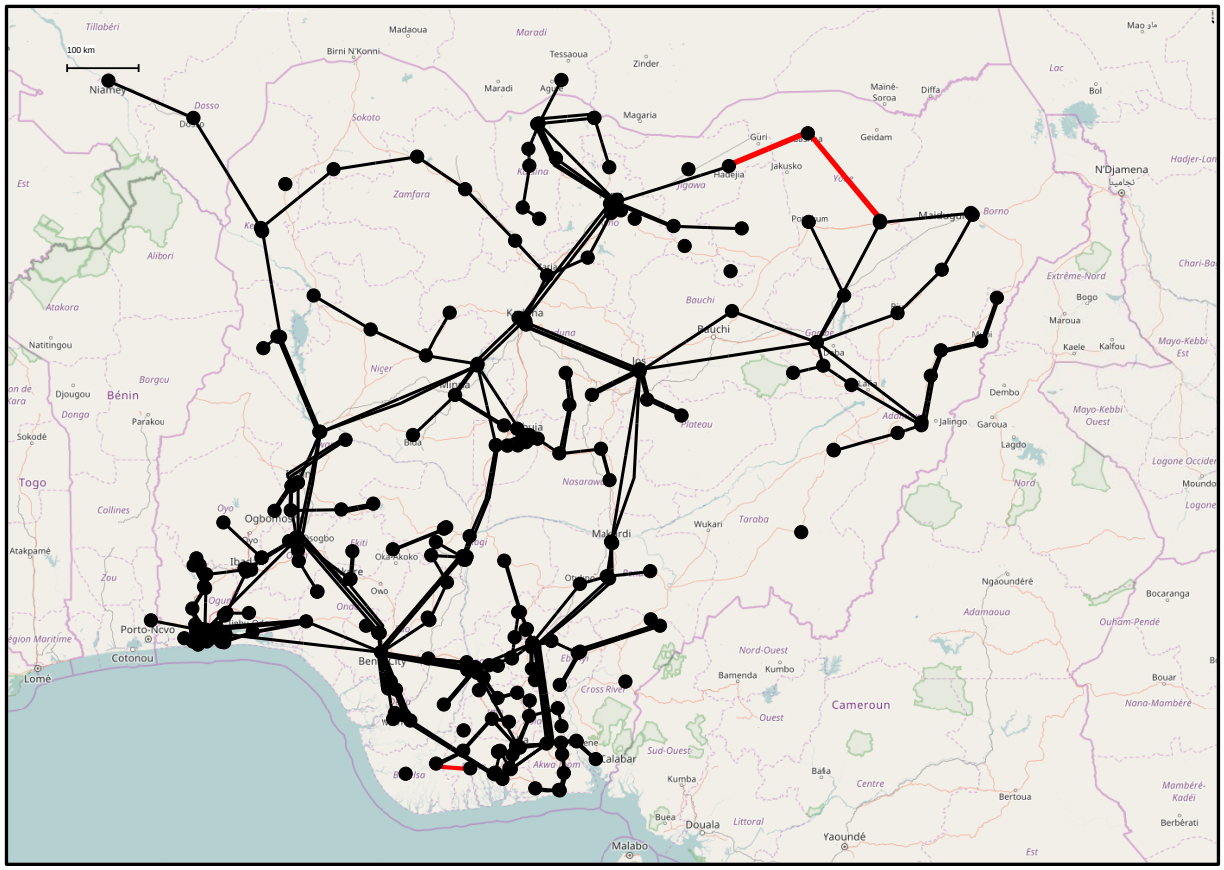

Figure 8:OHL modifications after 2018 (blue for 330kV, red for 132kV)

5. Transmission Capability of 330kV Network

5.1. Thermal Capability

5.1.1. 2017

The development of the 330kV network's thermal capability during 2017 is summarised in Table 7. The most significant change is in June, following the construction of the Aja-Epe-Omotosho double circuit lines, which reduces the load on the Ikeja-West-Omotosho line and increases the capability under (n-0) operating conditions.

Table 7: Transmission thermal capability of the entire network in 2017

Month	Capability limited by transformer [MW]		Limiting transformer (n-1)	Capability limited by line [MW]		Limiting Line (n-1)
	(n-0)	(n-1)		(n-0)	(n-1)	
January	6800	4600	Kano	10000	7400	Kaduna-Shiroro
February	6800	4600	Kano	10000	7400	Kaduna-Shiroro
March	6800	4600	Kano	10000	7400	Kaduna-Shiroro
April	6800	4600	Kano	10000	7400	Kaduna-Shiroro
May	6800	4600	Kano	10000	7400	Kaduna-Shiroro
June	7000	4800	Bernin Kebbi	10600	7300	Kaduna-Shiroro
July	7000	4800	Bernin Kebbi	10500	7400	Kaduna-Shiroro
August	7000	4800	Bernin Kebbi	10500	7400	Kaduna-Shiroro
September	7000	4800	Bernin Kebbi	10500	7400	Kaduna-Shiroro
October	7000	4800	Bernin Kebbi	10500	7400	Kaduna-Shiroro
November	7000	4800	Bernin Kebbi	10500	7400	Kaduna-Shiroro
December	7000	4800	Bernin Kebbi	11000	7600	Kaduna-Shiroro

The above values above do not consider contingencies of the non-secure parts of the 330kV network (i.e. non-meshed lines or non-redundant transformers), since such contingencies would lead to local power failures. The following 330kV network components fall into this category (Table 8).

Table 9: Non-Secure 330kV network components in 2017

Component	Transformers 330/132kV
Lines	
Kaduna-Kano	January-May
Bernin-Kebbi–Kainji	January-December
Ikeja-West–Sakete	January-December
Jos–Gombe	January-December
Gombe–Damaturu	January-December
Damaturu–Maiduguri	January-December
Gombe–Yola	January-December
Transformers	
Alagbon	January-December
Jebba	January-December
Kainji	January-December
Delta	January-December
Eyean	January-December
Lokoja	January-December
Damaturu	January-December
Maiduguri	January-December
Makurdi	January-December
Ugwuaji	January-December

5.1.2. 2018

The development of the 330kV network's thermal capability during 2018 is summarised in Table 10. It changes in November following the strengthening of the Benin-Osogbo 330kV link. However, when considering contingencies, there is no significant change during the year.

Table 10: Transmission thermal capability of the entire network in 2018

Month	Capability limited by transformer [MW]		Limiting transformer (n-1)	Capability limited by line [MW]		Limiting line (n-1)
	(n-0)	(n-1)		(n-0)	(n-1)	
January	7000	5000	Yola	11300	7200	Kaduna-Shiroro
February	7000	5000	Yola	11300	7200	Kaduna-Shiroro
March	7000	5000	Yola	11300	7200	Kaduna-Shiroro
April	7000	5000	Yola	11300	7200	Kaduna-Shiroro
May	7000	5000	Yola	11300	7200	Kaduna-Shiroro
June	7000	5000	Yola	11300	7200	Kaduna-Shiroro
July	7000	5000	Yola	11300	7200	Kaduna-Shiroro
August	7000	5000	Yola	11300	7200	Kaduna-Shiroro
September	7000	5000	Yola	11300	7200	Kaduna-Shiroro
October	7000	5000	Yola	11300	7200	Kaduna-Shiroro
November	7000	5000	Bernin Kebbi	12600	7000	Kaduna-Shiroro
December	7000	5000	Bernin Kebbi	12600	6900	Kaduna-Shiroro

The above values above do not consider contingencies of the non-secure parts of the 330kV network (i.e. non-meshed lines or non-redundant transformers), since such contingencies would lead to local power failures. The following 330kV network components fall into this category (Table 11).

Table 12: Non-Secure 330kV network components in 2018

Component	Transformers 330/132kV
Lines	
Bernin-Kebbi–Kainji	January-December
Ikeja-West–Sakete	January-December
Jos–Gombe	January-December
Gombe–Damaturu	January-December
Damaturu–Maiduguri	January-December
Gombe–Yola	January-December
Transformers	
Alagbon	January-December
Jebba	January-December
Kainji	January-December
Delta	January-December
Eyean	January-December
Lokoja	January-December
Damaturu	January-December
Maiduguri	January-December
Makurdi	January-December
Ugwuaji	January-December

5.1.3. 2019-2027

The development of the 330kV network's thermal capability up to 2027 is summarised in Table 10.

Significant changes occur after 2023 due to additional generation in the southeast and the decommissioning of Egbin power plant in the southwest. These changes in generation increase the load flow from the Benin to the Lagos areas.

Table 13: Transmission thermal capability of the entire network in 2019-2027

Year	Capability [MW]		Limiting transformer (n-1)	Capability limited by line [MW]		Limiting Line (n-1)
	(n-0)	(n-1)		(n-0)	(n-1)	
2017	7000	4800	Yola	10500	7600	Kaduna-Shiroro
2018	7000	5000	BerninKebbi	12600	6900	Kaduna-Shiroro
2019	7200	5000	BerninKebbi	12700	7000	Kaduna-Shiroro
2020	7400	5000	Yola	11700	6900	Kaduna-Shiroro
2021	8000	5000	Yola	13300	7400	Kaduna-Shiroro
2022	8000	5000	BerninKebbi	13300	7400	Kaduna-Shiroro
2023	8000	5000	BerninKebbi	12400	8000	Benin-Omotosho
2024	8000	5000	BerninKebbi	11300	8000	Benin-Omotosho
2025	8000	5000	BerninKebbi	8200	6200	Benin-Omotosho
2026	8000	5000	BerninKebbi	8200	6200	Benin-Omotosho
2027	8000	5000	BerninKebbi	8200	6200	Benin-Omotosho

5.2. Voltage Stability Constraints

5.2.1. 2017

Table 14 shows the capability of the 330kV network considering both thermal and voltage constraints. The capability reduces significantly in June due to the new 132kV circuits to Malumfashi and also to Gulak.

Table 14: Transmission capability considering voltage constraints in 2017

Month	Capability [MW]		Thermal or voltage-stability constraint (n-1)	Limiting component or boundary (n-1)
	(n-0)	(n-1)		
January	6200	6200	Voltage stability	Lagos, Jos and Yola imports
February	6200	6200	Voltage stability	Lagos, Jos and Yola imports
March	6200	6200	Voltage stability	Lagos, Jos and Yola imports
April	6200	6200	Voltage stability	Lagos, Jos and Yola imports
May	6200	6200	Voltage stability	Lagos, Jos and Yola imports
June	3400	3400	Voltage stability	Yola import
July	3400	3400	Voltage stability	Yola import
August	3400	3400	Voltage stability	Yola import
September	3400	3400	Voltage stability	Yola import
October	3400	3400	Voltage stability	Yola import
November	3400	3400	Voltage stability	Yola import
December	6200	4700	Voltage stability	Kaduna import

5.2.2. 2018

Table 15 shows the capability of the 330kV network considering both thermal and voltage constraints. The capability increases significantly in November following the strengthening of the Benin-Osogbo link.

Table 15: Transmission capability considering voltage constraints in 2018

Month	Capability [MW]		Thermal or voltage-stability constraint (n-1)	Limiting component or boundary (n-1)
	(n-0)	(n-1)		
January	6200	4700	Voltage stability	Kaduna import
February	6200	4700	Voltage stability	Kaduna import
March	6200	4700	Voltage stability	Kaduna import
April	6200	4700	Voltage stability	Kaduna import
May	6200	4700	Voltage stability	Kaduna import
June	6200	4700	Voltage stability	Kaduna import
July	6200	4700	Voltage stability	Kaduna import
August	6200	4700	Voltage stability	Kaduna import
September	6200	4700	Voltage stability	Kaduna import
October	6200	4700	Voltage stability	Kaduna import
November	6200	6200	Voltage stability	Yola import
December	6200	6200	Voltage stability	Yola import

5.2.3. 2019-2027

Table 16 shows the capability of the 330kV network considering both thermal and voltage constraints.

Under (n-0)-conditions the capability is limited by voltage constraints throughout the considered time period.

The increase in capability under (n-1) conditions in 2019 is due to higher voltage-constrained capabilities in the northern parts of the grid, which is due to the PV plants.

In 2020 the installation of additional generation in the southern network causes the limiting constraint under (n-1) conditions to be Kaduna-Shiroro link.

From 2022 onwards the transmission capacity under (n-1)-conditions is given by thermal constraints. A significant reduction occurs in 2025 following the decommissioning of Egbin generators.

Table 16: Transmission capability considering voltage constraints in 2019-2027

Year	Capability limited by line [MW]		Thermal or voltage-stability constraint		Limiting component or boundary
	(n-0)	(n-1)	(n-0)	(n-1)	(n-1)
2017	6200	4700	Voltage stability	Voltage stability	Kaduna import
2018	6200	6200	Voltage stability	Voltage stability	Yola import
2019	7000	7000	Voltage stability	Voltage stability	Yola import
2020	7000	6900	Voltage stability	Thermal	Kaduna-Shiroro
2021	7000	7000	Voltage stability	Voltage stability	Yola import
2022	8000	7400	Voltage stability	Thermal	Kaduna-Shiroro
2023	8000	8000	Voltage stability	Thermal	Kaduna-Shiroro
2024	8000	8000	Voltage stability	Thermal	Kaduna-Shiroro
2025	8000	6200	Voltage stability	Thermal	Benin-Omotosho
2026	8000	6200	Voltage stability	Thermal	Benin-Omotosho
2027	8000	6200	Voltage stability	Thermal	Benin-Omotosho

6. Transmission Capability of 132kV Networks

6.1. Thermal Capability

6.1.1. 2017

The thermal capabilities of the 132kV networks, which include transmission lines, are shown in Table 17.

The impact of transmission line contingencies was considered for all secure networks and for the secure parts of mixed networks. The column “critical contingency” lists the contingency that limits the load in the corresponding network most severely.

Table 17: Thermal capabilities of 132kV networks, which include transmission lines, in 2017

132kV network	Type	Thermal capability [MW]		Critical contingency
		Non-Secure (n-0)	Secure (n-1)	
IkejaWest-Ayobo	Secure	212	111	Ayobo_Ikeja-West_132_cct1
IkejaWest-Akangba	Secure	241	160	Akangba_Amuwo-Odofin_132_cct1
IkejaWest-Akangba2	Secure	302	142	Akangba_Itire_132_cct2
Akangba-Isolo	Secure	208	111	Akangba_Isolo_132_cct1
Aja_Akangba	Secure	386	186	Aja_Alagbon_132_cct1
IkejaWest_Lanlante	Secure	409	259	Alimosho_Ikeja-West_132_cct1
Aja_Lekki	Secure	193	104	Aja_Lekki_132_cct1
Ayede_IkejaWest-Egbin-IjebuOde	Mixed	489	240	Egbin_Ikorodu_132_cct1
Ayede-Osogbo-Iseyin	Mixed	156	123	Ayede_Ibadan-North_132_cct1
Benin-Delta-Effurun	Mixed	235	235	Amukpe_Delta_132_cct1
Aliade-NewHaven	Secure	238	123	Aliade_Oturkpo_132_cct1
Ajaokuta-Benin	Secure	262	174	Benin_Irrua_132_cct1
Katampe-Gwagwalada-Akangwa	Mixed	229	217	Apo_Katampe_132_cct2
Shiroro-Yelwa	Non-secure	126	-	
Osogbo-Ondo	Non-secure	77	-	
Osogbo-Ganmo-Omuaran	Mixed	149	117	Ganmo_Offa_132_cct1
Shiroro-Katampe-Bida	Mixed	312	187	Minna_Shiroro_132_cct1
IkejaWest-Oworosoki	Secure	186	99	Ikeja-West_Oworosoki_132_cct1
Eyean-Okada	Secure	47	42	Eyean_Okada_132_cct1
Asaba-Agbor	Secure	143	92	Agbor_Asaba_132_cct1
Alaoji-Yenagoa	Secure	123	90	Alaoji_Owerri_132_cct1
Adiabo_Calabar	Secure	151	79	Adiabo_Calabar_132_cct1
Alaoji-Alscon-Adiabo	Secure	188	123	Aba_Itu_132_cct1

132kV network	Type	Thermal capability [MW]		Critical contingency
		Non-Secure (n-0)	Secure (n-1)	
Afam-PHCT_(n-1)	Secure	175	126	Afam_Rivers_132_cct1
Alaoji-Umuhaia-Okigwe	Mixed	290	216	Onitsha_Oba_132_cct1
Uguaji-Abakaliki-Obudu	Mixed	102	102	New-Haven_Nkalagu_132_cct1
Onitsha-GCM	Non-secure	96	-	
Onitsha-Awka	Non-secure	82	-	
Aliade-Yandev	Non-secure	123	-	
Ayede_Jericho	Non-secure	105	-	
Ganmo-Ogbomoso	Secure	127	90	Ganmo_Ogbomoso_132_cct1
Kaduna-KadunaTown	Non-secure	81	-	
Kainji-NewBussa	Non-secure	71	-	
Katampe-CentralArea	Secure	191	99	Central-Area_Katampe_132_cct1
Kebbi-Niamey	Non-secure	123	-	
Makurdi-Aliade	Secure	138	119	Apir_Aliade_132_cct1
NewHaven-Nsukka	Secure	244	121	9th-Mile_Nsukka_132_cct1
OjiRiver-Nsukka / Onitsha-Ugwuaji	Mixed	57	48	New-Haven_Oji-River_132_cct1
PHCT-Main_PHCT-Town	Secure	146	77	PHCT-Main_PHCT-Town_132_cct1
Kano-DanAgundi	Non-secure	78	-	
Kebbi-Kaduna-Kano	Secure	201	106	Birnin-Kebbi_Sokoto_132_cct1
Kano-Katsina	Secure	233	123	Kankia_Kano_132_cct1
Kano-Hadejia	Non-secure	48	-	Gagarawa_132
Kano-Azare	Mixed	172	79	Dutse_Kano_132_cct1
Gombe-Potiskum	Non-secure	88	-	
Gombe-Maiduguri	Secure	180	69	Biu_Gombe_132_cct1
Jos-Gombe	Secure	168	123	Bauchi_Jos_132_cct1
Jos-Makeri-Pankshin	Mixed	247	123	Jos_Makeri_132_cct1
Jos-Kafanchan	Secure	246	123	Jos_Kafanchan_132_cct1
Gombe-Yola	Mixed	55	65	Gombe_T-Junction_132_cct1
Yola-Jalingo	Non-Secure	123	-	
Yola-Gulak	Secure	238	120	Yola_Song_132_cct1
Osogbo-Ado Ekiti	Secure	102	102	Ado-Ekiti_Akure_132_cct1
Osogbo-Ede	Non-Secure	100	-	
Kano-Dakata	Secure	133	76	Dakata_Walalambe_132_cct1
Katsina-Dambarta	Mixed	198	119	Daura_Katsina_132_cct1

132kV network	Type	Thermal capability [MW]		Critical contingency
		Non-Secure (n-0)	Secure (n-1)	
Katsina Malumfaschi	Non-Secure	119	-	

Table 18 shows the capability of 132kV/MV transformers, which are located at 330/132kV substations. These transformers are excluded from the circuits in Table 17. The non-secure capability represents the installed capacity, and the secure capability represents the effective capacity of the transformers.

Table 18: Thermal capabilities of 132kV networks without transmission lines in 2017

132kV network	Thermal capability [MW]	
	Non-Secure (n-0)	Secure (n-1)
Capacity of transformers supplying DISCOs at 330/132kV substations	3731	2610

6.1.2. 2018

The thermal capabilities of those 132kV networks, which include transmission lines and which have changed topologically since 2017, have been recalculated. The thermal capabilities of the 132kV networks are shown in Table 19.

Table 19: Thermal capabilities of 132kV networks, which include transmission lines, in 2018

132kV network	Type	Thermal capability [MW]		Critical contingency
		Non-Secure (n-0)	Secure (n-1)	
IkejaWest-Ayobo	Secure	212	111	Ayobo_Ikeja-West_132_cct1
IkejaWest-Akangba	Secure	241	160	Akangba_Amuwo-Odofin_132_cct1
IkejaWest-Akangba2	Secure	302	142	Akangba_Itire_132_cct2
Akangba-Isolo	Secure	208	111	Akangba_Isolo_132_cct1
Aja_Akangba	Secure	386	186	Aja_Alagbon_132_cct1
IkejaWest_Lanlante	Secure	409	259	Alimosho_Ikeja-West_132_cct1
Aja_Lekki	Secure	193	104	Aja_Lekki_132_cct1
Ayede_IkejaWest-Egbin-IjebuOde	Mixed	489	240	Egbin_Ikorodu_132_cct1
Ayede-Osogbo-Iseyin	Mixed	156	123	Ayede_Ibadan-North_132_cct1
Benin-Delta-Effurun	Mixed	235	235	Amukpe_Delta_132_cct1
Aliade-NewHaven	Secure	238	123	Aliade_Oturkpo_132_cct1
Ajaokuta-Benin	Secure	262	174	Benin_Irrua_132_cct1
Katampe-Gwagwalada-Akangwa	Mixed	229	217	Apo_Katampe_132_cct2

132kV network	Type	Thermal capability [MW]		Critical contingency
		Non-Secure (n-0)	Secure (n-1)	
Shiroro-Yelwa	Non-secure	126	-	
Osogbo-Ondo	Non-secure	77	-	
Osogbo-Ganmo-Omuaran	Mixed	149	117	Ganmo_Offa_132_cct1
Shiroro-Katampe-Bida	Mixed	312	187	Minna_Shiroro_132_cct1
IkejaWest-Oworosoki	Secure	186	99	Ikeja-West_Oworosoki_132_cct1
Eyean-Okada	Secure	47	42	Eyean_Okada_132_cct1
Asaba-Agbor	Secure	143	92	Agbor_Asaba_132_cct1
Alaoji-Yenagoa	Secure	160	103	Alaoji_Owerri_132_cct1
Adiabo_Calabar	Secure	151	79	Adiabo_Calabar_132_cct1
Alaoji-Alscon-Adiabo	Secure	188	123	Aba_Itu_132_cct1
Afam-PHCT_(n-1)	Secure	175	126	Afam_Rivers_132_cct1
Alaoji-Umuhaia-Okigwe	Mixed	290	216	Onitsha_Oba_132_cct1
Uguaji-Abakaliki-Obudu	Mixed	102	102	New-Haven_Nkalagu_132_cct1
Onitsha-GCM	Non-secure	96	-	
Onitsha-Awka	Non-secure	82	-	
Aliade-Yandev	Non-secure	123	-	
Ayede_Jericho	Non-secure	105	-	
Ganmo-Ogbomoso	Secure	127	90	Ganmo_Ogbomoso_132_cct1
Kaduna-KadunaTown	Non-secure	81	-	
Kainji-NewBussa	Non-secure	71	-	
Katampe-CentralArea	Secure	191	99	Central-Area_Katampe_132_cct1
Kebbi-Niamey	Non-secure	123	-	
Makurdi-Aliade	Secure	138	119	Apir_Aliade_132_cct1
NewHaven-Nsukka	Secure	244	121	9th-Mile_Nsukka_132_cct1
OjiRiver-Nsukka / Onitsha-Ugwuaji	Mixed	57	48	New-Haven_Oji-River_132_cct1
PHCT-Main_PHCT-Town	Secure	146	77	PHCT-Main_PHCT-Town_132_cct1
Kano-DanAgundi	Non-secure	78	-	
Kebbi-Kaduna-Kano	Secure	201	106	Birnin-Kebbi_Sokoto_132_cct1
Kano-Katsina	Secure	233	123	Kankia_Kano_132_cct1

132kV network	Type	Thermal capability [MW]		Critical contingency
		Non-Secure (n-0)	Secure (n-1)	
Kano-Hadejia	Non-secure	48	-	Gagarawa_132
Kano-Azare	Mixed	172	79	Dutse_Kano_132_cct1
Gombe-Potiskum	Non-secure	88	-	
Gombe-Maiduguri	Secure	180	69	Biu_Gombe_132_cct1
Jos-Gombe	Secure	168	123	Bauchi_Jos_132_cct1
Jos-Makeri-Pankshin	Mixed	247	123	Jos_Makeri_132_cct1
Jos-Kafanchan	Secure	246	123	Jos_Kafanchan_132_cct1
Gombe-Yola	Mixed	55	65	Gombe_T-Junction_132_cct1
Yola-Jalingo	Non-Secure	123	-	
Yola-Gulak	Secure	238	120	Yola_Song_132_cct1
Akure-AdoEkiti-Obajana	Secure	176	101	Ado-Ekiti_Akure_132_cct1
Osogbo-Ede	Non-Secure	100	-	
Kano-Dakata	Secure	133	76	Dakata_Walalambe_132_cct1
Katsina-Dambarta	Mixed	198	119	Daura_Katsina_132_cct1
Katsina Malumfaschi	Non-Secure	119	-	
Uguwaji-Mpu	Secure	242	121	Mpu_Nenwe_132_cct1

Table 20 shows the capability of 132kV/MV transformers, which are located at 330/132kV substations. These transformers are excluded from the circuits in Table 17. The non-secure capability represents the installed capacity and the secure capability represents the effective capacity of the transformers.

Table 20: Thermal capabilities of 132kV networks without transmission lines in 2018

132kV network	Thermal capability [MW]	
	Non-Secure (n-0)	Secure (n-1)
Capacity of transformers supplying DISCOs at 330/132kV substations	4355	2718

6.2. Voltage Stability Constraints

6.2.1. 2017

Table 21 shows the voltage constraints of 132kV networks in 2017. Empty cells refer to networks in which thermal constraints occur at lower load levels than voltage constraints.

Table 21: Voltage constraints in 132kV networks in 2017

132kV network	Type	Voltage constraint [MW]		Critical contingency
		Non-Secure (n-0)	Secure (n-1)	
IkejaWest-Ayobo	Secure			
IkejaWest-Akangba	Secure			
IkejaWest-Akangba2	Secure			
Akangba-Isolo	Secure			
Aja_Akangba	Secure			
IkejaWest_Lanlante	Secure			
Aja_Lekki	Secure			
Ayede_IkejaWest-Egbin-IjebuOde	Mixed			
Ayede-Osogbo-Iseyin	Mixed	135	87	Ayede_Ibadan-North_132_cct1
Benin-Delta-Effurun	Mixed			
Aliade-NewHaven	Secure	94	48	Aliade_Oturkpo_132_cct1
Ajaokuta-Benin	Secure	208	111	Benin_Irrua_132_cct1
Katampe-Gwagwalada-Akangwa	Mixed	214	191	Keffi_Kwoi_132_cct1
Shiroro-Yelwa	Non-secure	65	-	
Osogbo-Ondo	Non-secure			
Osogbo-Ganmo-Omuaran	Mixed	100	83	Egbe_Omuaran_132_cct2
Shiroro-Katampe-Bida	Mixed	199	165	Minna_Shiroro_132_cct1
IkejaWest-Oworosoki	Secure			
Eyean-Okada	Secure			
Asaba-Agbor	Secure			
Alaoji-Yenagoa	Secure			
Adiabo_Calabar	Secure			
Alaoji-Alscon-Adiabo	Secure			
Afam-PHCT_(n-1)	Secure	133	87	Afam_Rivers_132_cct1
Alaoji-Umuhaia-Okigwe	Mixed			
Uguaji-Abakaliki-Obudu	Mixed	85	81	New-Haven_Nkalagu_132_cct1
Onitsha-GCM	Non-Secure			
Onitsha-Awka	Non-Secure			
Aliade-Yandev	Non-Secure	77	-	
Ayede_Jericho	Non-Secure			
Ganmo-Ogbomoso	Secure			
Kaduna-KadunaTown	Non-Secure			
Kainji-NewBussa	Non-Secure			
Katampe-CentralArea	Secure			
Kebbi-Niamey	Non-Secure	71	-	

132kV network	Type	Voltage constraint [MW]		Critical contingency
		Non-Secure (n-0)	Secure (n-1)	
Makurdi-Aliade	Secure	76	19	Apir_Makurdi_132_cct1
NewHaven-Nsukka	Secure	68	58	9th-Mile_Nsukka_132_cct1
OjiRiver-Nsukka / Onitsha-Ugwuaji	Mixed			
PHCT-Main_PHCT-Town	Secure			
Kano-DanAgundi	Non-Secure			
Kebbi-Kaduna-Kano	Secure	108	45	Birnin-Kebbi_Sokoto_132_cct1
Kano-Katsina	Secure	60	46	Kankia_Kano_132_cct1
Kano-Hadejia	Non-Secure	27	-	
Kano-Azare	Mixed	71	45	Dutse_Kano_132_cct1
Gombe-Potiskum	Non-Secure	27	-	
Gombe-Maiduguri	Secure	32	22	Biu_Gombe_132_cct1
Jos-Gombe	Secure	63	29	Bauchi_Jos_132_cct1
Jos-Makeri-Pankshin	Mixed	97	86	Jos_Makeri_132_cct1
Jos-Kafanchan	Secure	92	76	Jos_Kafanchan_132_cct1
Gombe-Yola	Mixed	22	14	Gombe_T-Junction_132_cct1
Yola-Jalingo	Non-Secure	34	-	
Yola-Gulak	Secure	76	65	Yola_Song_132_cct1
Osogbo-Ado Ekiti	Secure	88	79	Ado-Ekiti_Akure_132_cct1
Osogbo-Ede	Non-Secure			
Kano-Dakata	Secure			
Katsina-Dambarta	Mixed	74	58	Daura_Katsina_132_cct1
Katsina Malumfaschi	Non-Secure	77	-	

6.2.2. 2018

Table 22 shows the voltage constraints of 132kV networks in 2018. Empty cells refer to networks in which thermal constraints occur at lower load levels than voltage constraints.

Table 22: Voltage constraints in 132kV networks in 2018

132kV network	Type	Voltage constraint [MW]		Critical contingency
		Non-Secure (n-0)	Secure (n-1)	
IkejaWest-Ayobo	Secure			
IkejaWest-Akangba	Secure			
IkejaWest-Akangba2	Secure			
Akangba-Isolo	Secure			
Aja_Akangba	Secure			
IkejaWest_Lanlante	Secure			
Aja_Lekki	Secure			
Ayede_IkejaWest-Egbin-IjebuOde	Mixed			
Ayede-Osogbo-Iseyin	Mixed	135	87	Ayede_Ibadan-North_132_cct1
Benin-Delta-Effurun	Mixed			
Aliade-NewHaven	Secure	94	48	Aliade_Oturkpo_132_cct1
Ajaokuta-Benin	Secure	208	111	Benin_Irrua_132_cct1
Katampe-Gwagwalada-Akangwa	Mixed	199	192	Keffi_Kwoi_132_cct1
Shiroro-Yelwa	Non-secure	65	-	
Osogbo-Ondo	Non-secure			
Osogbo-Ganmo-Omuaran	Mixed	100	83	Egbe_Omuaran_132_cct2
Shiroro-Katampe-Bida	Mixed	199	165	Minna_Shiroro_132_cct1
IkejaWest-Oworosoki	Secure			
Eyean-Okada	Secure			
Asaba-Agbor	Secure			
Alaoji-Yenagoa	Secure			
Adiabo_Calabar	Secure			
Alaoji-Alscon-Adiabo	Secure			
Afam-PHCT_(n-1)	Secure	133	87	Afam_Rivers_132_cct1
Alaoji-Umuhaia-Okigwe	Mixed			
Uguaji-Abakaliki-Obudu	Mixed	85	81	New-Haven_Nkalagu_132_cct1
Onitsha-GCM	Non-Secure			
Onitsha-Awka	Non-Secure			
Aliade-Yandev	Non-Secure	77	-	
Ayede_Jericho	Non-Secure			
Ganmo-Ogbomoso	Secure			
Kaduna-KadunaTown	Non-Secure			
Kainji-NewBussa	Non-Secure			

132kV network	Type	Voltage constraint [MW]		Critical contingency
		Non-Secure (n-0)	Secure (n-1)	
Katampe-CentralArea	Secure			
Kebbi-Niamey	Non-Secure	71	-	
Makurdi-Aliade	Secure	76	19	Apir_Makurdi_132_cct1
NewHaven-Nsukka	Secure	100	71	Ayangba_Nsukka_132_cct1
OjiRiver-Nsukka / Onitsha-Ugwuaji	Mixed			
PHCT-Main_PHCT-Town	Secure			
Kano-DanAgundi	Non-Secure			
Kebbi-Kaduna-Kano	Secure	108	45	Birnin-Kebbi_Sokoto_132_cct1
Kano-Katsina	Secure	60	46	Kankia_Kano_132_cct1
Kano-Hadejia	Non-Secure	27	-	
Kano-Azare	Mixed	71	45	Dutse_Kano_132_cct1
Gombe-Potiskum	Non-Secure	27	-	
Gombe-Maiduguri	Secure	32	22	Biu_Gombe_132_cct1
Jos-Gombe	Secure	63	29	Bauchi_Jos_132_cct1
Jos-Makeri-Pankshin	Mixed	97	86	Jos_Makeri_132_cct1
Jos-Kafanchan	Secure	92	76	Jos_Kafanchan_132_cct1
Gombe-Yola	Mixed	22	14	Gombe_T-Junction_132_cct1
Yola-Jalingo	Non-Secure	34	-	
Yola-Gulak	Secure	76	65	Yola_Song_132_cct1
Akure-AdoEkiti-Obajana	Secure			
Osogbo-Ede	Non-Secure			
Kano-Dakata	Secure			
Katsina-Dambarta	Mixed	74	58	Daura_Katsina_132_cct1
Katsina Malumfaschi	Non-Secure	77	-	
Uguwaji-Mpu	Secure	117	95	Mpu_Nenwe_132_cct1

6.3. Overall Capability, 2017 and 2018

6.3.1. 2017

Table 23 summarises the capability at 132kV level.

Table 23: Total capability at 132kV level in 2017

Capability	Sum of capabilities [MW]	
	Non-Secure (n-0)	Secure (n-1)
Capability of 132kV circuits between 330/132kV substations	7621	4175
Capacity of transformers supplying DISCOs at 330/132kV substations	3731	2610
Total capability	**11352**	**6785**

6.3.2. 2018

Table 24 summarises the capability at 132kV level.

Table 24: Total capability at 132kV level in 2018

Capability	Sum of capabilities [MW]	
	Non-Secure (n-0)	Secure (n-1)
Capability of 132kV circuits between 330/132kV substations	8123	4439
Capacity of transformers supplying DISCOs at 330/132kV substations	4355	2718
Total capability	**12478**	**7157**

6.3.3. Comparison 2017 and 2018

Table 25 shows the total capabilities, i.e. the sum of the capabilities of the individual 132kV networks, in 2017 and 2018. The non-secure and secure capabilities increase only marginally from one year to the next.

Table 25: Total capability at 132kV level in 2017 and 2018

Year	Sum of capabilities [MW]	
	Non-Secure (n-0)	Secure (n-1)
2017	11352	6785
2018	12478	7157

7. Maximum Short-Circuit Currents

The following subsections list the maximum short-circuit currents at the 330kV and 132kV nodes at the end of 2017 and 2018. The increases in the short-circuit levels from 2017 to 2018 are also shown. These arise due to changes in both the transmission and generation systems.

The values provided in this section can, in future, be compared to the substation short-circuit ratings, to ensure that these are not exceeded following the network expansions.

The maximum short-circuit levels are very low, especially in the northern and north-eastern parts of the network. The actual short-circuit levels during the day-to-day operation will be even lower, since then fewer generators will be on line.

7.1. 330kV Busbars

Table 26 shows the maximum short-circuit values at the 330kV busbars in 2017 and 2018.

Table 26: Maximum short-circuit currents at 330kV nodes in 2017 and 2018

Busbar	2017		2018		Increase
	Ik" [kA]	Sk" [MVA]	Ik" [kA]	Sk" [MVA]	
Adiabo	13.4	7687	13.8	7889	3%
Afam	21.5	12304	23.1	13210	7%
Aja	23.9	13668	24.1	13752	1%
Ajaokuta	14.3	8158	14.7	8391	3%
Akangba	20.4	11659	20.5	11726	1%
Akure	0.7	409	8.7	4999	1123%
Aladja	13.9	7958	14.9	8528	7%
Alagbon	0.9	516	0.9	516	0%
Alaoji-GS	19.0	10831	21.1	12047	11%
Alaoji-TS	20.9	11968	23.0	13164	10%
Aliade	6.9	3960	7.2	4100	4%
Asaba	22.0	12555	25.3	14464	15%
Ayede	10.9	6218	11.3	6461	4%
Benin	34.5	19707	38.5	22030	12%
Birnin-Kebbi	1.9	1061	1.9	1069	1%
Damaturu	1.3	733	1.3	746	2%
Delta	17.7	10129	20.1	11462	13%
Egbin	28.8	16468	29.0	16584	1%
Epe	18.0	10310	18.1	10368	1%
Eyean	22.8	13019	25.9	14831	14%
Ganmo	9.1	5203	10.3	5862	13%
Geregu	14.2	8137	14.6	8366	3%
Gombe	1.9	1066	1.9	1094	3%
Gwagwalada	7.9	4518	8.7	4997	11%
Ibom	1.6	928	1.6	929	0%
Ikeja-West	27.0	15432	27.2	15550	1%
Ikot-Ekpene	19.1	10898	20.2	11536	6%
Jebba-GS	14.7	8417	16.2	9232	10%
Jebba	15.4	8810	17.1	9759	11%

Busbar	2017		2018		Increase
	Ik" [kA]	Sk" [MVA]	Ik" [kA]	Sk" [MVA]	
Jos	6.0	3430	6.5	3742	9%
Kaduna	7.5	4311	8.9	5094	18%
Kainji-GS	11.8	6716	12.3	7015	4%
Kano	3.4	1920	3.6	2058	7%
Katampe	6.3	3574	7.0	3978	11%
Katsina	2.4	1379	2.5	1449	5%
Lokoja	10.8	6171	11.2	6392	4%
Maiduguri	0.9	508	0.9	514	1%
Makurdi	6.4	3659	6.7	3802	4%
New-Haven	13.7	7828	14.3	8196	5%
Obajana	0.0	0	0.8	464	100%
Odukpani	12.7	7263	13.0	7421	2%
Oke-Aro	26.4	15112	26.6	15218	1%
Okpai	14.4	8236	19.3	11019	34%
Olorunsogo	21.2	12129	21.4	12260	1%
Omotosho	27.1	15477	27.4	15669	1%
Onitsha	22.1	12614	25.4	14546	15%
Osogbo	13.3	7621	16.9	9657	27%
PHCT-Main	5.1	2890	5.2	2989	3%
Sakete	6.7	3853	6.8	3860	0%
Sapele	27.1	15481	28.9	16495	7%
Shiroro	11.3	6448	16.2	9248	43%
Ugwuaji	13.9	7959	14.6	8336	5%
Yola	1.2	660	1.2	671	2%

7.2. 132kV Busbars

Table 27 shows the maximum short-circuit values at the 132kV busbars in 2017 and 2018.

Table 27: Maximum short-circuit currents at 132kV nodes in 2017 and 2018

Busbar	2017		2018		Increase
	Ik" [kA]	Sk" [MVA]	Ik" [kA]	Sk" [MVA]	
9th-Mile	7.1	1627	7.2	1644	1%
Aba	14.2	3254	14.5	3321	2%
Abakaliki	2.0	461	2.0	462	0%
Aboh-Mbaise	0.0	0	4.6	1057	100%
Adiabo	9.0	2047	9.0	2063	1%
Ado-Ekiti	1.5	354	4.3	991	180%
Afam	20.0	4566	20.6	4718	3%
Agbara	14.0	3197	14.0	3203	0%
Agbor	4.0	922	4.1	933	1%
Ahoada	4.8	1095	4.8	1098	0%
Aja	18.3	4194	18.4	4203	0%
Ajaokuta-Steel	9.7	2223	9.8	2239	1%
Ajaokuta-Town	9.7	2223	9.8	2239	1%

Busbar	2017		2018		Increase
	Ik'' [kA]	Sk'' [MVA]	Ik'' [kA]	Sk'' [MVA]	
Ajaokuta	13.5	3094	13.7	3127	1%
Akangba	25.0	5718	25.1	5736	0%
Akoka	13.9	3174	13.9	3179	0%
Akure	1.9	431	8.6	1957	354%
Akwanga	1.5	332	1.5	336	1%
Alagbon	18.1	4134	18.1	4143	0%
Alaoji-TS	20.1	4598	20.7	4739	3%
Alausa	10.0	2279	10.0	2282	0%
Aliade	2.9	667	2.9	671	1%
Alimosho	13.4	3065	13.4	3070	0%
Alscon	4.2	950	4.2	951	0%
Amasiri	1.5	340	1.5	341	0%
Amukpe	8.4	1921	8.5	1939	1%
Amuwo-Odofin	18.7	4264	18.7	4274	0%
Apapa-Road	19.1	4359	19.1	4369	0%
Apir	4.8	1095	4.8	1107	1%
Apo	7.4	1682	7.8	1781	6%
Arochukwu	1.8	405	1.8	407	0%
Asaba	8.3	1905	8.5	1952	2%
Ashaka	1.2	279	1.2	281	1%
Awka	4.4	999	4.4	1009	1%
Ayangba	0.0	0	2.1	482	100%
Ayede	12.3	2816	12.6	2876	2%
Ayobo	16.2	3714	16.3	3721	0%
Azare	1.5	343	1.5	348	1%
Bauchi	2.1	489	2.2	495	1%
Benin	13.1	3006	13.4	3053	2%
BerninGwari	1.2	280	1.2	284	1%
Bida	1.5	354	1.6	359	2%
Birnin-Kebbi	3.4	780	3.4	785	1%
Biu	1.4	316	1.4	319	1%
Calabar	6.8	1564	6.9	1573	1%
Central-Area	5.3	1201	5.5	1252	4%
Dakata	4.5	1031	4.7	1073	4%
Damaturu	2.0	464	2.1	470	1%
Dambarta	1.3	307	1.4	310	1%
Damboa	1.4	316	1.4	318	1%
Dan-Agundi	4.6	1049	4.8	1093	4%
Daura	2.3	514	2.3	525	2%
Delta	12.7	2906	12.9	2942	1%
Dosso	1.1	249	1.1	250	0%
Dutse	2.2	502	2.2	512	2%
Dutsin-Ma	1.5	340	1.5	345	1%
East-Mains	6.2	1420	6.5	1483	4%
Ede	6.7	1523	7.2	1639	8%
Effurun	3.9	897	3.9	900	0%

Busbar	2017		2018		Increase
	Ik" [kA]	Sk" [MVA]	Ik" [kA]	Sk" [MVA]	
Egbe	1.9	435	1.9	440	1%
Egbin	23.4	5344	23.4	5351	0%
Ejigbo	21.4	4890	21.4	4903	0%
Eket	4.4	1015	4.4	1017	0%
Elelenwo	12.8	2923	13.1	2987	2%
Eleme	0.0	0	10.8	2458	100%
Eyean	2.2	504	2.2	507	1%
Funtua	1.8	410	1.8	415	1%
GCM	6.5	1494	6.6	1518	2%
Gagarawa	0.7	169	0.7	170	1%
Ganmo	8.6	1959	9.0	2061	5%
Gazoua	1.6	366	1.6	371	1%
Gombe	3.4	776	3.5	792	2%
Gombi	1.2	280	1.2	282	1%
Gulak	0.8	174	0.8	174	0%
Gusau	1.3	287	1.3	289	1%
Gwagwalada	7.5	1723	7.9	1809	5%
Hadejia	0.7	169	0.7	170	1%
Ibadan-North	9.8	2241	10.0	2285	2%
Ibom	4.3	980	4.3	981	0%
Ideato	6.0	1376	6.1	1391	1%
Ife	3.6	830	3.8	862	4%
Igangan	2.1	469	2.1	469	0%
Igboora	1.8	403	1.8	403	0%
Ijebu-Ode	3.3	757	3.3	758	0%
Ijora	19.9	4551	20.0	4562	0%
Ikeja-West	26.8	6120	26.9	6140	0%
Ikorodu	19.0	4333	19.0	4341	0%
Ilesha	5.9	1358	6.3	1447	7%
Illupeju	18.2	4156	18.2	4164	0%
Ilorin	7.6	1739	7.9	1818	5%
Inner-Galaxy-Steel	13.1	3004	13.4	3065	2%
Irrua	3.5	799	3.5	801	0%
Iseyin	2.0	460	2.0	463	1%
Isolo	19.7	4497	19.7	4508	0%
Itakpe	4.5	1033	4.5	1037	0%
Itire	23.2	5299	23.2	5314	0%
Itu	5.9	1351	5.9	1356	0%
Iwo	6.7	1529	6.8	1560	2%
Jalingo	0.8	187	0.8	188	0%
Jebba	3.0	693	3.1	699	1%
Jericho	11.0	2517	11.2	2566	2%
Jos	6.3	1448	6.6	1506	4%
Kachia	1.4	314	1.4	317	1%
Kaduna-Power-Plant	6.5	1493	6.9	1576	6%
Kaduna-Town	6.0	1370	6.3	1439	5%

Busbar	2017		2018		Increase
	Ik'' [kA]	Sk'' [MVA]	Ik'' [kA]	Sk'' [MVA]	
Kaduna	10.9	2501	12.0	2742	10%
Kafanchan	2.9	664	3.0	676	2%
Kainji	4.2	964	4.2	971	1%
Kankara	1.1	257	1.1	260	1%
Kankia	2.6	583	2.6	596	2%
Kano	5.7	1301	6.0	1369	5%
Karu	5.4	1239	5.6	1291	4%
Katampe	8.6	1974	9.3	2116	7%
Katsina	4.2	951	4.3	987	4%
Keffi	2.6	594	2.6	606	2%
Kontagora	1.2	264	1.2	267	1%
Kubwa	7.8	1776	8.3	1892	7%
Kukwaba	6.4	1464	6.7	1534	5%
Kurfi	2.2	502	2.2	512	2%
Kwanar-Dango	2.9	669	3.0	685	2%
Kwoi	1.7	382	1.7	387	1%
Lafia	0.0	0	1.2	275	100%
Lanlante	1.8	403	1.8	403	0%
Lekki	9.7	2221	9.7	2224	0%
Lokoja	4.2	949	4.2	955	1%
Maiduguri	1.8	403	1.8	407	1%
Makeri	3.6	821	3.7	839	2%
Makurdi	5.0	1152	5.1	1165	1%
Malumfashi	0.9	207	0.9	208	1%
Maryland	18.1	4128	18.1	4136	0%
Mayo-Belwa	1.9	424	1.9	429	1%
Mbalano	5.1	1175	5.2	1185	1%
Minna	4.9	1115	5.1	1170	5%
Mpu	0.0	0	2.5	570	100%
Mubi	1.0	225	1.0	226	1%
National-Stadium	6.8	1560	7.2	1648	6%
Nenwe	0.0	0	3.5	790	100%
New-Abeokuta	3.0	680	3.0	680	0%
New-Bussa	2.7	614	2.7	617	0%
New-Haven	10.0	2285	10.1	2320	2%
Niamey	0.6	145	0.6	145	0%
Nkalagu	5.1	1175	5.2	1184	1%
Nnewi	7.1	1633	7.2	1657	1%
Nsukka	3.6	832	3.7	837	1%
Numan	1.8	412	1.8	417	1%
Oba	9.5	2167	9.7	2213	2%
Obajana	0.0	0	2.2	501	100%
Obudu	1.6	371	1.6	372	0%
Odogunyan	14.2	3256	14.3	3261	0%
Offa	6.0	1367	6.2	1424	4%
Ogara	5.3	1221	5.4	1228	1%

Busbar	2017		2018		Increase
	Ik'' [kA]	Sk'' [MVA]	Ik'' [kA]	Sk'' [MVA]	
Ogba	10.5	2396	10.5	2399	0%
Ogbomoso	3.8	859	3.8	878	2%
Ogoja	2.0	461	2.0	462	0%
Ohafia	2.5	567	2.5	569	0%
Oji-River	5.6	1276	5.6	1288	1%
Ojo	15.5	3549	15.6	3556	0%
Okada	1.7	382	1.7	383	0%
Oke-Aro	16.8	3831	16.8	3838	0%
Okeagbe	1.5	354	4.3	991	180%
Okene	4.9	1128	5.0	1132	0%
Okigwe	5.4	1242	5.5	1254	1%
Old-Abeokuta	3.1	717	3.1	717	0%
Olorunsogo	8.3	1892	8.3	1896	0%
Omoku	4.8	1095	4.8	1098	0%
Omotosho	8.6	1973	8.6	1976	0%
Omuaran	2.5	571	2.5	581	2%
Ondo-1	1.7	384	1.7	390	2%
Ondo	1.7	384	1.7	390	2%
Onitsha	15.8	3621	16.4	3760	4%
Ose	3.5	799	3.5	801	0%
Osogbo	13.2	3020	15.4	3521	17%
Otta	15.8	3614	15.8	3621	0%
Oturkpo	2.6	585	2.6	588	0%
Owerri	6.6	1504	6.6	1514	1%
Oworosoki	6.4	1458	6.4	1459	0%
PHCT-Main	10.4	2373	10.8	2458	4%
PHCT-Town-1	9.6	2184	9.9	2256	3%
Pankshin	1.7	381	1.7	385	1%
Papalanto	9.3	2117	9.3	2119	0%
Potiskum	0.7	162	0.7	163	0%
Rivers-IPP	14.6	3337	15.0	3420	2%
Savannah	1.2	282	1.2	284	1%
Shagamu-Cement	8.0	1826	8.0	1828	0%
Shagamu	9.9	2264	9.9	2268	0%
Shiroro	9.0	2056	9.9	2275	11%
Shonga	2.4	549	2.4	556	1%
Sokoto	1.5	335	1.5	336	0%
Song	1.5	343	1.5	347	1%
Suleja	5.3	1218	5.6	1274	5%
Talata-Mafara	1.2	277	1.2	278	0%
Tamburawa	4.0	921	4.2	954	4%
Tegina	2.3	535	2.4	549	3%
Ugwuaji	5.2	1199	5.3	1207	1%
Ukpilla	3.7	850	3.7	853	0%
Umuahia	6.4	1458	6.4	1472	1%
Uyo	5.2	1188	5.2	1192	0%

Busbar	2017		2018		Increase
	Ik" [kA]	Sk" [MVA]	Ik" [kA]	Sk" [MVA]	
Walalambe	4.7	1079	4.9	1125	4%
Wudil	2.2	502	2.2	512	2%
Yandev	1.9	428	1.9	430	0%
Yelwa	0.8	176	0.8	178	1%
Yenagoa	3.1	713	3.1	714	0%
Yola	2.3	518	2.3	525	1%
Zaria	3.4	785	3.5	805	3%

8. Summary

The capability of the transmission network was calculated under the conditions of all active generators in service and the load distributed according to the MYTO allocation. It is noted that the actual capability varies continuously depending on the generation dispatch and the availability of transmission equipment. It can be higher or lower than the calculated values.

Both the thermal and the voltage stability-constrained capabilities of the 330kV and the 132kV networks have been calculated. When considering these constraints as well as the thermal capabilities of transmission lines, the capability of the 330kV network will be as follows:

Year	Capability limited by line [MW]		Thermal or voltage-stability constraint		Limiting component or boundary (n-1)
	(n-0)	(n-1)	(n-0)	(n-1)	
2017	6200	4700	Voltage stability	Voltage stability	Kaduna import
2018	6200	6200	Voltage stability	Voltage stability	Yola import
2019	7000	7000	Voltage stability	Voltage stability	Yola import
2020	7000	6900	Voltage stability	Thermal	Kaduna-Shiroro
2021	7000	7000	Voltage stability	Voltage stability	Yola import
2022	8000	7400	Voltage stability	Thermal	Kaduna-Shiroro
2023	8000	8000	Voltage stability	Thermal	Kaduna-Shiroro
2024	8000	8000	Voltage stability	Thermal	Kaduna-Shiroro
2025	8000	6200	Voltage stability	Thermal	Benin-Omotosho
2026	8000	6200	Voltage stability	Thermal	Benin-Omotosho
2027	8000	6200	Voltage stability	Thermal	Benin-Omotosho

Under (n-1)-conditions, the capability will be limited by voltage constraints throughout the considered time period.

Following the installation of PV in 2019, the voltage constraints in the northern part of the grid improve, leading to an increase in the transmission capability. After 2022, the capability is limited by thermal constraints. The capability under (n-1)-conditions drops significantly in 2025 following the decommissioning of the Egbin generators.

There are around 60 individual 132kV networks. Their thermal capabilities and voltage constraints were analysed separately for the networks as at December 2017 and December 2018. It was found that, in both years, the capabilities of about half of these networks were limited by voltage stability constraints. The voltage stability constraints occur mainly in the northern and north-eastern parts of the power system, where the short-circuit levels are very low.

Furthermore, despite the expansion of many 132kV grids in 2017 and 2018, the sum of the capacities of all 132kV grids did not increase significantly by 2018, as shown in the summary below. Many of the 132kV networks are not (n-1) secure, i.e. the failure of a single component leads to a loss of supply.

Year	Sum of capabilities [MW]	
	Non-Secure (n-0)	Secure (n-1)
2017	11352	6785
2018	12478	7157

In summary, there are both significant thermal and voltage constraints in the 330kV and the 132kV networks. Despite numerous transmission and generation projects, the transmission capacity will remain well below the projected power demand (see also Part 4 – Generation Adequacy Report: Outlook 2017-2027).

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Annex 1 – Transmission Assets 2017

Annex 1.1 – Transmission Lines

Name	Region	Voltage level [kV]	Length [km]
Adiabo_Odukpani_330_cct1	8 PT HARCO	330	17.7
Adiabo_Odukpani_330_cct2	8 PT HARCO	330	17.7
Afam_Alaoji_330_cct2	8 PT HARCO	330	25
Afam_Alaoji-TS_330_cct1	8 PT HARCO	330	25
Aja_Egbin_330_cct1	1 LAGOS	330	14
Aja_Egbin_330_cct2	1 LAGOS	330	14
Ajaokuta_Benin_330_cct1	4 BENIN	330	195
Ajaokuta_Benin_330_cct2	4 BENIN	330	195
Ajaokuta_Geregu_330_cct1	4 BENIN	330	1.5
Ajaokuta_Geregu_330_cct2	4 BENIN	330	1.5
Ajaokuta_Lokoja_330_cct1	4 BENIN	330	47.39
Ajaokuta_Lokoja_330_cct2	4 BENIN	330	47.39
Akangba_Ikeja-West_330_cct1	1 LAGOS	330	17
Akangba_Ikeja-West_330_cct2	1 LAGOS	330	17
Aladja_Delta_330_cct1	4 BENIN	330	32
Aladja_Sapele_330_cct1	4 BENIN	330	63
Alaoji_Onitsha_330_cct1	7 ENUGU	330	138
Alaoji-GS_Alaoji-TS_330_cct1	8 PT HARCO	330	10
Alaoji-GS_Alaoji-TS_330_cct2	8 PT HARCO	330	10
Aliade_Makurdi_330_cct1	7 ENUGU	330	46
Aliade_Makurdi_330_cct2	7 ENUGU	330	46
Aliade_Ugwuaji_330_cct1	7 ENUGU	330	157
Aliade_Ugwuaji_330_cct2	7 ENUGU	330	157
Asaba_Onitscha_cct1	7 ENUGU	330	0.2
Ayede_Olorunsogo_330_cct1	1 LAGOS	330	60
Ayede_Osogbo_330_cct1	2 OSOGBO	330	115
Benin_Delta_330_cct1	4 BENIN	330	41
Benin_Egbin_330_cct1	4 BENIN	330	280
Benin_Eyean_330_cct1	4 BENIN	330	25.1
Benin_Eyean_330_cct2	4 BENIN	330	25.1
Benin_Omotosho_330_cct1	4 BENIN	330	125
Benin_Onitsha_330_cct1	7 ENUGU	330	137
Benin_Onitsha_330_cct2	7 ENUGU	330	137
Benin_Onitsha_330_cct3	7 ENUGU	330	137
Benin_Onitsha_330_cct4	7 ENUGU	330	136.8
Benin_Osogbo_330_cct1	2 OSOGBO	330	251
Benin_Sapele_330_cct1	4 BENIN	330	50
Benin_Sapele_330_cct2	4 BENIN	330	50
Benin_Sapele_330_cct3	4 BENIN	330	50
Birnin-Kebbi_Kainji-GS_330_cct1	3 SHIRORO	330	310
Damaturu_Gombe_330_cct1	6 BAUCHI	330	160
Damaturu_Maiduguri_330_cct1	6 BAUCHI	330	260
Egbin_Ikeja-West_330_cct1	1 LAGOS	330	18

Egbin_Oke-Aro_330_cct1	1 LAGOS	330	18
Egbin_Oke-Aro_330_cct2	1 LAGOS	330	18
Ganmo_Jebba-TS_330_cct1	2 OSOGBO	330	110
Ganmo_Osogbo_330_cct1	2 OSOGBO	330	47
Gombe_Jos_330_cct1	6 BAUCHI	330	264
Gombe_Yola_330_cct1	6 BAUCHI	330	240
Gwagwalada_Katampe_330_cct1	3 SHIRORO	330	72.01
Gwagwalada_Lokoja_330_cct1	4 BENIN	330	174.6
Gwagwalada_Lokoja_330_cct2	6 BAUCHI	330	174.6
Gwagwalada_Shiroro_330_cct1	3 SHIRORO	330	145.99
Ikeja-West_Oke-Aro_330_cct1	1 LAGOS	330	18
Ikeja-West_Oke-Aro_330_cct2	1 LAGOS	330	18
Ikeja-West_Olorunsogo_330_cct1	1 LAGOS	330	77
Ikeja-West_Omotosho_330_cct1	1 LAGOS	330	155
Ikeja-West_Osogbo_330_cct1	2 OSOGBO	330	250
Ikeja-West_Sakete_330_cct1	1 LAGOS	330	70
Jebba-GS_Jebba-TS_330_cct1	3 SHIRORO	330	8
Jebba-GS_Jebba-TS_330_cct2	3 SHIRORO	330	8
Jebba-TS_Kainji-GS_330_cct1	3 SHIRORO	330	81
Jebba-TS_Kainji-GS_330_cct2	3 SHIRORO	330	81
Jebba-TS_Osogbo_330_cct1	3 SHIRORO	330	157
Jebba-TS_Osogbo_330_cct2	3 SHIRORO	330	157
Jebba-TS_Shiroro_330_cct1	3 SHIRORO	330	244
Jebba-TS_Shiroro_330_cct2	3 SHIRORO	330	244
Jos_Kaduna_330_cct1	5 KADUNA	330	196
Jos_Makurdi_330_cct1	6 BAUCHI	330	230
Jos_Makurdi_330_cct2	6 BAUCHI	330	230
Kaduna_Kano_330_cct1	5 KADUNA	330	230
Kaduna_Shiroro_330_cct1	3 SHIRORO	330	96
Kaduna_Shiroro_330_cct2	5 KADUNA	330	96
Kainji_New-Bussa_330_cct1	3 SHIRORO	330	10
Katampe_Shiroro_330_cct1	3 SHIRORO	330	144
New-Haven_Onitsha_330_cct1	7 ENUGU	330	96
New-Haven_Ugwuaji_330_cct1	7 ENUGU	330	5
New-Haven_Ugwuaji_330_cct2	7 ENUGU	330	5
Okpai_Onitsha_330_cct1	7 ENUGU	330	60
Okpai_Onitsha_330_cct2	7 ENUGU	330	60
Aba_Alaoji_132_cct1	8 PT HARCO	132	10
Aba_Alaoji_132_cct2	8 PT HARCO	132	10
Aba_Itu_132_cct1	8 PT HARCO	132	85.4
Abakaliki_Nkalagu_132_cct1	7 ENUGU	132	54.25
Adiabo_Calabar_132_cct1	8 PT HARCO	132	13
Adiabo_Calabar_132_cct2	8 PT HARCO	132	13
Adiabo_Itu_132_cct1	8 PT HARCO	132	47.36
Ado-Ekiti_Akure_132_cct1	2 OSOGBO	132	47

Ado-Ekiti_Akure_132_cct2	2 OSOGBO	132	47
Afam_Alaoji-TS_132_cct1	8 PT HARCO	132	46
Afam_Alaoji-TS_132_cct2	8 PT HARCO	132	46
Afam_PHCT-Main_132_cct1	8 PT HARCO	132	37.8
Afam_Rivers_132_cct1	8 PT HARCO	132	18.9
Agbara_Ikeja-West_132_cct1	1 LAGOS	132	32.04
Agbara_Ikeja-West_132_cct2	1 LAGOS	132	32.04
Agbara_Ojo_132_cct1	1 LAGOS	132	16.37
Agbara_Ojo_132_cct2	1 LAGOS	132	16.37
Agbor_Asaba_132_cct1	7 ENUGU	132	52
Agbor_Asaba_132_cct2	7 ENUGU	132	52
Ahoada_Owerri_132_cct1	8 PT HARCO	132	73
Ahoada_Owerri_132_cct2	8 PT HARCO	132	73
Ahoada_Yenagoa_132_cct1	8 PT HARCO	132	46
Ahoada_Yenagoa_132_cct2	8 PT HARCO	132	46
Aja_Alagbon_132_cct1	1 LAGOS	132	26
Aja_Alagbon_132_cct2	1 LAGOS	132	26
Aja_Lekki_132_cct1	1 LAGOS	132	20
Aja_Lekki_132_cct2	1 LAGOS	132	20
Ajaokuta_Ajaokuta-Steel_132_cct1	4 BENIN	132	11
Ajaokuta_Ajaokuta-Steel_132_cct2	4 BENIN	132	11
Ajaokuta_Itakpe_132_cct1	4 BENIN	132	45
Ajaokuta_Okene_132_cct1	4 BENIN	132	60
Akangba_Amuwo-Odofin_132_cct1	1 LAGOS	132	10
Akangba_Amuwo-Odofin_132_cct2	1 LAGOS	132	10
Akangba_Apapa-Road_132_cct1	1 LAGOS	132	4.5
Akangba_Apapa-Road_132_cct2	1 LAGOS	132	4.5
Akangba_Ijora_132_cct1	1 LAGOS	132	8.3
Akangba_Ijora_132_cct2	1 LAGOS	132	8.3
Akangba_Isolo_132_cct1	1 LAGOS	132	4.5
Akangba_Isolo_132_cct2	1 LAGOS	132	4.5
Akangba_Itire_132_cct1	1 LAGOS	132	3
Akangba_Itire_132_cct2	1 LAGOS	132	3
Akoka_Alagbon_132_cct1	1 LAGOS	132	12
Akoka_Ijora_132_cct1	1 LAGOS	132	8
Akoka_Oworosoki_132_cct1	1 LAGOS	132	4.45
Akoka_Oworosoki_132_cct2	1 LAGOS	132	4.45
Akure_Osogbo_132_cct1(1)	2 OSOGBO	132	92
Akwanga_Keffi_132_cct1	3 SHIRORO	132	62
Alagbon_Ijora_132_cct1	1 LAGOS	132	4
Alaoji_Owerri_132_cct1	8 PT HARCO	132	60
Alaoji_Owerri_132_cct2	8 PT HARCO	132	60
Alaoji_Umuahia_132_cct1	8 PT HARCO	132	66
Alaoji_Umuahia_132_cct2	8 PT HARCO	132	66
Alausa_Ogba_132_cct1	1 LAGOS	132	2

Alausa_Ogba_132_cct2	1 LAGOS	132	2
Aliade_Makurdi_132_cct1	7 ENUGU	132	25
Aliade_Oturkpo_132_cct1	7 ENUGU	132	39.2
Aliade_Yandev_132_cct1	7 ENUGU	132	39.2
Alimosho_Ikeja-West_132_cct1	1 LAGOS	132	3.5
Alimosho_Ikeja-West_132_cct2	1 LAGOS	132	3.5
Alimosho_Ogba_132_cct1	1 LAGOS	132	9.5
Alimosho_Ogba_132_cct2	1 LAGOS	132	9.5
Amukpe_Benin_132_cct1	4 BENIN	132	12
Amukpe_Delta_132_cct1	4 BENIN	132	90
Amuwo-Odofin_Apapa-Road_132_cct1	1 LAGOS	132	2
Amuwo-Odofin_Apapa-Road_132_cct2	1 LAGOS	132	13.487
Amuwo-Odofin_Ojo_132_cct1	1 LAGOS	132	8.9
Amuwo-Odofin_Ojo_132_cct2	1 LAGOS	132	8.9
Apo_Karu_132_cct1	3 SHIRORO	132	10
Apo_Katampe_132_cct1	3 SHIRORO	132	15
Apo_Katampe_132_cct2	3 SHIRORO	132	15
Apo_Kukwaba_132_cct1	3 SHIRORO	132	24
Apo_Kukwaba_132_cct2	3 SHIRORO	132	24
Ashaka_Ashaka-RNDAB_132_cct1	6 BAUCHI	132	10
Ashaka-RNDAB_Gombe_132_cct1	6 BAUCHI	132	76
Ashaka-RNDAB_Potiskum_132_cct1	6 BAUCHI	132	106
Awka_Oji-River_132_cct1	7 ENUGU	132	33.35
Awka_Onitsha_132_cct1	7 ENUGU	132	30
Ayede_Ibadan-North_132_cct1	2 OSOGBO	132	6
Ayede_Jericho_132_cct1	2 OSOGBO	132	2
Ayede_Shagamu_132_cct1	2 OSOGBO	132	92
Ayobo_Ikeja-West_132_cct1	1 LAGOS	132	10
Ayobo_Ikeja-West_132_cct2	1 LAGOS	132	10
Azare_Dutse_132_cct1	5 KADUNA	132	43
Azare_Wudil_132_cct1	5 KADUNA	132	100
Bauchi_Gombe_132_cct1	6 BAUCHI	132	146
Bauchi_Jos_132_cct1	6 BAUCHI	132	118
Benin_Irrua_132_cct1	4 BENIN	132	88.8
Benin_Ogara_132_cct1	4 BENIN	132	53
Bida_Minna_132_cct1	3 SHIRORO	132	90
Birnin-Gwari_Tegina_132_cct1	3 SHIRORO	132	70
Birnin-Kebbi_Dosso_132_cct1	3 SHIRORO	132	128
Birnin-Kebbi_Sokoto_132_cct1	3 SHIRORO	132	130
Biu_Damboa_132_cct1	6 BAUCHI	132	142
Biu_Gombe_132_cct1	6 BAUCHI	132	142
Central-Area_Katampe_132_cct1	3 SHIRORO	132	30
Central-Area_Katampe_132_cct2	3 SHIRORO	132	30
Dakata_Hadejia_132_cct1	5 KADUNA	132	150
Dakata_Kano_132_cct1	5 KADUNA	132	13

Dakata_Kano_132_cct2	5 KADUNA	132	13
Damboa_Maiduguri_132_cct1	6 BAUCHI	132	71
Dan-Agundi_Kano_132_cct1	5 KADUNA	132	9
Delta_Effurun_132_cct1	4 BENIN	132	32
Delta_Ogara_132_cct1	4 BENIN	132	54
Dosso_Niamey_132_cct1	3 SHIRORO	132	135
Dutse_Kano_132_cct1	5 KADUNA	132	108.5
East-Mains_Gwagwalada_132_cct1	3 SHIRORO	132	42
East-Mains_Gwagwalada_132_cct2	3 SHIRORO	132	42
East-Mains_Kukwaba_132_cct1	3 SHIRORO	132	24
East-Mains_Kukwaba_132_cct2	3 SHIRORO	132	24
Egbin_Ikorodu_132_cct1	1 LAGOS	132	20
Egbin_Ikorodu_132_cct2	1 LAGOS	132	20
Ejigbo_Ikeja-West_132_cct1	1 LAGOS	132	13.32
Ejigbo_Ikeja-West_132_cct2	1 LAGOS	132	13.32
Ejigbo_Itire_132_cct1	1 LAGOS	132	8
Ejigbo_Itire_132_cct2	1 LAGOS	132	8
Eket_Ibom_132_cct1	8 PT HARCO	132	90
Eket_Ibom_132_cct2	8 PT HARCO	132	27.356
Eket_Uyo_132_cct1	8 PT HARCO	132	46
Eket_Uyo_132_cct2	8 PT HARCO	132	46
Elelenwo_Rivers-IPP_132_cct1	8 PT HARCO	132	3.96
Elelenwo_Rivers-IPP_132_cct2	8 PT HARCO	132	3.96
Eyean_Okada_132_cct1	4 BENIN	132	60
Eyean_Okada_132_cct2	4 BENIN	132	60
Funtua_Gusau_132_cct1	5 KADUNA	132	110
Funtua_Zaria_132_cct1	5 KADUNA	132	70
Gamno_Offa_132_cct1	2 OSOGBO	132	50
Ganmo_Ilorin_132_cct1	2 OSOGBO	132	5
Ganmo_Ilorin_132_cct2	2 OSOGBO	132	5
Ganmo_Offa_132_cct2	2 OSOGBO	132	50
Gazoua_Katsina_132_cct1	5 KADUNA	132	71.28
GCM_Onitsha_132_cct1	7 ENUGU	132	18.5
Gombe_T-Junction_132_cct1	6 BAUCHI	132	40
Gusau_Talata-Mafara_132_cct1	5 KADUNA	132	85
Ibadan-North_Iwo_132_cct1	2 OSOGBO	132	18
Ife_Ilesha_132_cct1	2 OSOGBO	132	19.5
Ife_Ondo_132_cct1	2 OSOGBO	132	58
Ijebu-Ode_Shagamu_132_cct1	1 LAGOS	132	41
Ikeja-West_Illupeju_132_cct1	1 LAGOS	132	20
Ikeja-West_Illupeju_132_cct2	1 LAGOS	132	20
Ikeja-West_Otta_132_cct1	1 LAGOS	132	12
Ikeja-West_Otta_132_cct2	1 LAGOS	132	12
Ikeja-West_Oworosoki_132_cct1	1 LAGOS	132	49
Ikeja-West_Oworosoki_132_cct2	1 LAGOS	132	49

Ikorodu_Maryland_132_cct1	1 LAGOS	132	13.715
Ikorodu_Shagamu-Tee_132_cct1	1 LAGOS	132	30.9
Illupeju_Maryland_132_cct1	1 LAGOS	132	5.7
Illupeju_Maryland_132_cct2	1 LAGOS	132	5.7
Irrua_Ukpilla_132_cct1	4 BENIN	132	43
Iseyin_Iwo_132_cct1	2 OSOGBO	132	71
Itu_Uyo_132_cct1	8 PT HARCO	132	18
Itu_Uyo_132_cct2	8 PT HARCO	132	18
Iwo_Osogbo_132_cct1	2 OSOGBO	132	80
Jalingo_Mayo-Belwa	6 BAUCHI	132	140
Jos_Kafanchan_132_cct1	6 BAUCHI	132	77
Jos_Kafanchan_132_cct2	6 BAUCHI	132	77
Jos_Makeri_132_cct1	6 BAUCHI	132	50
Jos_Makeri_132_cct2	6 BAUCHI	132	50
Kaduna_Kaduna-Town_132_cct1	5 KADUNA	132	14
Kaduna_Zaria_132_cct1	5 KADUNA	132	62
Kankia_Kano_132_cct1	5 KADUNA	132	113
Kankia_Katsina_132_cct1	5 KADUNA	132	69
Kano_Katsina_132_cct1	5 KADUNA	132	145
Kano_Tamburawa_132_cct1	5 KADUNA	132	20
Kano_Wudil_132_cct1	5 KADUNA	132	50
Karu_Keffi_132_cct1	3 SHIRORO	132	41
Katampe_Kubwa_132_cct1	3 SHIRORO	132	7
Katampe_Kubwa_132_cct2	3 SHIRORO	132	7
Kontagora_Tegina_132_cct1	3 SHIRORO	132	90
Kontagora_Yelwa_132_cct1	3 SHIRORO	132	88
Kubwa_Suleja_132_cct1	3 SHIRORO	132	40
Kubwa_Suleja_132_cct2	3 SHIRORO	132	40
Kwanar-Dangora_Tamburawa_132_cct1	5 KADUNA	132	40
Kwanar-Dangora_Zaria_132_cct1	5 KADUNA	132	84.8
Maryland_Oke-Aro_132_cct1	1 LAGOS	132	8.168
Mayo-Belwa_Yola_132_cct1	6 BAUCHI	132	20
Mbalano_Okigwe_132_cct1	8 PT HARCO	132	20
Minna_Shiroro_132_cct1	3 SHIRORO	132	68
Minna_Shiroro_132_cct2	3 SHIRORO	132	68
Minna_Suleja_132_cct1	3 SHIRORO	132	99
Minna_Suleja_132_cct2	3 SHIRORO	132	99
New-Haven_Nkalagu_132_cct1	7 ENUGU	132	39
New-Haven_Nkalagu_132_cct2	7 ENUGU	132	39
New-Haven_Oji-River_132_cct1	7 ENUGU	132	44.1
New-Haven_Oturkpo_132_cct1	7 ENUGU	132	156.1
Numan_T-Off_132_cc1	6 BAUCHI	132	85
Numan_Yola_132_cct1	6 BAUCHI	132	50
Offa_Omuaran_132_cct1	2 OSOGBO	132	47.53

Offa_Osogbo_132_cct1	2 OSOGBO	132	43.5
Ogba_Otta_132_cct1	1 LAGOS	132	44.3
Oke-Aro_Ikorodu_132_cct1	1 LAGOS	132	8.687
Okene_Ukpilla_132_cct1	4 BENIN	132	33
Old-Abeokuta_Papalanto_132_cct1	1 LAGOS	132	55
Osogbo_Ilesha_132_cct1	2 OSOGBO	132	17
Otta_Papalanto_132_cct1	1 LAGOS	132	12
PHCT-Main_PHCT-Town_132_cct1	8 PT HARCO	132	3
PHCT-Main_PHCT-Town-1_132_cct2	8 PT HARCO	132	3
PHCT-Main_Rivers_132_cct1	8 PT HARCO	132	18.9
Savannah_T-Junction_132_cct1	6 BAUCHI	132	52
Shagamu_Shagamu-Tee_132_cct1	1 LAGOS	132	5
Shagamu-Cement_Shagamu-Tee_132_cct1	1 LAGOS	132	3
Shiroro_Tegina_132_cct1	3 SHIRORO	132	65
Sokoto_Talata-Mafara_132_cct1	3 SHIRORO	132	125
Kingsway_Nsukka_66_cct1	7 ENUGU	66	10
Kingsway_Oji-River_66_cct1	7 ENUGU	66	10

Annex 1.2 – Transmission Transformers (not supplying DISCOs)

Name	Region	Rating HV [MVA]	Rating MV [MVA]	Rating LV [MVA]	Voltage level HV side [kV]	Voltage level MV side [kV]	Voltage level LV side [kV]	2w/3w
Aja_330_132_trf1	1 LAGOS	150	150	27,5	330	138,6	33	3w
Aja_330_132_trf2	1 LAGOS	150	150	27,5	330	138,6	33	3w
Aja_330_132_trf3	1 LAGOS	150	150	27,5	330	138,6	33	3w
Akangba_330_132_trf1	1 LAGOS	150	150	27,5	330	145,2	33	3w
Akangba_330_132_trf2	1 LAGOS	150	150	27,5	330	145,2	33	3w
Akangba_330_132_trf3	1 LAGOS	90	90	22,5	330	145,2	13,8	3w
Akangba_330_132_trf4	1 LAGOS	90	90	22,5	330	145,2	13,8	3w
Akangba_330_132_trf5	1 LAGOS	90	90	22,5	330	145,2	13,8	3w
Akangba_330_132_trf6	1 LAGOS	90	90	22,5	330	132	13,8	3w
Egbin_330_132_trf1	1 LAGOS	150	150	27,5	330	138,6	33	3w
Egbin_330_132_trf2	1 LAGOS	150	150	150	330	138,6	33	3w
Ikeja-West_330_132_trf1	1 LAGOS	150	50	50	330	132	33	3w
Ikeja-West_330_132_trf2	1 LAGOS	150	150	75	330	143,88	33	3w
Ikeja-West_330_132_trf3	1 LAGOS	150	150	75	330	143,88	33	3w
Ikeja-West_330_132_trf4	1 LAGOS	150	150	75	330	143,88	33	3w
Ikeja-West_330_132_trf5	1 LAGOS	150	150	27,5	330	145,2	33	3w
Ikeja-West_330_132_trf6	1 LAGOS	150	150	75	330	143,88	33	3w
Oke-Aro_330_132_trf1	1 LAGOS	300	225	75	330	138,6	33	3w
Oke-Aro_330_132_trf2	1 LAGOS	300	300	75	330	138,6	33	3w
Ayede_132_33_trf3	2 OSOGBO	60				132	33	2w
Ayede_330_132_trf1	2 OSOGBO	150	150	75	330	143,88	33	3w
Ayede_330_132_trf2	2 OSOGBO	150	150	75	330	143,88	33	3w
Ayede_330_132_trf3	2 OSOGBO	150	150	37,5	330	132	33	3w
Ganmo_330_132_trf1	2 OSOGBO	150	150	37,5	330	137,28	33	3w
Ganmo_330_132_trf2	2 OSOGBO	150	112,5	37,5	330	137,28	33	3w
Osogbo_330_132_trf1	2 OSOGBO	150	150	37,5	330	132	33	3w
Osogbo_330_132_trf2	2 OSOGBO	150	150	37,5	330	141,24	33	3w
Osogbo_330_132_trf3	2 OSOGBO	90	90	22,5	330	141,24	18	3w
Osogbo_330_132_trf4	2 OSOGBO		150					3w
Bkebbi_330_132_trf1	3 SHIRORO	150	150	37,5	330	137,28	33	3w
Bkebbi_330_132_trf2	3 SHIRORO	90	90	90	330	137,28	13,8	3w
Bkebbi_330_132_trf3	3 SHIRORO	90	90	90	330	132	13,8	3w
Gwagwalada_330_132_trf1	3 SHIRORO	150	150	37,5	330	145,2	33	3w
Gwagwalada_330_132_trf2	3 SHIRORO	150	150	37,5	330	145,2	33	3w
Jebba-Ts_330_132_trf1	3 SHIRORO	90	90	20	330	132	13,8	3w
Katampe_330_132_trf1	3 SHIRORO	150	150	37,5	330	145,2	33	3w
Katampe_330_132_trf2	3 SHIRORO	150	150	37,5	330	145,2	33	3w

Katampe_330_132_trf3	3 SHIRORO	150	150	37,5	330	145,2	33	3w
Shiroro_330_132_trf1	3 SHIRORO	150	150	37,5	330	134,64	33	3w
Shiroro_330_132_trf2	3 SHIRORO	150	150	37,5	330	134,64	33	3w
Shiroro_330_132_trf3	3 SHIRORO	150	150	37,5	330	134,64	33	3w
Ajaokuta_330_132_trf1	4 BENIN	162	162	40,5	330	132	33	3w
Ajaokuta_330_132_trf2	4 BENIN	162	162	80	330	132	33	3w
Ajaokuta_330_132_trf3	4 BENIN	162	162	40,5	330	132	33	3w
Benin_330_132_trf1	4 BENIN	150	150	37,5	330	143,88	33	3w
Benin_330_132_trf2	4 BENIN	150	150	50	330	142,56	33	3w
Delta-Iv_330_132_trf1	4 BENIN	150	150	27,5	330	133,32	33	3w
Eyean_330_132_Trf1	4 BENIN	300	225	75	330	138,6	33	3w
Lokoja_330_132_Trf1	4 BENIN	150	150	37,5	330	145,2	33	3w
Omotosho_330_132_trf1	4 BENIN		150			330	132	2w
Kaduna_330_132_trf1	5 KADUNA	90	90	22,5	330	132	33	3w
Kaduna_330_132_trf2	5 KADUNA	60	60	15	330	132	13,8	3w
Kaduna_330_132_trf3	5 KADUNA	150	150	37,5	330	132	33	3w
Kaduna_330_132_trf4	5 KADUNA	150	150	37,5	330	132	33	3w
Kaduna_330_132_trf5	5 KADUNA	150	150	37,5	330	132	33	3w
Kano_330_132_trf1	5 KADUNA	150	150	37,5	330	138,6	33	3w
Kano_330_132_trf2	5 KADUNA	150	150	50	330	138,6	33	3w
Kano_330_132_trf3	5 KADUNA	150	150	37,5	330	138,6	33	3w
Kano_330_132_trf4	5 KADUNA	150	150	37,5	330	138,6	33	3w
Kano_330_132_trf5	5 KADUNA	150	150	37,5	330	138,6	33	3w
Alangbon_330_132_trf1	6 BAUCHI	90	90	22,5	330	132	13,8	3w
Asaba_330_132_trf1	6 BAUCHI	150	150	37,5	330	145,2	33	3w
Asaba_330_132_trf2	6 BAUCHI	150	150	37,5	330	145,2	33	3w
Gombe_330_132_trf1	6 BAUCHI	150	150	37,5	330	138,6	33	3w
Gombe_330_132_trf2	6 BAUCHI	150	150	37,5	330	138,6	33	3w
Gombe_330_132_trf3	6 BAUCHI	150	150	37,5	330	138,6	33	3w
Jos_330_132_trf1	6 BAUCHI	150	150	37,5	330	138,6	33	3w
jos_330_132_trf2	6 BAUCHI	150	150	37,5	330	138,6	33	3w
Yola_330_132_trf1	6 BAUCHI	150	150	37,5	330	145,2	33	3w
Yola_330_132_trf2	6 BAUCHI	150	150	37,5	330	132	33	3w
Apir_132_33_trf1	7 ENUGU	40				132	33	2w
Makurdi_330_132_trf1	7 ENUGU	150	150	37,5	330	132	33	3w
New-Haven_330_132_trf1	7 ENUGU	150	150	37,5	330	138,6	33	3w
New-Haven_330_132_trf2	7 ENUGU	150	150	75	330	138,6	33	3w
Oji-River_132_66_trf1	7 ENUGU	30		30		132	66	2w
Onitsha_330_132_trf1	7 ENUGU	150	150	37,5	330	142,56	33	3w
Onitsha_330_132_trf2	7 ENUGU	150	150	37,5	330	132	33	3w
Onitsha_330_132_trf3	7 ENUGU	90	90	22,5	330	142,56	13,8	3w
Onitsha_330_132_trf4	7 ENUGU	90	90	30	330	142,56	13,8	3w
Ugwuaji_330_132_trf1	7 ENUGU	150	150	27,5	330	132	33	3w
Adiabo_330_132_33_trf1	8 PT HARCO	150	150	37,5	330	145,2	33	3w
Adiabo_330_132_33_trf2	8 PT HARCO	150	150	37,5	330	145,2	33	3w
Afam_132_11_trf1	8 PT HARCO	64				132	11	2w
Afam_132_33_trf1	8 PT HARCO	30				132	33	2w

Afam-Iv_330_132_trf1	8 PT HARCO	162	162	60	330	145,2	33	3w
Afam-Iv_330_132_trf2	8 PT HARCO	198	198	60	330	145,2	33	3w
Alaoji_132_33_trf1	8 PT HARCO	60				132	33	2w
Alaoji_132_33_trf2	8 PT HARCO	60				132	33	2w
Alaoji_132_33_trf3	8 PT HARCO	30				132	33	2w
Alaoji_132_33_trf4	8 PT HARCO	60				132	33	2w
Alaoji_330_132_trf1	8 PT HARCO	150	150	37,5	330	145,2	33	3w
Alaoji_330_132_trf2	8 PT HARCO	150	150	37,5	330	145,2	33	3w
Alaoji_330_132_trf3	8 PT HARCO	150	150	37,5	330	145,2	33	3w

Annex 1.3 – Transformers at Transmission Substation (supplying DISCOs)

Name	Region	DISCO	Rating HV [MVA]	Rating MV [MVA]	Rating LV [MVA]	Voltage level HV side [kV]	Voltage level MV side [kV]	Voltage level LV side [kV]	2w/3w
Agbara_132_33_trf1	1 LAGOS	Eko	60		60	132		33,99	2w
Agbara_132_33_trf2	1 LAGOS	Eko	60		60	132		33,99	2w
Agbara_132_33_trf3	1 LAGOS	Eko	60		60	132		33,99	2w
Aja_132_33_trf1	1 LAGOS	Eko	60		60	132		33,66	2w
Aja_132_33_trf2	1 LAGOS	Eko	60		60	132		33,66	2w
Aja_132_33_trf3	1 LAGOS	Eko	100			132		33	2w
Akangba_132_33_trf1	1 LAGOS	Eko	60		60	132		33	2w
Akangba_132_33_trf2	1 LAGOS	Eko	60		60	132		33	2w
Akangba_132_33_trf3	1 LAGOS	Eko	60		60	132		33	2w
Akoka_132_33_trf1	1 LAGOS	Eko	40		40	132		34,65	2w
Akoka_132_33_trf2	1 LAGOS	Eko	45		45	132		34,65	2w
Alagbon_132_33_trf1	1 LAGOS	Eko	60		60	132		34,65	2w
Alagbon_132_33_trf2	1 LAGOS	Eko	60		60	132		34,65	2w
Amuwo-Odofin_132_33_trf1	1 LAGOS	Eko	30		30	132		34,32	2w
Amuwo-Odofin_132_33_trf2	1 LAGOS	Eko	60		60	132		34,32	2w
Amuwo-Odofin_132_33_trf3	1 LAGOS	Eko	40		40	132		34,32	2w
Apapa-Road_132_33_trf1	1 LAGOS	Eko	45		45	132		34,65	2w
Apapa-Road_132_33_trf2	1 LAGOS	Eko	45		45	132		34,65	2w
Egbin_132_33_trf3	1 LAGOS	Eko	100			132		33	2w
Ijora_132_33_trf1	1 LAGOS	Eko	30		30	132		34,32	2w
Ijora_132_33_trf2	1 LAGOS	Eko	30		30	132		34,32	2w
Ijora_132_33_trf3	1 LAGOS	Eko	45		45	132		34,65	2w
Ijora_132_33_trf4	1 LAGOS	Eko	30		30	132		34,32	2w
Itire_132_33_trf1	1 LAGOS	Eko	40		40	132		34,65	2w
Itire_132_33_trf2	1 LAGOS	Eko	30		30	132		34,65	2w
Itire_132_33_trf3	1 LAGOS	Eko	60		60	132		34,65	2w
Lekki_132_33_trf1	1 LAGOS	Eko	60		60	132		34,65	2w
Lekki_132_33_trf2	1 LAGOS	Eko	60		60	132		34,65	2w
Ojo_132_33_trf1	1 LAGOS	Eko	30		30	132		33	2w
Ojo_132_33_trf2	1 LAGOS	Eko	30		30	132		33	2w
Ojo_132_33_trf3	1 LAGOS	Eko	60		60	132		33,66	2w
Ojo_132_33_trf4	1 LAGOS	Eko	60		60	132		33,66	2w
Ijebu-Ode_132_33_trf1	1 LAGOS	Ibadan	30		30	132		33,66	2w
Ijebu-Ode_132_33_trf2	1 LAGOS	Ibadan	30		30	132		33,66	2w

Old-Abeokuta_132_33_trf1	1 LAGOS	Ibadan	30		30	132		31,35	2w
Old-Abeokuta_132_33_trf2	1 LAGOS	Ibadan	30		30	132		31,35	2w
Old-Abeokuta_132_33_trf3	1 LAGOS	Ibadan	30		30	132		31,35	2w
Otta_132_33_trf1	1 LAGOS	Ibadan	60		60	132		34,65	2w
Otta_132_33_trf2	1 LAGOS	Ibadan	40		40	132		34,65	2w
Otta_132_33_trf3	1 LAGOS	Ibadan	40		40	132		34,65	2w
Papalanto_132_33_trf1	1 LAGOS	Ibadan	30		30	132		34,32	2w
Papalanto_132_33_trf2	1 LAGOS	Ibadan	15		15	132		33,99	2w
Papalanto_132_33_trf3	1 LAGOS	Ibadan	15		15	132		33,99	2w
Shagamu_132_33_trf1	1 LAGOS	Ibadan	30		30	132		33	2w
Shagamu_132_33_trf2	1 LAGOS	Ibadan	30		30	132		33	2w
Alausa_132_33_trf1	1 LAGOS	Ikeja	30		30	132		34,65	2w
Alausa_132_33_trf2	1 LAGOS	Ikeja	30		30	132		34,65	2w
Alausa_132_33_trf3	1 LAGOS	Ikeja	60		60	132		34,65	2w
Alimosho_132_33_trf1	1 LAGOS	Ikeja	100		100	132		34,65	2w
Alimosho_132_33_trf2	1 LAGOS	Ikeja	30		30	132		34,65	2w
Alimosho_132_33_trf3	1 LAGOS	Ikeja	30		30	132		34,65	2w
Ayobo_132_33_trf1	1 LAGOS	Ikeja	60		60	132		34,65	2w
Ayobo_132_33_trf2	1 LAGOS	Ikeja	60		60	132		34,65	2w
Ejigbo_132_33_trf1	1 LAGOS	Ikeja	30		30	132		34,32	2w
Ejigbo_132_33_trf2	1 LAGOS	Ikeja	30		30	132		34,32	2w
Ejigbo_132_33_trf3	1 LAGOS	Ikeja	100		100	132		34,32	2w
Ikorodu_132_33_trf1	1 LAGOS	Ikeja	60		60	132		33,33	2w
Ikorodu_132_33_trf2	1 LAGOS	Ikeja	60		60	132		33,33	2w
Ikorodu_132_33_trf3	1 LAGOS	Ikeja	100		100	132		33,33	2w
Illupeju_132_11_trf1	1 LAGOS	Ikeja	15		15	132		10,78	2w
Illupeju_132_11_trf2	1 LAGOS	Ikeja	15		15	132		10,78	2w
Illupeju_132_33_trf1	1 LAGOS	Ikeja	30		30	132		32,34	2w
Illupeju_132_33_trf2	1 LAGOS	Ikeja	30		30	132		32,34	2w
Illupeju_132_33_trf4	1 LAGOS	Ikeja	30			132		33	2w
Isolo_132_33_trf1	1 LAGOS	Ikeja	30		30	132		34,32	2w
Isolo_132_33_trf2	1 LAGOS	Ikeja	60		60	132		34,32	2w
Isolo_132_33_trf3	1 LAGOS	Ikeja	60		60	132		34,32	2w
Maryland_132_33_trf1	1 LAGOS	Ikeja	60		60	132		34,65	2w
Maryland_132_33_trf2	1 LAGOS	Ikeja	30		30	132		34,65	2w
Maryland_132_33_trf3	1 LAGOS	Ikeja	30		30	132		34,65	2w
Ogba_132_11_trf1	1 LAGOS	Ikeja	20		20	132		11,55	2w
Ogba_132_33_trf1	1 LAGOS	Ikeja	30		30	132		34,65	2w
Ogba_132_33_trf2	1 LAGOS	Ikeja	60		60	132		34,65	2w
Ogba_132_33_trf3	1 LAGOS	Ikeja	60		60	132		34,65	2w
Ogba_132_33_trf4	1 LAGOS	Ikeja	40		40	132		34,65	2w
Oke-Aro_132_33_trf1	1 LAGOS	Ikeja	60		60	132		34,65	2w
Oke-Aro_132_33_trf2	1 LAGOS	Ikeja	60		60	132		34,65	2w
Oworosoki_132_33_trf1	1 LAGOS	Ikeja	60		60	132		34,65	2w
Oworosoki_132_33_trf2	1 LAGOS	Ikeja	60		60	132		34,65	2w

Ado-Ekiti_132_33_trf1	2 OSOGBO	Benin	40		40	132		33	2w
Ado-Ekiti_132_33_trf2	2 OSOGBO	Benin	40		40	132		33	2w
Akure_132_33_trf1	2 OSOGBO	Benin	60		60	132		32,67	2w
Akure_132_33_trf2	2 OSOGBO	Benin	30		30	132		32,67	2w
Akure_132_33_trf3	2 OSOGBO	Benin	30		30	132		32,67	2w
Ondo_132_33_trf1	2 OSOGBO	Benin	30		30	132		34,32	2w
Ondo_132_33_trf2	2 OSOGBO	Benin	30		30	132		33	2w
Ayede_132_33_trf1	2 OSOGBO	Ibadan	100		100	132		33,66	2w
Ayede_132_33_trf2	2 OSOGBO	Ibadan	60		60	132		33,66	2w
Ganmo_132_33_trf1	2 OSOGBO	Ibadan	60		60	132		32,34	2w
Ganmo_132_33_trf2	2 OSOGBO	Ibadan	60		60	132		32,34	2w
Ganmo_132_33_trf3	2 OSOGBO	Ibadan	45			132		33	2w
Ganmo_132_33_trf4	2 OSOGBO	Ibadan	60			132		33	2w
Ibadan-North_132_33_trf1	2 OSOGBO	Ibadan	60		60	132		33	2w
Ibadan-North_132_33_trf2	2 OSOGBO	Ibadan	60		60	132		33	2w
Ife_132_33_trf1	2 OSOGBO	Ibadan	30		30	132		33,66	2w
Ife_132_33_trf2	2 OSOGBO	Ibadan	30		30	132		33,66	2w
Ilesha_132_33_trf1	2 OSOGBO	Ibadan	40		40	132		33,66	2w
Ilesha_132_33_trf2	2 OSOGBO	Ibadan	40		40	132		33,66	2w
Ilorin_132_33_trf1	2 OSOGBO	Ibadan	45		45	132		32,34	2w
Ilorin_132_33_trf2	2 OSOGBO	Ibadan	60		60	132		32,34	2w
Iseyin_132_33_trf1	2 OSOGBO	Ibadan	45		45	132		32,01	2w
Iwo_132_33_trf1	2 OSOGBO	Ibadan	40		40	132		33	2w
Jericho_132_33_trf1	2 OSOGBO	Ibadan	45		45	132		33,33	2w
Jericho_132_33_trf2	2 OSOGBO	Ibadan	40		40	132		33,33	2w
Offa_132_33_trf1	2 OSOGBO	Ibadan	30		30	132		34,32	2w
Omuaran_132_33_trf1	2 OSOGBO	Ibadan	30		30	132		33,99	2w
Omuaran_132_33_trf2	2 OSOGBO	Ibadan	30		30	132		33,99	2w
Osogbo_132_33_trf1	2 OSOGBO	Ibadan	60		60	132		32,34	2w
Osogbo_132_33_trf2	2 OSOGBO	Ibadan	30		30	132		32,34	2w
Osogbo_132_33_trf3	2 OSOGBO	Ibadan	60		60	132		32,34	2w
Osogbo_132_33_trf4	2 OSOGBO	Ibadan	60			132		33	2w
Osogbo_132_33_trf5	2 OSOGBO	Ibadan	30			132		33	2w
Akwanga_132_33_trf1	3 SHIRORO	Abuja	40		40	132		34,155	2w
Akwanga_132_33_trf2	3 SHIRORO	Abuja	40		40	132		34,155	2w
Apo_132_33_trf1	3 SHIRORO	Abuja	45		45	132		34,65	2w
Apo_132_33_trf2	3 SHIRORO	Abuja	45		45	132		34,65	2w
Apo_132_33_trf4	3 SHIRORO	Abuja	100		100	132		34,65	2w
Bida_132_11_trf1	3 SHIRORO	Abuja	15		15	132		11,5	2w
Bida_132_11_trf2	3 SHIRORO	Abuja	15		15	132		11,5	2w
Bida_132_33_trf1	3 SHIRORO	Abuja	30		30	132		34,65	2w
Bida_132_33_trf2	3 SHIRORO	Abuja	30		30	132		34,65	2w
Central-Area_132_33_trf1	3 SHIRORO	Abuja	60		60	132		33,99	2w
Central-Area_132_33_trf2	3 SHIRORO	Abuja	60		60	132		33,99	2w
Central-Area_132_33_trf3	3 SHIRORO	Abuja	60		60	132		33,99	2w
Gwagwalada_132_33_trf1	3 SHIRORO	Abuja	60		60	132		34,65	2w
Gwagwalada_132_33_trf2	3 SHIRORO	Abuja	60			132		33	2w

Karu_132_33_trf1	3 SHIRORO	Abuja	60		60	132		34,65	2w
Karu_132_33_trf2	3 SHIRORO	Abuja	60		60	132		34,65	2w
Katampe_132_33_trf1	3 SHIRORO	Abuja	60		60	132		34,65	2w
Katampe_132_33_trf2	3 SHIRORO	Abuja	60		60	132		34,65	2w
Keffi_132_33_trf1	3 SHIRORO	Abuja	30		30	132		34,65	2w
Kontagora_132_33_trf1	3 SHIRORO	Abuja	30		30	132		33	2w
Kubwa_132_33_trf1	3 SHIRORO	Abuja	60		60	132		33,66	2w
Kubwa_132_33_trf2	3 SHIRORO	Abuja	60		60	132		33,66	2w
Minna_132_11_trf1	3 SHIRORO	Abuja	15		15	132		11,5	2w
Minna_132_11_trf2	3 SHIRORO	Abuja	15		15	132		11,5	2w
Minna_132_33_trf1	3 SHIRORO	Abuja	60		60	132		34,65	2w
Minna_132_33_trf2	3 SHIRORO	Abuja	60		60	132		34,65	2w
Minna_132_33_trf3	3 SHIRORO	Abuja	30		30	132		34,65	2w
Shiroro_132_33_trf1	3 SHIRORO	Abuja	30		30	132		33,66	2w
Suleja_132_11_trf1	3 SHIRORO	Abuja	7,5		7,5	132		11,55	2w
Suleja_132_33_trf1	3 SHIRORO	Abuja	45		45	132		34,65	2w
Suleja_132_33_trf2	3 SHIRORO	Abuja	30		30	132		34,65	2w
Tegina_132_33_trf1	3 SHIRORO	Abuja	30		30	132		33	2w
Jebba_132_33_trf1	3 SHIRORO	Ibadan	30		30	132		33,33	2w
Biu_132_33_trf1	3 SHIRORO	Kaduna	60		60	132		33	2w
Biu_132_33_trf2	3 SHIRORO	Kaduna	30		30	132		33	2w
Bkebbi_132_33_trf1	3 SHIRORO	Kaduna	60		60	132		33	2w
Sokoto_132_33_trf1	3 SHIRORO	Kaduna	30		30	132		34,65	2w
Sokoto_132_33_trf2	3 SHIRORO	Kaduna	30		30	132		34,65	2w
Sokoto_132_33_trf3	3 SHIRORO	Kaduna	30		30	132		34,65	2w
Talata-Mafara_132_33_trf1	3 SHIRORO	Kaduna	30		30	132		34,65	2w
Ajaokuta_132_33_trf1	4 BENIN	Abuja	60		60	132		34,65	2w
Ajaokuta_132_33_trf2	4 BENIN	Abuja	60		60	132		34,65	2w
Lokoja_132_33_Trf1	4 BENIN	Abuja	60		60	132		34,65	2w
Okene_132_33_trf1	4 BENIN	Abuja	30		30	132		33,99	2w
Okene_132_33_trf2	4 BENIN	Abuja	40		40	132		33,99	2w
Amukpe_132_33_trf1	4 BENIN	Benin	30		30	132		34,65	2w
Amukpe_132_33_trf2	4 BENIN	Benin	60		60	132		32,67	2w
Asaba_132_33_trf1	4 BENIN	Benin	60		60	132		34,65	2w
Asaba_132_33_trf2	4 BENIN	Benin	60		60	132		34,65	2w
Benin_132_33_trf1	4 BENIN	Benin	60		60	132		33,66	2w
Benin_132_33_trf2	4 BENIN	Benin	60		60	132		33,66	2w
Benin_132_33_trf3	4 BENIN	Benin	60		60	132		33,66	2w
Benin_132_33_trf4	4 BENIN	Benin	60		60	132		33,66	2w
Delta_132_33_trf1	4 BENIN	Benin	60		60	132		34,65	2w
Delta_132_33_trf2	4 BENIN	Benin	30		30	132		34,65	2w
Effurun_132_33_trf1	4 BENIN	Benin	60		60	132		34,65	2w
Effurun_132_33_trf2	4 BENIN	Benin	60		60	132		34,65	2w
Effurun_132_33_trf3	4 BENIN	Benin	60		60	132		34,65	2w
Irrua_132_33_trf1	4 BENIN	Benin	60		60	132		34,32	2w
Irrua_132_33_trf2	4 BENIN	Benin	30		30	132		34,32	2w

Okada_132_33_Trf1	4 BENIN	Benin	40		40	132		34,65	2w
Okada_132_33_Trf2	4 BENIN	Benin	40		40	132		34,65	2w
Ukpilla_132_33_trf1	4 BENIN	Benin	15		15	132		34,65	2w
Azare_132_33_trf1	5 KADUNA	Jos	30		30	132		33,99	2w
Azare_132_33_trf2	5 KADUNA	Jos	30		30	132		33,99	2w
Gusau_132_33_trf1	5 KADUNA	Kaduna	30		30	132		34,65	2w
Gusau_132_33_trf2	5 KADUNA	Kaduna	30		30	132		34,65	2w
Kaduna_132_33_trf1	5 KADUNA	Kaduna	60		60	132		33,66	2w
Kaduna_132_33_trf2	5 KADUNA	Kaduna	60		60	132		33,66	2w
Kaduna_132_33_trf3	5 KADUNA	Kaduna	60		60	132		33,66	2w
Kaduna_132_33_trf4	5 KADUNA	Kaduna	60		60	132		33	2w
Kaduna_132_33_trf5	5 KADUNA	Kaduna	30					33	2w
Kaduna-Town_132_11_trf1	5 KADUNA	Kaduna	15		15	132		11,55	2w
Kaduna-Town_132_33_trf2	5 KADUNA	Kaduna	60		60	132		34,65	2w
Kaduna-Town_132_33_trf3	5 KADUNA	Kaduna	30		30	132		34,65	2w
Kaduna-Town_132_33_trf4	5 KADUNA	Kaduna	60		60	132		34,65	2w
Zaria_132_33_trf1	5 KADUNA	Kaduna	40		40	132		31,68	2w
Zaria_132_33_trf2	5 KADUNA	Kaduna	60		60	132		31,68	2w
Dakata_132_33_trf1	5 KADUNA	Kano	60		60	132		33,66	2w
Dakata_132_33_trf2	5 KADUNA	Kano	60		60	132		33,66	2w
Dakata_132_33_trf3	5 KADUNA	Kano	30		30	132		33,66	2w
Dan-Agundi_132_33_trf1	5 KADUNA	Kano	60		60	132		34,65	2w
Dan-Agundi_132_33_trf2	5 KADUNA	Kano	60		60	132		34,65	2w
Dutse_132_33_trf1	5 KADUNA	Kano	30		30	132		33,99	2w
Dutse_132_33_trf2	5 KADUNA	Kano	30		30	132		33,99	2w
Funtua_132_11_trf1	5 KADUNA	Kano	7,5		7,5	132		11,55	2w
Funtua_132_11_trf2	5 KADUNA	Kano	7,5		7,5	132		11,55	2w
Funtua_132_33_trf1	5 KADUNA	Kano	30		30	132		34,65	2w
Hadejia_132_33_trf1	5 KADUNA	Kano	7,5		7,5	132		31,35	2w
Hadejia_132_33_trf2	5 KADUNA	Kano	15		15	132		31,35	2w
Kankia_132_33_trf1	5 KADUNA	Kano	30		30	132		34,65	2w
Kankia_132_33_trf2	5 KADUNA	Kano	30		30	132		33	2w
Kano_132_11_trf1	5 KADUNA	Kano	15			132		11	2w
Kano_132_33_trf1	5 KADUNA	Kano	40		40	132		34,32	2w
Kano_132_33_trf2	5 KADUNA	Kano	30		30	132		33,99	2w
Kano_132_33_trf3	5 KADUNA	Kano	30		30	132		34,32	2w
Kano_132_33_trf4	5 KADUNA	Kano	60		60	132		34,32	2w
Katsina_132_33_trf1	5 KADUNA	Kano	60		60	132		33	2w
Katsina_132_33_trf2	5 KADUNA	Kano	30		30	132		33	2w
Katsina_132_33_trf3	5 KADUNA	Kano	30		30	132		33	2w
Kwanar-Dango_132_33_trf1	5 KADUNA	Kano	30		30	132		34,32	2w
Tamburawa_132_33_trf1	5 KADUNA	Kano	30		30	132		33	2w
Tamburawa_132_33_trf2	5 KADUNA	Kano	30		30	132		34,65	2w

Bauchi_132_33_trf1	6 BAUCHI	Jos	40		40	132		34,65	2w
Bauchi_132_33_trf2	6 BAUCHI	Jos	40		40	132		34,65	2w
Gombe_132_33_trf1	6 BAUCHI	Jos	45			132		33	2w
Gombe_132_33_trf2	6 BAUCHI	Jos	60	33,75	11,25	132	34,65	11	3w
Jos_132_33_trf1	6 BAUCHI	Jos	60		60	132		34,65	2w
Jos_132_33_trf2	6 BAUCHI	Jos	60		60	132		34,65	2w
Makeri_132_33_trf1	6 BAUCHI	Jos	60		60	132		34,32	2w
Makeri_132_33_trf2	6 BAUCHI	Jos	60		60	132		34,32	2w
Kafanchan_132_33_trf1	6 BAUCHI	Kaduna	40		40	132		34,32	2w
Bkebbi_132_33_trf2	6 BAUCHI	Yola	30		30	132		33,99	2w
Bkebbi_132_33_trf3	6 BAUCHI	Yola	15		15	132		33	2w
Jalingo_132_33_trf1	6 BAUCHI	Yola	30		30	132		34,65	2w
Jalingo_132_33_trf2	6 BAUCHI	Yola	30		30	132		34,65	2w
Maiduguri_132_33_trf1	6 BAUCHI	Yola	15		15	132		33	2w
Maiduguri_132_33_trf2	6 BAUCHI	Yola	45		45	132		33	2w
Maiduguri_132_33_trf3	6 BAUCHI	Yola	45		45	132		33	2w
Potiskum_132_33_trf1	6 BAUCHI	Yola	30		30	132		34,32	2w
Potiskum_132_33_trf2	6 BAUCHI	Yola	30		30	132		34,32	2w
Savannah_132_33_trf1	6 BAUCHI	Yola	15		15	132		34,65	2w
Yola_132_33_trf1	6 BAUCHI	Yola	30		30	132		34,65	2w
Yola_132_33_trf2	6 BAUCHI	Yola	60		60	132		34,65	2w
Abakaliki_132_33_trf1	7 ENUGU	Enugu	30		30	132		33	2w
Abakaliki_132_33_trf2	7 ENUGU	Enugu	60		60	132		33	2w
Agu-Awka_132_33_trf1	7 ENUGU	Enugu	40		40	132		34,65	2w
Awka_132_33_trf1	7 ENUGU	Enugu	30		30	132		32,34	2w
Awka_132_33_trf2	7 ENUGU	Enugu	30		30	132		32,34	2w
GCM_132_33_trf1	7 ENUGU	Enugu	60		60	132		34,65	2w
New-Haven_132_33_trf1	7 ENUGU	Enugu	60		60	132		33,66	2w
New-Haven_132_33_trf2	7 ENUGU	Enugu	60		60	132		33,66	2w
New-Haven_132_33_trf3	7 ENUGU	Enugu	30		30	132		33,66	2w
New-Haven_132_33_trf4	7 ENUGU	Enugu	30		30	132		33,66	2w
Nkalagu_132_33_trf1	7 ENUGU	Enugu	30		30	132		33,99	2w
Nkalagu_132_33_trf2	7 ENUGU	Enugu	30		30	132		33,99	2w
Nsukka_66_33_trf1	7 ENUGU	Enugu	7,5		7,5	66		33,99	2w
Nsukka_66_33_trf2	7 ENUGU	Enugu	7,5		7,5	66		33,99	2w
Oji-River_132_33_trf1	7 ENUGU	Enugu	15		15	132		34,65	2w
Onitsha_132_11_trf1	7 ENUGU	Enugu	15		15	132		11,5	2w
Onitsha_132_11_trf2	7 ENUGU	Enugu	20		20	132		11,5	2w
Onitsha_132_33_trf2	7 ENUGU	Enugu	15		15	132		33	2w
Onitsha_132_33_trf3	7 ENUGU	Enugu	60		60	132		33	2w
Onitsha_132_33_trf4	7 ENUGU	Enugu	60		60	132		33	2w
Onitsha_132_33_trf5	7 ENUGU	Enugu	40		40	132		33	2w
Ugwuaji_132_33_trf1	7 ENUGU	Enugu	60		60	132		34,65	2w
Makurdi_132_33_trf1	7 ENUGU	Jos	40		40	132		34,65	2w
Oturkpo_132_33_trf1	7 ENUGU	Jos	30		30	132		34,65	2w
Yandev_132_33_trf1	7 ENUGU	Jos	45		45	132		33	2w
Yandev_132_33_trf2	7 ENUGU	Jos	60		60	132		34,65	2w

Aba_132_33_trf1	8 PT HARCO	Enugu	60		60	132		33,99	2w
Aba_132_33_trf2	8 PT HARCO	Enugu	60		60	132		33,99	2w
Aba_132_33_trf3	8 PT HARCO	Enugu	30		30	132		34,65	2w
Aba_132_6.6_trf1	8 PT HARCO	Enugu	7,5		7,5	132		6,6	2w
Owerri_132_33_trf1	8 PT HARCO	Enugu	40		40	132		33,66	2w
Owerri_132_33_trf2	8 PT HARCO	Enugu	60		60	132		33,66	2w
Owerri_132_33_trf3	8 PT HARCO	Enugu	60		60	132		33,66	2w
Umuahia_132_33_trf1	8 PT HARCO	Enugu	40		40	132		33	2w
Umuahia_132_33_trf2	8 PT HARCO	Enugu	40		40	132		33,99	2w
Ahoada_132_33_trf1	8 PT HARCO	PH	30		30	132		33	2w
Ahoada_132_33_trf2	8 PT HARCO	PH	30		30	132		33	2w
Calabar_132_33_trf1	8 PT HARCO	PH	60		60	132		34,65	2w
Calabar_132_33_trf2	8 PT HARCO	PH	60		60	132		34,65	2w
Calabar_132_33_trf3	8 PT HARCO	PH	60		60	132		34,65	2w
Eket_132_33_trf1	8 PT HARCO	PH	60		60	132		34,65	2w
Eket_132_33_trf2	8 PT HARCO	PH	45		45	132		34,65	2w
Elelenwo_132_33_trf1	8 PT HARCO	PH	60		60	132		34,65	2w
Elelenwo_132_33_trf2	8 PT HARCO	PH	60		60	132		34,65	2w
Itu_132_33_trf1	8 PT HARCO	PH	60		60	132		34,65	2w
Phct-Main_132_33_trf1	8 PT HARCO	PH	60		60	132		34,65	2w
Phct-Main_132_33_trf2	8 PT HARCO	PH	60		60	132		34,65	2w
PHCT-Main_132_33_trf3	8 PT HARCO	PH	60		60	132		34,65	2w
Phct-Town-1_132_33_trf1	8 PT HARCO	PH	60		60	132		33	2w
Phct-Town-1_132_33_trf2	8 PT HARCO	PH	30		30	132		33	2w
Phct-Town-1_132_33_trf3	8 PT HARCO	PH	30		30	132		33	2w
PHCT-Town-1_132_33_trf4	8 PT HARCO	PH	30		30	132		33	2w
Uyo_132_33_trf1	8 PT HARCO	PH	60		60	132		33	2w
Uyo_132_33_trf2	8 PT HARCO	PH	60		60	132		34,65	2w
Yenagoa_132_33_trf1	8 PT HARCO	PH	40		40	132		33	2w
Yenagoa_132_33_trf2	8 PT HARCO	PH	40		40	132		33	2w

Annex 1.4 – Effective Substation Capacities (sites supplying DISCOs)

DISCO	Site	Effective capacity [MVA]
Abuja_DISCO	Ajaokuta	60
Abuja_DISCO	Akwanga	40
Abuja_DISCO	Apo	145
Abuja_DISCO	Bida	45
Abuja_DISCO	Central-Area	120
Abuja_DISCO	Gwagwalada	60
Abuja_DISCO	Karu	60
Abuja_DISCO	Katampe	60
Abuja_DISCO	Keffi	30
Abuja_DISCO	Kontagora	30
Abuja_DISCO	Kubwa	60
Abuja_DISCO	Lokoja	60
Abuja_DISCO	Minna	105
Abuja_DISCO	Okene	30
Abuja_DISCO	Shiroro	30
Abuja_DISCO	Suleja	37.5
Abuja_DISCO	Tegina	30
Benin_DISCO	Ado-Ekiti	40
Benin_DISCO	Akure	90
Benin_DISCO	Amukpe	90
Benin_DISCO	Asaba	60
Benin_DISCO	Benin	120
Benin_DISCO	Delta	90
Benin_DISCO	Effurun	120
Benin_DISCO	Irrua	90
Benin_DISCO	Okada	40
Benin_DISCO	Ondo	30
Benin_DISCO	Ukpilla	15
Eko_DISCO	Agbara	120
Eko_DISCO	Aja	60
Eko_DISCO	Akangba	120
Eko_DISCO	Akoka	40
Eko_DISCO	Alagbon	60
Eko_DISCO	Amuwo-Odofin	90
Eko_DISCO	Apapa-Road	45
Eko_DISCO	Ijora	90
Eko_DISCO	Itire	90
Eko_DISCO	Lekki	60
Eko_DISCO	Ojo	90
Enugu_DISCO	Aba	130

Enugu_DISCO	Abakaliki	90
Enugu_DISCO	Agu-Awka	40
Enugu_DISCO	Awka	30
Enugu_DISCO	GCM	60
Enugu_DISCO	New-Haven	90
Enugu_DISCO	Nkalagu	30
Enugu_DISCO	Nsukka	7.5
Enugu_DISCO	Oji-River	15
Enugu_DISCO	Onitsha	105
Enugu_DISCO	Owerri	100
Enugu_DISCO	Ugwuaji	100
Ibadan_DISCO	Ayede	160
Ibadan_DISCO	Ganmo	60
Ibadan_DISCO	Ibadan-North	60
Ibadan_DISCO	Ife	30
Ibadan_DISCO	Ijebu-Ode	30
Ibadan_DISCO	Ilesha	40
Ibadan_DISCO	Ilorin	105
Ibadan_DISCO	Iseyin	45
Ibadan_DISCO	Iwo	30
Ibadan_DISCO	Jericho	40
Ibadan_DISCO	Offa	30
Ibadan_DISCO	Old-Abeokuta	60
Ibadan_DISCO	Omuaran	30
Ibadan_DISCO	Osogbo	90
Ibadan_DISCO	Otta	100
Ibadan_DISCO	Papalanto	45
Ibadan_DISCO	Shagamu	30
Ikeja_DISCO	Alausa	90
Ikeja_DISCO	Alimosho	130
Ikeja_DISCO	Ayobo	60
Ikeja_DISCO	Ejigbo	130
Ikeja_DISCO	Ikorodu	160
Ikeja_DISCO	Illupeju	45
Ikeja_DISCO	Isolo	90
Ikeja_DISCO	Maryland	90
Ikeja_DISCO	Ogba	110
Ikeja_DISCO	Oke-Aro	60
Ikeja_DISCO	Oworosoki	60
Jos_DISCO	Azare	30
Jos_DISCO	Bauchi	40
Jos_DISCO	Gombe	60
Jos_DISCO	Jos	60
Jos_DISCO	Makeri	60
Jos_DISCO	Makurdi	40

Jos_DISCO	Oturkpo	30
Jos_DISCO	Yandev	105
Kaduna_DISCO	Birnin-Kebbi	90
Kaduna_DISCO	Gusau	30
Kaduna_DISCO	Kaduna-Town	105
Kaduna_DISCO	Kaduna-Town	180
Kaduna_DISCO	Kafaanchan	40
Kaduna_DISCO	Sokoto	60
Kaduna_DISCO	Talata-Mafara	30
Kaduna_DISCO	Zaria	100
Kano_DISCO	Dakata	90
Kano_DISCO	Dan-Agundi	60
Kano_DISCO	Dutse	30
Kano_DISCO	Funtua	37.5
Kano_DISCO	Hadejia	22.5
Kano_DISCO	Kankia	30
Kano_DISCO	Kano	130
Kano_DISCO	Katsina	90
Kano_DISCO	Kwanar	30
Kano_DISCO	Tamburawa	30
PH_DISCO	Ahoada	30
PH_DISCO	Calabar	120
PH_DISCO	Eket	105
PH_DISCO	Elelenwo	120
PH_DISCO	Itu	60
PH_DISCO	PHCT-Main	120
PH_DISCO	PHCT-Town	120
PH_DISCO	Uyo	60
PH_DISCO	Yenogoa	40
Yola_DISCO	Biu	45
Yola_DISCO	Jalingo	30
Yola_DISCO	Maiduguri	60
Yola_DISCO	Potiskum	30
Yola_DISCO	Savannah	15
Yola_DISCO	Yola	90

Annex 1.5 – Shunt Reactors

Name	Region	Type	Voltage level [kV]	Q [Mvar]
Alaoji_330_Reac_1	8 PT HARCO	Reactor	330	75
Benin_330_Reac_1	4 BENIN	Reactor	330	75
Benin_330_Reac_2	4 BENIN	Reactor	330	75
Gombe_330_Reac_1	6 BAUCHI	Reactor	330	50
Gombe_330_Reac_2	6 BAUCHI	Reactor	330	50
Ikeja-West_330_Reac_1	1 LAGOS	Reactor	330	75
Ikeja-West_330_Reac_2	1 LAGOS	Reactor	330	75
Jebba_330_Reac_1	3 SHIRORO	Reactor	330	75
Jebba_330_Reac_2	3 SHIRORO	Reactor	330	75
Jos_330_Reac_1	6 BAUCHI	Reactor	330	75
Kaduna_330_Reac_1	5 KADUNA	Reactor	330	75
Kano_330_Reac_1	5 KADUNA	Reactor	330	75
Katampe_330_Reac_1	3 SHIRORO	Reactor	330	75
Makurdi_330_Reac_1	7 ENUGU	Reactor	330	75
Oke-Aro_330_Reac_1	1 LAGOS	Reactor	330	75
Onitsha_330_Reac_1	7 ENUGU	Reactor	330	75
Osogbo_330_Reac_1	2 OSOGBO	Reactor	330	75
Yola_330_Reac_1	6 BAUCHI	Reactor	330	75
Gombe_33_Reac_1	6 BAUCHI	Reactor	33	30
Gombe_33_Reac_2	6 BAUCHI	Reactor	33	30
Yola_33_Reac_1	6 BAUCHI	Reactor	33	30
Yola_33_Reac_2	6 BAUCHI	Reactor	33	30

Annex 1.6 – Shunt Capacitors

Name	Region	Type	Voltage level [kV]	Q [Mvar]
Kano_330_Cap_1	5 KADUNA	Capacitor	330	50
Kano_330_Cap_2	5 KADUNA	Capacitor	330	50
Agbara_33_Cap_1	1 LAGOS	Capacitor	33	20
Akure_33_Cap_1	2 OSOGBO	Capacitor	33	20
Akwanga_33_Cap_1	3 SHIRORO	Capacitor	33	20
Akwanga_33_Cap_2	3 SHIRORO	Capacitor	33	20
Amukpe_33_Cap_1	4 BENIN	Capacitor	33	20
Awka_33_Cap_1	7 ENUGU	Capacitor	33	20
Ayede_33_Cap_1	2 OSOGBO	Capacitor	33	20
Ayede_33_Cap_2	2 OSOGBO	Capacitor	33	20
Dakata_33_Cap_1	5 KADUNA	Capacitor	33	20
Dakata_33_Cap_2	5 KADUNA	Capacitor	33	20
Effurun_33_Cap_1	4 BENIN	Capacitor	33	20
Ijebu-Ode_33_Cap_1	1 LAGOS	Capacitor	33	20
Ikorodu_33_Cap_1	1 LAGOS	Capacitor	33	20
Ikorodu_33_Cap_2	1 LAGOS	Capacitor	33	20
Ilorin_33_Cap_1	2 OSOGBO	Capacitor	33	20
Irrua_33_Cap_1	4 BENIN	Capacitor	33	20
Iseyin_33_Cap_1	2 OSOGBO	Capacitor	33	20
Kaduna-Town_33_Cap_1	5 KADUNA	Capacitor	33	20
Kaduna-Town_33_Cap_2	5 KADUNA	Capacitor	33	20
Kontagora_33_Cap_1	3 SHIRORO	Capacitor	33	20
Kontagora_33_Cap_2	3 SHIRORO	Capacitor	33	20
Makurdi_33_Cap_1	7 ENUGU	Capacitor	33	20
Minna_33_Cap_1	3 SHIRORO	Capacitor	33	20
Minna_33_Cap_2	3 SHIRORO	Capacitor	33	20
Old-Abeokuta_33_Cap_1	1 LAGOS	Capacitor	33	20
Old-Abeokuta_33_Cap_2	1 LAGOS	Capacitor	33	20
Shagama_33_Cap_1	1 LAGOS	Capacitor	33	20
Uyo_33_Cap_1	8 PT HARCO	Capacitor	33	20
Zaria_33_Cap_1	5 KADUNA	Capacitor	33	20
Zaria_33_Cap_2	3 SHIRORO	Capacitor	33	20

Annex 2 – Transmission Expansion

Annex 2.1 – 2017

Table 28: Transmission expansions, 2017

Project Title	Completion	Line length [km]	Rating [MVA]
Grid rehabilitation and reinforcement, Katsina, Hadejia, Kontagora, 132/33kV transformers	Jun. 2017		3 x 60MVA
Rehabilitation of Afam TS with 1 x 150MVA 330/132/33kV transformer and construction of Afam IV to Afam I 132kV transmission line	Jun. 2017		150MVA
Daura 2 x 30/40MVA substation and 2x 132kV line bay ext. at Katsina, Katsina State	Jun. 2017		2 x 40MVA
Kafanchan 2 x 60MVA, 132/33kV transformers, Kaduna State	Jun. 2017		2 x 60MVA
Katsina- Daura 132kV DC line, Katsina State	Jun. 2017	82	2 x 121MVA
1x150MVA, 330/132kV substation at Maiduguri + 60MVA 132/33kV substation, Borno State	Jun. 2017		150 & 60MVA
2X60MVA substation at Ede	Jun. 2017		2 x 60MVA
DC 132kV line from Alscon to Ibom, power and switching station to link the GIS at Alscon with associated bay extensions at Ibom Power - Akwa Ibom State	Jun. 2017	2.9	2 x 121MVA
2 X 150MVA 330/132kV substation and 2 X 60MVA 132/33kV substation, Akure	Jun. 2017		2x150MVA & 2x60MVA
Kaduna - Jos 330kV DC Line. Plateau and Kaduna States	Dec. 2017	200	2 x 777MVA
Obudu - Ogoja 132kV DC Line Cross River State	Aug. 2017	48	2 x 121MVA
Erukan - Omotosho 330kV DC Transmission line	Dec. 2017	132	2 x 777MVA
Kukwaba 2x60MVA, 132/33kV substation	Jun. 2017		2 x 60MVA
Damaturu 1x150MVA, 330/132kV substation, Yobe State	Jun. 2017		1 x 150MVA
New Abeokuta - Igboora - Lanlate 132kV DC line and Tee- Off at Igboora- Igangan	Jun. 2017	100	2 x 121MVA
Onitsha - Oba - Nnewi - Ideato- Okigwe 132kV DC line	Sep. 2017	90	2 x 121MVA
Katampe-National Stadium 132kV DC line, FCT, Abuja	Jun. 2017	12.4	2 x 121MVA
Construction of 1x28MVA Substation at Mayo Belwa(Mobitra)	Jun. 2017		28MVA
Talata Mafara 2x30/40MVA 132/33kV substation	Jun. 2017		2 x 40MVA
1 x 60MVA 132/33kV Substation each at Ughelli and Amukpe, Delta State	Jun. 2017		2 x 60MVA

Project Title	Completion	Line length [km]	Rating [MVA]
Makeri - Pankshin 132kV DC line, Plateau State	Jun. 2017	122	2 x 121MVA
Arochukwu 2x30/40MVA 132/33kV substation Abia	Jun. 2017		2 x 40MVA
2 x 60MVA, 132/33kV substation at Ayobo with 132kV DC T/line Ikeja West - Ayobo	Jun. 2017		2 x 60MVA
2 x 60MVA, 132/33kV substation at Odogunyan	Jun. 2017		2 x 60MVA
2x 60MVA 132/33kV substation at Egbe and 2x132kV line bays extension at Omu-aran	Jun. 2017		2 x 60MVA
Mbalano 2x30/40MVA, 132/33kV substation, Abia	Jun. 2017		2 x 60MVA
Nnewi 2x60 MVA 132kV substation, Anambra State	Jun. 2017		2 x 60MVA
Okigwe 2x30/40MVA 132/33kV substation, Imo	Jun. 2017		2 x 40MVA
Ohafia - Arochukwu 132kV Line	Jun. 2017	32	1 x 121MVA
Ohafia 2x30/40MVA 132/33kV substation. Abia	Jul. 2017		2 x 40MVA
2x60MVA, 132/33kV substation at Aboh Mbaise and 2x132kV line bays extension at Owerri	Aug. 2017		2 x 60MVA
Ogoja 2x30/40MVA,132/33kV Substation	Jun. 2017		2 x 60MVA
Ikorodu - Odogunyan - Shagamu 132kV DC Transmission Line	Jun. 2017	39	2 x 121MVA
2 x 60MVA 132/33kV Substation at Ogbomosho	Jun. 2017		2 x 60MVA
Umuahia - Mbalano 132kV SC Line, Abia State	May. 2017	30	1 x 121MVA
2x30/40 MVA, 132/33 kV substation at Lanlate plus 2 x132kV Line Bays at New Abeokuta 132/33 kV substation	Jun. 2017		2 x 40MVA
2x60MVA, 132/33kV substation at Ideato and 2x132kV line bays extension at Okigwe	Aug. 2017		2 x 60MVA
1x30MVA, 132/33 kV Substation at Wudil, Kano State	Jun. 2017		30MVA
Katampe Capacitor Bank Projects	Jun. 2017		50MVA
Kano- Walalanbe 132kV Line (Turn in and out of Dan agundi-Dakata 132kV single Cct Line) and 2 x 30/40MVA S/S at Walalambe Kano State	Jun. 2017		2 x 40MVA
Yelwa - Yauri 2 x 30/40MVA S/S and 100KM of 33kV Line Kebbi State	Jun. 2017		2 x 40MVA
Umuahia-Ohafia 132kV SC line Abia	Aug. 2017	49	1 x 121MVA
Abakaliki - Amasiri 132kV DC line	Dec. 2017	70	2 x 121MVA
2x60MVA, 132/33kV substation at Dambatta, Kano State.	Jun. 2017		2 x 60MVA
2x30/40MVA, 132/33kV S/S at Lafia in Nasarawa	Jun. 2017		2 x 40MVA
Transmission - 2x60MVA 132/33kV Substation at Igangan & 132kV Switching Station at Igboora	Jun. 2017		2 x 60MVA
Katsina-Kurfi-Dutsinma-Kankara-Malumfashi 132kV Line	Jun. 2017	173	1 x 121MVA
2x60 MVA, 132/33 kV substation at Oba and 2 x132kV Line Bays at Nnewi	Jun. 2017		2 x 60MVA

Project Title	Completion	Line length [km]	Rating [MVA]
Yola-Song-Mubi-Gulak 132kV DC line	Jun. 2017	350	2 x 121MVA
2x60MVA 132/33kV substation at Okeagbe, Ondo State and line bays extension at Obajana	Jun. 2017		2 x 60MVA
Kano-Katsina 330kV DC Transmission Line	Jun. 2017	180	2 x 777MVA
Construction of 2x150MVA 330/132kV and 2x60MVA, 132/33kV Substation at Kastina Plus 2x330kV line bays extension at Kumbotso	Jun. 2017		2 x 60MVA
Omotosho-Epe-Aja 330kV DC Line.	Jun. 2017	135	2 x 777MVA
2x60MVA substation at Kachia	Jun. 2017		2 x 60MVA
2x150MVA, 330/132kV substation at Obajana	Jun. 2017		
Nnenwe-Mpu 132kV DC line	Jun. 2017	45	2 x 121MVA
2x60MVA, 132/33kV substation at Kwoi	Jun. 2017		2 x 60MVA
Ganmo - Ogbomosho 132kV Line (45KM)	Jul. 2017	60	2 x 121MVA
2x60MVA, 132/33kV substation at Malumfashi	Jul. 2017		2 x 60MVA
Gagarawa 2x60 MVA, 132/33 kV substation, Jigawa State	Jun. 2017		2 x 60MVA
Ganmo-Shonga 132kV DC Line	Dec. 2017	120	2 x 121MVA
Delta-Port Harcourt 330kV DC line	Oct. 2017	194	2 x 777MVA
2x60MVA, 132/33kV substations at Song	Jun. 2017		2 x 60MVA
2x60MVA, 132/33kV S/S at Shonga.	Jun. 2017		2 x 60MVA
Kaduna Power Plant to Mando Road and Substation Extension	Jun. 2017	25	2 x 121MVA
Keffi-Kwoi-Kachia 132kV DC line	Nov. 2017	137	2 x 121MVA
Kumbotso (Daura)-Dambatta 132kV Line	Jun. 2017	60	1 x 121MVA
2x60MVA, 132/33kV substation at Kankara	Jun. 2017		2 x 60MVA
2x60MVA, 132/33kV substation at Little Gombi	Jun. 2017		2 x 60MVA
2x60MVA, 132/33kV substations at Mubi	Jun. 2017		2 x 60MVA
2x60MVA, 132/33kV substations at Gulak	Jun. 2017		2 x 60MVA
132/33kV Substation at Ayangba Kogi State	Jun. 2017		2 x 60MVA
Omu Aran-Egbe 132kV DC line	Oct. 2017	50	2 x 121MVA
2x 150MVA 330/132kV substation at Omotosho	Jun. 2017		2 x 150MVA
2x60MVA, 132/33kV substation at Dutsinma	Jun. 2017		2 x 60MVA
2x60MVA, 132/33kV Substation at Ose LGA Headquarters, Ondo State	March 2017		2 x 60MVA
2x60MVA, 132/33kV substation at Kurfi	Jun. 2017		2 x 60MVA

Project Title	Completion	Line length [km]	Rating [MVA]
2x60MVA, 132/33kV substation at Nnenwe	Jan. 2017		2 x 60MVA
Provision of additional 2x150MVA 330/132kV Transformer capacity at Olorunsogo T/S.	Jun. 2017		2 x 150MVA
2nd Kaduna-Kano 330kV DC line	Dec. 2017	235	2 x 777MVA
2x60MVA, 132/33kV substation at Amasiri, Afikpo and 2x132kV line bay extension at Abakaliki	Jul. 2017		2 x 60MVA

Annex 2.1 – 2018

Table 29: Transmission expansions, 2018

Project Title	Completion	Line length [km]	Rating [MVA]
Benin North-Oshogbo 330kV DC line with one SC turning in and out to New Akure substation	Nov 18	250	2 x 777MVA
Nsukka - Ayangba 132kV DC Line: Enugu, Kogi States	Mar. 2018	80	2 x 121MVA
Owerri - Aboh Mbaise 132kV DC line	Dec. 2018	26	2 x 121MVA
2x60MVA,132/33kV substation at Mpu, with 2x132kV line bay extension at Nnenwe	Aug 18		2 x 60MVA
Ugwuaji-Nnenwe 132kV DC line	Dec. 2018	41	2 x 121MVA
Obajana-Okeagbe 132kV DC line	Mar. 2018	90	2 x 121MVA
Construction of 132kV DC line from Akwanga to Lafia, Nasarawa State	Apr 18	60	2 x 121MVA

Annex 2.1 – 2019-2027

The following changes were assumed to take place in 2022 as no further information was available.

Table 30: Transmission expansions, 2022

Project Title	Completion	Line length [km]	Rating [MVA]
Onitsha-Ifitedunu 132kV DC line	Dec. 2022	45	2 x 121MVA
2x60MVA, 132/33kV subst. at Ifitedunu and 2x132kV line bays extension at Onitsha	Dec. 2022		2 x 60MVA
Damaturu - Gashua 132kV DC line	Dec. 2022	245	2 x 121MVA
Gashua - Hadejia 132kV DC line	Dec. 2022	150	2 x 121MVA
2x 60MVA, 132/33kV subst. at Gashua and 2x132kV line bays extensions at Damaturu and Hadejia	Dec. 2022		2 x 60MVA
Yenagoa - Oporoma 132kV DC line	Dec. 2022	50	2 x 121MVA
2x 60MVA, 132/33kV subst. at Oporoma and 2x 132kV line bays extension at Yenegoa subst.	Dec. 2022		2 x 60MVA
2X60MVA 132/33kV Subst. at Obudu and 33kV ranch feeder	Dec. 2022		2 x 60MVA
Transmission and supply of 2X30/40MVA, 132/33kV subst. at Gaya	Dec. 2022	0	2 x 40MVA

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