

# GRID MAP FOR EXISTING TRANSMISSION AND GENERATION NETWORK

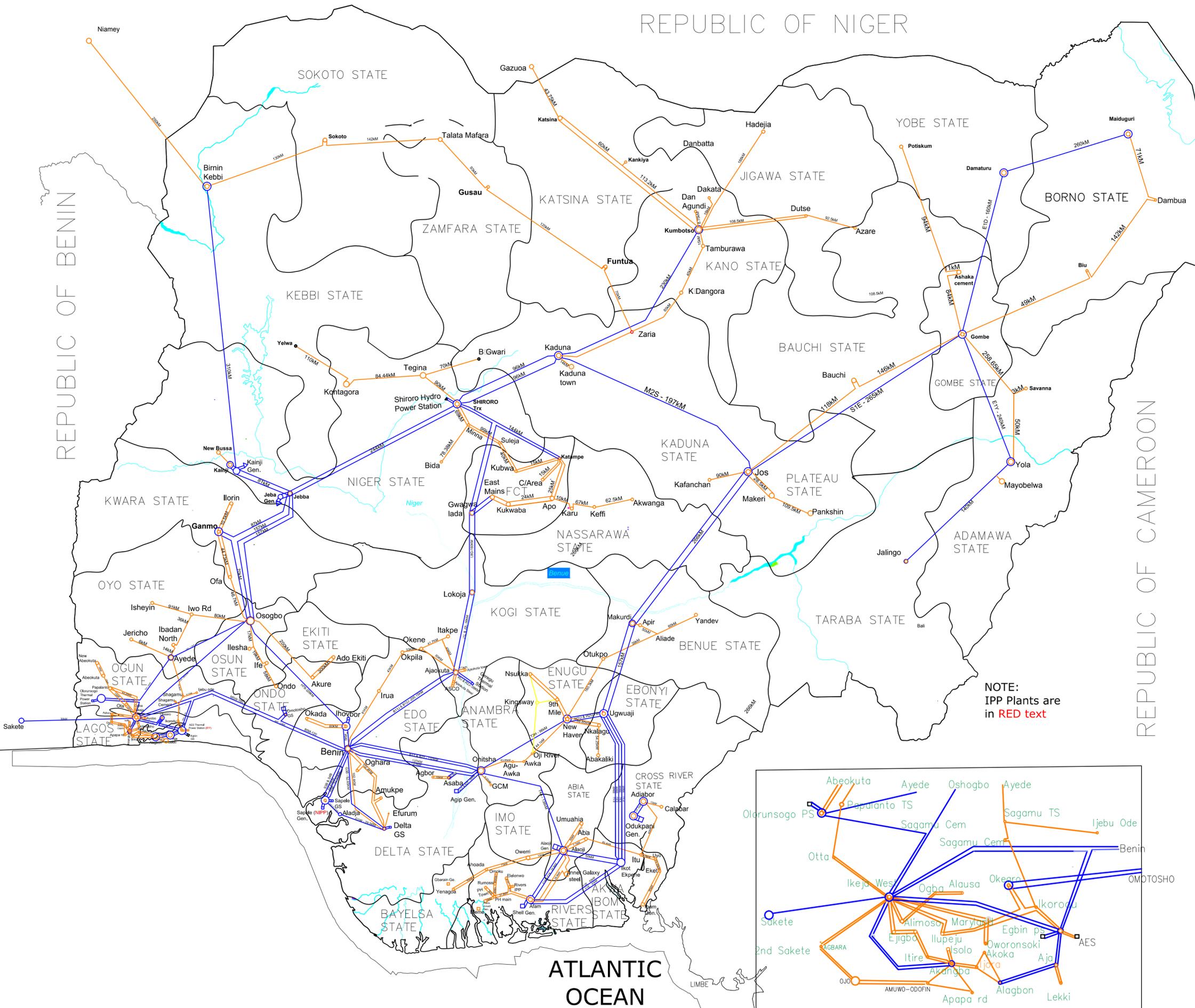
REPUBLIC OF NIGER

REPUBLIC OF CHAD

REPUBLIC OF BENIN

REPUBLIC OF CAMEROON

## Annex 4.1a

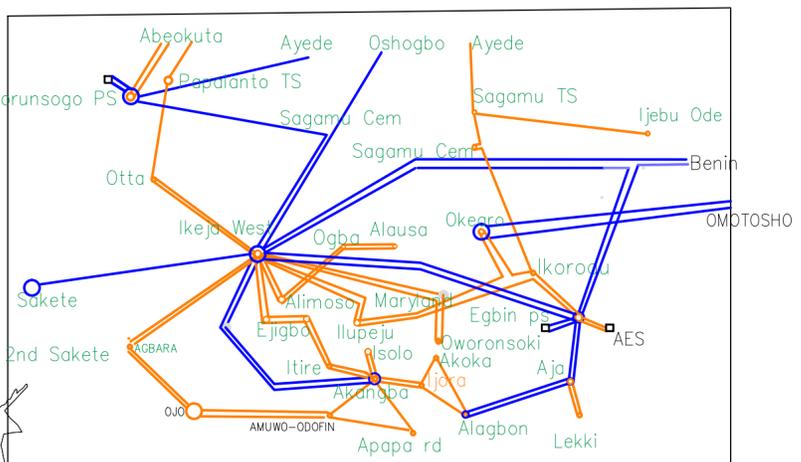


**NOTE:**  
IPP Plants are  
in RED text

| LEGEND |   |
|--------|---|
|        | EXISTING 330KV TRANSMISSION LINES ON 350MM <sup>2</sup> TWIN 'BISON' CONDUCTOR                        |
|        | EXISTING 132KV TRANSMISSION LINES ON 150MM <sup>2</sup> 'BEAR' OR 120MM <sup>2</sup> 'WOLF' CONDUCTOR |
|        | EXISTING 66KV TRANSMISSION LINES ON 120MM <sup>2</sup> 'WOLF' OR 'PHANTA' CONDUCTOR                   |
|        | EXISTING 330/132KV S/S  |
|        | EXISTING 132/33KV S/S   |
|        | EXISTING HYDRO POWER GENERATING STATION   |
|        | EXISTING THERMAL GENERATING STATION   |

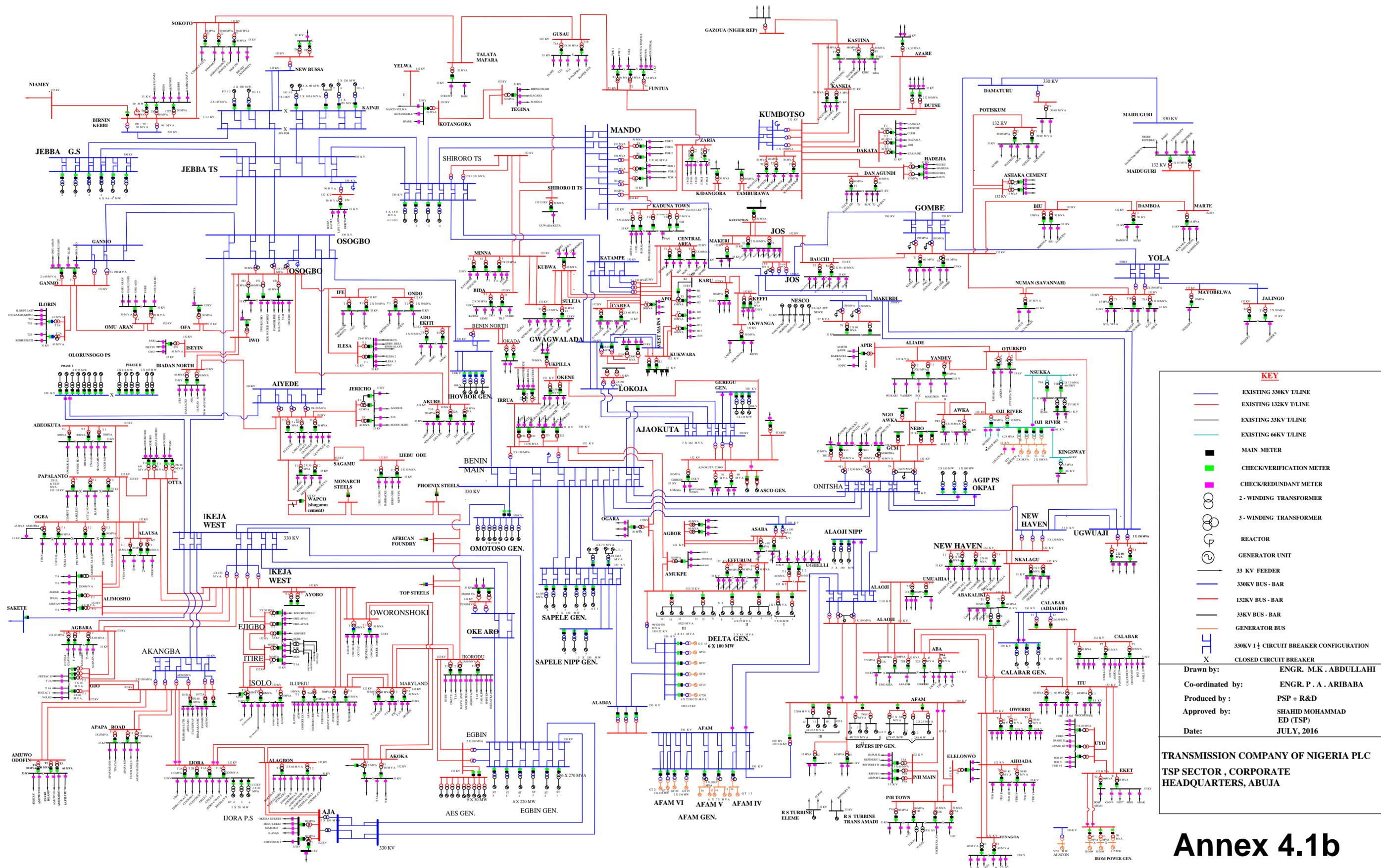
**POWER HOLDING COMPANY OF NIGERIA (PHCN) PLC**

| Nigerian Existing Transmission + Generation Network |                    |              |
|---|--------------------|--------------|
| Prepared By   | PSP-TSP            | Scale:       |
| Designed By   |                    | NOT TO SCALE |
| Checked By  | Engr P. A. Aribaba | 2016         |
| Recommended By                                      |                    | Date         |



ATLANTIC OCEAN

# SINGLE LINE DIAGRAM OF THE EXISTING NIGERIA GRID NETWORK



**KEY**

- EXISTING 330KV T/LINE
- EXISTING 132KV T/LINE
- EXISTING 66KV T/LINE
- MAIN METER
- CHECK/VERIFICATION METER
- CHECK/REDUNDANT METER
- 2- WINDING TRANSFORMER
- 3- WINDING TRANSFORMER
- REACTOR
- GENERATOR UNIT
- 33 KV FEEDER
- 330KV BUS - BAR
- 132KV BUS - BAR
- 33KV BUS - BAR
- GENERATOR BUS
- 330KV 1/2 CIRCUIT BREAKER CONFIGURATION
- CLOSED CIRCUIT BREAKER

Drawn by: ENGR. M.K. ABDULLAH  
 Co-ordinated by: ENGR. P. A. ARIBABA  
 Produced by: PSP & R&D  
 Approved by: SHAHID MOHAMMAD ED (TSP)  
 Date: JULY, 2016

**TRANSMISSION COMPANY OF NIGERIA PLC**  
**TSP SECTOR , CORPORATE HEADQUARTERS, ABUJA**

## Annex 4.1b

**Annex 4.2a**  
**CLASSIFICATION OF ON-GOING TCN AND NIPP CAPITAL PROJECTS BY ZONES**  
**TCN Projects**

| S/N                                | PROJECT TITLE  | STATE                  | DATE OF COMMENCEMENT                 | EXPECTED DATE OF COMPLETION | TOTAL COST (NAIRA) | NAME OF CONTRACTOR                  | COMPLETION STATUS | IMPACT OF PROJECT   |
|------------------------------------|--|------------------------|--------------------------------------|-----------------------------|--------------------|-------------------------------------|-------------------|---|
| <b>Projects In South-East Zone</b> |  |                        |                                      |                             |                    |                                     |                   |   |
| 1                                  | Owerri-Ahoada-Yenegoa 132kv DC lines and substations Imo-Rivers-Bayelsa States | Imo/Rivers/Bayelsa     | Oct, 2000                            | 2010                        | 11,509,951,810.57  | Pivot Engineering Co. Ltd           | Completed         | Delivery of bulk power to Yenagoa in Bayelsa State & Ahaoada in Rivers State. Enhancement of industrial and socio-economic activities in the states.                                |
| 2                                  | Construction of Alaoji-Umuahia 132kV DC line                                   | Abia                   | Sept., 2001                          | June, 2012                  | 1,347,505,044.12   | Pivot Engineering Co. Ltd           | Completed         | Increase in power supply to Umuahia and environs. Boosting of socio-economic activities in the areas.   |
| 3                                  | Umuahia 2x30/40MVA, 132/33kV Substation  | Abia                   | May, 2001                            | June, 2013                  | 1,602,261,641.87   | Valenz Holdings (Nig) Ltd.          | Completed         | Increase in power supply to Umuahia and environs. Boosting of socio-economic activities in the areas.   |
| 4                                  | Mbalano-Okigwe 132kv SC line   | Abia                   | Sept,2001                            | Apr, 2012                   | 329,754,483.86     | Atlantic Engineering & Construction | Completed         | Provision of bulk energy delivery to Okigwe and environs; increase in socio-economic activity in the areas.   |
| 5                                  | Construction of 150MVA 330/132/33kV T/F and 330kV bays at Onitsha and Benin.   | Anambra/Edo            | 18th May, 2001; reawarded Sept. 2008 | June, 2013                  | 639,623,673.85     | Siemens Ltd. MBH Power Ltd          | Completed         | 150MVA increase in transformer capacity at 330kV Voltage level at Onitsha. Boost in economic activity in the South East Zone.   |
| 6                                  | 2nd Benin-Onitsha 330kv SC line.   | Anambra/Edo            | 17th, Sept. 2008                     | June, 2015                  | 4,205,289,346.35   | ABB; Dextron Engineering Ltd        | Completed         | Increase in wheeling capacity to the South-East Zone and Benue State. Boost in socio-economic activity in the South East zone and Benue State.                                      |
| 7                                  | 3rd Benin - Onitsha 330KV DC Line  | Anambra/Edo            | Dec, 2007                            | Feb., 2013                  | 6,539,926,332.00   | KEC International                   | Completed         | Increase in wheeling capacity to the South-East Zone and Benue State. Boost in socio-economic activity in the South East zone and Benue State.                                      |
| 8                                  | 2 x 330KV Line bay extension at Kaduna, Jos and Onitsha                        | Kaduna/Plateau/Anambra | Nov, 2009                            | Sept, 2015                  | 1,240,589,916.19   | Valenz Holding Ltd                  | 30%               | Increase in wheeling capacity to the South-East and North-East Zones. Boost in socio-economic activity in the affected areas.   |
| 9                                  | 2x60MVA, 132/33kv at Aboh -Mbaise S/S  | Imo                    | Nov, 2009                            | July, 2014                  | 1,480,777,014.45   | Ashtavinayaka/Bran Engineering Ltd  | 75%               | Improvement in power supply to Aboh Mbaise (Imo State) and environs to meet the power demand of the areas, increase socio-economic activity & generate employment in the areas.     |
| 10                                 | 2x60 MVA, 132/33 kV substation at Ideato and 2 x132KV Line Bays at Okigwe      | Imo                    | Nov, 2009                            | December, 2014              | 1,852,143,857.48   | Ashtavinayaka/Bran Engineering Ltd  | 70%               | Improvement in power supply to Ideato (Imo State) and environs to meet the power demand of the areas, increase socio-economic activity & generate employment in the areas.          |
| 11                                 | Onitsha - Oba - Nnewi - Ideato - Okigwe 132kv DC Line                          | Anambra/Imo            | January, 2014                        | June, 2015                  | 1,649,992,957.64   | Ashtavinayaka/Bran Engineering Ltd  | 10%               | Bulk power supply to parts of Anambra and Imo States. Improvement in socio-economic life of the people of the states.   |
| 12                                 | Arochukwu 2x30/40MVA, 132/33kV substation                                      | Abia                   | Sept,2001                            | June, 2015                  | 921,727,696.35     | Omen International Ltd.             | 86                | Improvement in power supply to Arochukwu and environs to meet the power demand of the areas, increase socio-economic activity & generate employment in the areas.                   |
| 13                                 | Okigwe 2x30/40MVA 132/33kV Substation  | Imo                    | Sept,2001                            | March, 2015                 | 1,839,789,715.03   | Union Allied Engineering Ltd.       | 65                | Improvement in power supply to Okigwe and environs to meet the power demand of the areas, increase socio-economic activity & generate employment in the areas.                      |
| 14                                 | Ohafia 2x30/40MVA 132/33kV substation.   | Abia                   | Sept,2001                            | March, 2015                 | 1,972,613,202.90   | Union Allied Engineering Ltd.       | 60                | Improvement in power supply to Ohafia and environs to meet the power demand of the areas, increase socio-economic activity & generate employment in the areas.                      |
| 15                                 | Mbalano 2x30/40MVA 132/33kV substation.  | Abia                   | Nov, 2001                            | March, 2015                 | 1,409,011,316.42   | Union Allied Engineering Ltd.       | 60                | 80MVA transformer capacity at 132kV Voltage level at Mbalano to meet the power requirement of the town and environs, increase socio-economic activity and generate employment.      |
| 16                                 | Nnewi 2x60 MVA 132kV substation  | Anambra                | April, 2006                          | March, 2015                 | 1,233,491,817.28   | Valenz Holdings (Nig) Ltd.          | 70                | Improvement in power supply to Nnewi and environs to meet the power demand of the areas, increase socio-economic activity & generate employment in the areas.                       |
| 17                                 | Nsukka - Ayangba 132KV DC Line   | Enugu/Kogi             | Aug. 2009                            | Dec., 2015                  | 1,480,777,014.45   | West Com Ltd/PPCL                   | 35                | Improvement in power supply to Nsukka and environs to meet the power demand of the areas, increase socio-economic activity & generate employment in the areas.                      |
| 18                                 | 2x60 MVA, 132/33 kV substation at Oba and 2 x132KV Line Bays at Nnewi          | Anambra                | Dec., 2009                           | December, 2015              | 1,863,432,339.26   | Xian/GIT Engineering                | 42                | Improvement in power supply to Oba and adjoining parts of Anambra State to meet the power demand of the areas, increase socio-economic activity & generate employment in the areas. |

**Annex 4.2a**  
**CLASSIFICATION OF ON-GOING TCN AND NIPP CAPITAL PROJECTS BY ZONES**  
**TCN Projects**

| S/N                                | PROJECT TITLE  | STATE      | DATE OF COMMENCEMENT | EXPECTED DATE OF COMPLETION               | TOTAL COST (NAIRA) | NAME OF CONTRACTOR                   | COMPLETION STATUS | IMPACT OF PROJECT   |
|------------------------------------|--|------------|----------------------|---|--------------------|--------------------------------------|-------------------|---|
| 19                                 | Owerri - Abo Mbase 132KV DC Line   | Imo        | January, 2011        | March, 2016                               | 781,193,181.81     | Bateman                              | 12                | Improvement in power supply to parts of Imo State to meet the power demand of the people, increase socio-economic activity and generate employment in the areas.                          |
| 20                                 | Onitsha-Ifitedunu 132kv DC Transmission line   | Anambra    | Yet to commence      | Yet to commence                           | 2,265,940,601.10   | Sinotec-CCC JV                       | 0                 | Improvement in power supply to Ifitedunu and adjoining parts of Anambra State to meet the power demand of the areas, increase socio-economic activity& generate employment in the areas.  |
| 21                                 | Construction of 2 x 60MVA 132/33kV Sunstation at Ifitedinu and 2 x 132kv line bays extension at Onitsha                            | Anambra    | Yet to commence      | Yet to commence                           | 2,582,869,065.18   | MBH Power Ltd                        | 0                 | Improvement in power supply to Ifitedunu and adjoining parts of Anambra State to meet the power demand of the areas, increase socio-economic activity& generate employment in the areas.  |
| 22                                 | 2x60MVA, 132/33kV substation at Amasiri, Afikpo and 2x132kV line bay extension at Abakaliki  | Ebonyi     | Yet to commence      | Yet to commence                           | 1,453,991,357.66   | NCPE                                 | 0                 | Contract was terminated and re-procured.  |
| 23                                 | 2x60MVA, 132/33kV substation at Mpu, with 2x132kV line bay extension at Nnenwe   | Enugu      | Dec. 2010            | December, 2015                            | 1,478,201,187.82   | Ashtavinayaka/Bran Engineering       | 15                | Improvement in power supply to Mpu and adjoining parts of Enugu State to meet the power demand of the areas, increase socio-economic activity& generate employment in the areas.          |
| 24                                 | Umuahia-Ohafia 132kv SC line   | Abia       | Sept,2001            | June, 2015                                | 886,549,064.79     | Harlesden Engineering Ltd            | 60                | Improvement in power supply to Ohafia and environs to meet the power demand of the areas, increase socio-economic activity& generate employment in the areas.                             |
| 25                                 | Umuahia - Mbalano 132KV Line   | Abia       | April, 2001          | March, 2015                               | 557,323,066.60     | Santon Energy L:td                   | 67                | Improvement in power supply to Mbalano and adjoining parts of Imo State to meet the power demand of the areas, increase socio-economic activity& generate employment in the areas.        |
| 26                                 | Ohafia - Arochukwu 132KV Line  | Abia       | Sept. 2008           | March, 2015                               | 765,778,020.25     | Mogabs Nig. Ltd                      | 65                | Improvement in power supply to Ohafia and Arochukwu areas of Abia State to meet the power people and of the areas, increase socio-economic activity and generate employment in the areas. |
| 27                                 | Abakaliki - Amasiri 132kv DC line  | Ebonyi     | 2011                 | December, 2015                            | 1,448,780,446.73   | Fluor Eng/Eurafric                   | 20                | Improvement in power supply to the entire Ebonyi South Senatorial Zone to meet the power demand of the areas, increase socio-economic activity& generate employment in the areas.         |
| 28                                 | Ugwuaji-Nnenwe 132kV DC line   | Enugu      | 2011                 | December, 2015                            | 860,431,361.12     | Ashtavinayaka/Bran Eng Ltd           | 10                | Improvement in power supply to Nnenwe and adjoining parts of Enugu State to meet the power demand of the areas, increase socio-economic activity& generate employment in the areas.       |
| 29                                 | 2x60MVA, 132/33kV substation at Nnenwe   | Enugu      | 2011                 | December, 2015                            | 1,754,876,530.28   | Metro Elektrik                       | 2                 | Improvement in power supply to Nnenwe and adjoining parts of Enugu State to meet the power demand of the areas, increase socio-economic activity& generate employment in the areas.       |
| 30                                 | Nnenwe-Mpu 132kv DC line   | Enugu      | 2011                 | December, 2015                            | 860,403,171.63     | Power Projects Ltd/Dorman Long       | 8                 | Improvement in power supply to Mpu and adjoining parts of Enugu State to meet the power demand of the areas, increase socio-economic activity& generate employment in the areas.          |
| <b>Projects In South-West Zone</b> |  |            |                      |   |                    |                                      |                   |   |
| 31                                 | Akure-Ado Ekiti 132kv SC line  | Ondo/Ekiti | May ,2003            | June, 2012                                | 849,000,374.22     | Siemens Ag + Dextron Engineering Ltd | Completed         | Improved power wheeling capacity to Ekiti State. Enhancement of socio-economic activity and generation of employment.   |
| 32                                 | 2 x 60MVA, 132/33kV substations at Odogunyan and Ayobo with 132kV DC Tline Ikeja West - Ayobo.                                     |            | 2010                 | Ayobo - March, 2014.<br>Odogunyan - June, | 3,657,155,630.00   | Laga CePower Ltd                     | Completed         | Improved power supply Odogunyan and Ayobo areas of Ogun and Lagos States (respectively). Enhancement of socio-economic activity and generation of employment.                             |
| 33                                 | Benin North-Oshogbo 330KV DC line with one SC turning in and out to New Akure substation   | Edo/Osun   | Dec. 2010            | December, 2015                            | 7,460,190,274.90   | Gammon India Ltd                     | 28                | Improvement in power wheeling to Osgbo and Akure (Ondo State). Enhancement of the socio-economic live of the people of the states.  |
| 34                                 | New Akure 2X150MVA,330/132KV + 2x60MVA, 132/33kV Substation and 2x330kV line bays extensions in Benin North and Osogbo substations | Osun/Ondo  | October, 2011        | June, 2015                                | 4,541,953,527.00   | Matelec                              | 60                | Increase in power supply to Akure and entire Ondo State t bBoost economic activity and employment generation  |
| 35                                 | New Abeokuta - Igboora - Lanlate 132kv DC Line and Tee- Off at Igboora- Igangan  | Ogun       | January, 2014        | December, 2015                            | 1,389,786,019.95   | LAGA CE Power                        | 10                | Bulk power supply to Lanlate town and improved power supply to the town and environs. Stimulation of growth in socio-economic activity and generation of employment.                      |
| 36                                 | Ganmo -Ogbomosho 132kV DC line   | Kwara/Oyo  | Feb. 2011            | December, 2015                            | 1,223,259,627.73   | Trencco Power/Eco Energo Group       | 15                | Bulk power supply to Ogbomosho and environs. Stimulation of growth in socio-economic activity and generation of employment.   |

**Annex 4.2a**  
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**TCN Projects**

| S/N                                 | PROJECT TITLE   | STATE          | DATE OF COMMENCEMENT                 | EXPECTED DATE OF COMPLETION | TOTAL COST (NAIRA) | NAME OF CONTRACTOR              | COMPLETION STATUS | IMPACT OF PROJECT  |
|-------------------------------------|---|----------------|--------------------------------------|-----------------------------|--------------------|---------------------------------|-------------------|--|
| 37                                  | 2 x60MVA 132/33kV S/S at Ogbomosho 1no. 132kV Bay Extension at Ganmo                                      | Oyo/Kwara      | Dec, 2007                            | March, 2015                 | 1,381,986,399.86   | Payma Bargh/ Cartlark           | 70                | Bulk power supply to Ogbomosho and environs. Stimulation of growth in socio-economic activity and generation of employment.  |
| 38                                  | 2x30/40 MVA, 132/33 kV substation at Lanlate plus 2 x132KV Line Bays at New Abeokuta 132/33 kV substation | Ogun           | August, 2010                         | March, 2015                 | 1,577,304,387.87   | Skipper Electricals Ltd         | 70                | Bulk power supply to Lanlate town and improved power supply to the town and environs. Stimulation of growth in socio-economic activity and generation of employment. |
| 39                                  | Ikorodu - Odogunyan - Shagamu 132kV DC Transmission Line  | Lagos/Ogun     | 2010                                 | June, 2015                  | 3,192,097,185.53   | PPCL/ Westcom JV                | 55                | Bulk power supply to Odogunyan and Shagamu and environs. Stimulation of growth in socio-economic activity and generation of employment.                              |
| 40                                  | Transmission - 2x60MVA 132/33KV Substation at Iangan & 132kV Switching Station at Igboora                 | Ogun           | Aug, 2010                            | December, 2015              | 2,420,443,752.74   | Rhuoga Energy                   | 45                | Boost in power supply to Iangan and environs, enhancement of socio-economic activity and creation of employment in the areas.  |
| 41                                  | Omotosho-Epe-Aja 330KV DC Line.   | Lagos          | Jan. 2011                            | June, 2015                  | 6,620,497,079.07   | KEC International Limited       | 50                | Increase in power wheeling capacity to Aja and Epe in Lagos State. Boost in socio-economic activity.   |
| 42                                  | Oshogbo- Ede 132kV DC Line  | Osun/Ondo      | Jan. 2011                            | June, 2015                  | 530,226,664.19     | Aster Infrac/Aster Teleservices | 72                | Bulk power supply to Ede town and environs. Stimulation of growth in socio-economic activity and generation of employment in the areas.                              |
| 43                                  | 2X60MVA Substation at Ede   | Osun           | Marc 3, 2011                         | December, 2015              | 1,747,600,713.91   | Cobra-Sibga JV                  | 20                | Bulk power supply to Ede town and environs. Stimulation of growth in socio-economic activity and generation of employment in the areas.                              |
| 44                                  | Erukan - Omotosho 330KV DC Trx. Line  | Ogun           | Dec.2010                             | December, 2015              | 6,222,079,519.42   | Energ Nig Limited               | 20                | Increase in wheeling capacity from Omotosho Power Plant. Boost in socio-economic activity in the South West zone   |
| 45                                  | 2x 150MVA, 330/132kV + 2x60MVA, 132/33kV substation at Omotosho   | Ogun           | Dec. 2010                            | December, 2015              | 3,614,033,428.98   | AK-AY Elektrik                  | 15                | Increase in transmission capacity and power supply to Omotosho and adjoining areas to Boost economic activity, employment generation                                 |
| 46                                  | Obajana-Okeagbe 132kV DC line   | Kogi/Ondo      | 2011                                 | December, 2015              | 1,969,973,210.18   | Everest Infra energy Ltd        | 5                 | Improvement of power supply to Okeagbe and entire Ondo State. Boosting of socio-economic life of the people of the state   |
| 47                                  | 2x60MVA 132/33kV substation at Okeagbe, Ondo State and line bays extension at Obajana                     | Ondo/Kogi      | March, 2012                          | Sept, 2015                  | 1,541,961,682.82   | Power Control & Appliances      | 40                | Improvement of power supply to Okeagbe and entire Ondo State. Boosting of socio-economic life of the people of the state   |
| 48                                  | 2x60MVA, 132/33kV Substation at Ose LGA Headquarters, Ondo State  | Ondo           | March, 2012                          | April, 2016                 | 1,607,059,828.55   | Junot Eng. Services Ltd         | 5                 | Improvement of power supply to Ose and adjoining parts of Ondo State. Boosting of socio-economic life of the people of the state                                     |
| 49                                  | Provision of additional 2x150MVA 330/132KV Transformer capacity at Olorunsogo T/S.                        |                | October, 2011                        | December, 2015              | 3,628,192,987.56   | Matelec                         | 10                | Increase in transmission capacity and power supply to Olorunsogo area and environs areas to Boost economic activity, employment generation                           |
| <b>Projects In South-South Zone</b> |   |                |                                      |                             |                    |                                 |                   |  |
| 50                                  | Owerri-Ahoada-Yenegoa 132kv DC lines and substations Imo-Rivers-Bayelsa States                            | Rivers/Bayelsa | Oct, 2000                            | 2010                        | 11,509,951,810.57  | Pivot Engineering Co. Ltd       | Completed         | Delivery of bulk power to Yenegoa in Bayelsa State & Ahoada in Rivers State. Enhancement of industrial and socio-economic activities in the States.                  |
| 51                                  | Afam-Port Harcourt 132kV D/C turning in and out at Port Harcourt main Ts                                  | Rivers         | 2009                                 | August, 2012                | 270,000,000.00     | Rivers State Govt.              | Completed         | Increase power weeling capacity to Port Harcourt to meet the load demand in PH and increase socio-economic activity; create employment                               |
| 52                                  | Construction of 150MVA, 330/132/33kV transformer at Onitsha, 330kV bays at Onitsha and Benin.             | Edo            | 18th May, 2001; reawarded Sept. 2008 | June, 2013                  | 639,623,673.85     | Siemens Ltd. MBH Power Ltd      | Completed         | Boost in power supply to Onitsha and Benin areas. Boost in economic activity in the South East and South-Sout Zones.   |
| 53                                  | 3rd Benin - Onitsha 330KV DC Line   | Edo            | Dec, 2007                            | Feb., 2013                  | 6,539,926,332.00   | KEC International               | Completed         | Boost in power supply to Onitsha and Benin areas. Boost in economic activity in the South East and South-Sout Zones.   |
| 54                                  | Calabar 2x150MVA, 330/132/33kV Substation and line bay at Alaaji Substation.                              | Cross Rivers   | 15th Aug. 2006                       | June.2013                   | 598,094,641.88     | Areva T & D SPR MBH Power Ltd.  | Completed         | Boost in power supply to Calabar and the entire Cross River State. Generation of employment and increase in economic activity in the state.                          |

**Annex 4.2a**  
**CLASSIFICATION OF ON-GOING TCN AND NIPP CAPITAL PROJECTS BY ZONES**  
**TCN Projects**

| S/N                                   | PROJECT TITLE  | STATE        | DATE OF COMMENCEMENT     | EXPECTED DATE OF COMPLETION | TOTAL COST (NAIRA) | NAME OF CONTRACTOR                             | COMPLETION STATUS | IMPACT OF PROJECT  |
|---------------------------------------|--|--------------|--------------------------|-----------------------------|--------------------|--|-------------------|--|
| 55                                    | 1x60MVA Substation at Ughelli Power Plant and 1x30/40MVA substation reinforcement at Amukpe  | Delta        | Dec, 2008                | March, 2015                 | 791,334,541.30     | Continental Engr'g Nig. Ltd.                   | 94                | Improvement in power supply to Amukpe, Sapele and environs. Boost in economic activity in the areas.   |
| 56                                    | 2nd Benin-Onitsha 330kv SC line.   | Edo          | 17th,Sept.2008           | June, 2015                  | 4,205,289,346.35   | ABB;<br>Dextron Engineering Ltd                | 85                | Boost in power supply to Onitsha and Benin areas. Boost in economic activity in the South East and South-Sout Zones.   |
| 57                                    | 2x30/40MVA 132/33kV S/S at Ogoja   | Cross Rivers | Dec, 2007                | March, 2015                 | 1,336,710,579.79   | Income Electrix Ltd                            | 75                | Improvement in power supply to Ogoja and environs to meet the power demand of the areas, increase socio-economic activity and generate employment in the areas.        |
| 58                                    | Rehabilitation of Afam TS with 1 x 150MVA 330/132/33kV transformer and construction of Afam IV to Afam II 132kV Transmission Line                      | Rivers       | 2010                     | June, 2015                  | 1,472,806,633.00   | Telavars Group                                 | 65                | Improvement in power supply to entire Rivers State to meet the power demand, increase socio-economic activity and generate employment in parts of the state.           |
| 59                                    | DC 132kV line from Alscou to Ibom Power and Switching Station to link the GIS at Alscou with associated bay extensions at Ibom Power - Akwa Ibom State | Akwa Ibom    | 2011                     | April, 2015                 | 747,246,322.01     | KEC International Ltd                          | 80                | Boost in power supply to Akwa Ibom State. Generation of employment and increase in economic activity in the state.   |
| 60                                    | Benin North-Oshogbo 330KV DC line with one SC turning in and out to New Akure substation   | Edo          | Dec. 2010                | December, 2015              | 7,460,190,274.90   | Gammon India Ltd                               | 28                | Increase in power wheeling capacity between Osogbo and Benin and improved power availability for socio-economic development in the affected zones.                     |
| 61                                    | Obudu - Ogoja 132KV DC Line  | Cross Rivers | Dec, 2007 /Dec., 2011    | December, 2015              | 1,148,659,353.21   | Jilon Elect Engr; Sinotec/KEC                  | 7                 | Improvement in power supply to Ogoja, Obudu and environs to meet the power demand of the areas, increase socio-economic activity and generate employment in the areas. |
| 62                                    | 1x60MVA, 132/33kV substation reinforcement at Ukpilla substation, Edo State  | Edo          | March, 2012              | Sept., 2015                 | 542,587,478.01     | Power Control & Appliances                     | 42                | Improvement in power supply to Ukpilla and environs to meet the power demand of the areas, increase socio-economic activity and generate employment in the areas.      |
| 63                                    | Yenagoa - Oporoma 132kv DC Transmission Line (50km)  | Bayelsa      | Yet to commence          | Yet to commence             | 5,965,951,491.16   | Fluor Eng/ Eurafric                            | 0                 | Improvement of power supply to Oporoma and other parts of Bayelsa State. Increase in employment generation and socio-economic development.                             |
| 64                                    | 2x 60MVA, 132/33KV Substation at Oporoma and 2x 132KV Line bays Extension at Yenagoa Substation  | Bayelsa      | Yet to commence          | Yet to commence             | 2,598,473,746.01   | Alfa/Cobra/Feeders JV                          | 0                 | Improvement of power supply to Oporoma and other parts of Bayelsa State. Increase in employment generation and socio-economic development.                             |
| 65                                    | Delta-Port Harcourt 330KV DC line  | Delta/Rivers | March, 2012              | Sep, 2016                   | 6,173,850,833.93   | Icom Tele Ltd                                  | 5                 | Increase in power wheeling and availability to the states of the South-South Zone. Increase in employment generation and socio-economic development.                   |
| 66                                    | 4x330kv line bays extensions at Delta and Port Harcourt substations  | Delta/Rivers | March, 2012              | December, 2015              | 1,237,745,143.35   | MBH Power Ltd                                  | 20                | Increase in power wheeling and availability to the states of the South-South Zone. Increase in employment generation and socio-economic development.                   |
| <b>Projects In North Central Zone</b> |  |              |                          |                             |                    |  |                   |  |
| 67                                    | Katampe-National Stadium 132kv DC line   | Abuja/FCT    | Sept, 2001;<br>Dec. 2010 | March, 2015                 | 2,656,115,130.98   | ABB Powerlines; Energo Nigeria Ltd             | 95                | Improvement in power wheeling capacity to National Stadium/Kukwaba areas of FCT. Enhancement of socio-economic activity and generation of employment.                  |
| 68                                    | Kukwaba 2x60MVA, 132/33kV substation   | Abuja/FCT    | 2007                     | March, 2015                 | 1,395,055,232.60   | North China Power Engineering/News Engineering | 80                | Improvement in power supply to National Stadium/Kukwaba areas of FCT. Enhancement of socio-economic activity and generation of employment.                             |
| 69                                    | Nsukka - Ayangba 132KV DC Line   | Kogi         | Aug. 2009                | Dec., 2015                  | 1,480,777,014.45   | West Com Ltd/PPCL                              | 35                | Increase in power availability to Ayangba and environs. Enhancement in socio-economic life of the people.  |
| 70                                    | 132/33KV Substation at Ayangba   | Kogi         | Dec, 2007                | Dec, 2015                   | 1,281,971,870.25   | Omen International Ltd.                        | 12                | Increase in power availability to Ayangba and environs. Enhancement in socio-economic life of the people.  |
| 71                                    | 1x150MVA, 330/132kV + 1x60MVA, 132/33kV substation at Obajana  | Kogi         | December, 2007           | June, 2015                  | 2,568,846,118.51   | Payma Bargh/ Cartlark                          | 35                | Improvement in power supply to Obajana to meet the power demand of the industrial area and environs, to boost socio-economic activity and generate employment          |
| 72                                    | Construction of Akwanga-Lafia 132kV Double Circuit Transmission Line   | Nasarawa     | January, 2011            | April, 2016                 | 1,147,170,485.67   | Bateman  | 10                | Bulk power supply to Lafia town and environs. Stimulation of growth in socio-economic activity, generation of employment   |

**Annex 4.2a**  
**CLASSIFICATION OF ON-GOING TCN AND NIPP CAPITAL PROJECTS BY ZONES**  
**TCN Projects**

| S/N                                | PROJECT TITLE  | STATE         | DATE OF COMMENCEMENT  | EXPECTED DATE OF COMPLETION               | TOTAL COST (NAIRA) | NAME OF CONTRACTOR                            | COMPLETION STATUS | IMPACT OF PROJECT   |
|------------------------------------|--|---------------|-----------------------|---|--------------------|---|-------------------|---|
| 73                                 | 2x30/40MVA, 132/33kV S/S at Lafia  | Nasarawa      | January, 2011         | Dec, 2015                                 | 1,490,085,721.56   | Monotech Input/Bangladesh                     | 37                | Bulk power supply to Lafia town and environs. Stimulation of growth in socio-economic activity, generation of employment                                      |
| 74                                 | Makere - Pankshin 132KV DC Line  | Plateau       | Dec, 2007             | March, 2015                               | 564,386,464.12     | Mogabs Nig. Ltd                               | 90                | Increased power supply to Makeri, Pankshin and their environs. Boost insocio-economic live in the areas and entire Plateau State.                             |
| 75                                 | 2 x 30MVA, 132/33KV S/S at Pankshin and Makeri   | Plateau       | Dec, 2007             | Makeri - Aug., 2013.<br>Pankshin - March, | 2,058,143,958.24   | North China/EESE                              | Completed         | Increased power supply to Makeri, Pankshin and their environs. Boost insocio-economic live in the areas and entire Plateau State.                             |
| 76                                 | 2x60MVA, 132/33KV S/S at Shonga.   | Kwara         | Jan. 2011             | March, 2016                               | 1,600,790,830.21   | New World/Ruoga Energy                        | 17                | Bulk power supply to Songa and environs. Stimulation of growth in socio-economic activity, generation of employment   |
| 77                                 | Ganmo -Ogbomosho 132kv DC line   | Kwara         | Feb. 2011             | Dec., 2015                                | 1,223,259,627.73   | Trencco Power/Eco Energo Group                | 15                | Bulk power supply to Ogbomosho and environs. Stimulation of growth in socio-economic activity, generation of employment                                       |
| 78                                 | Lokoja - Obajana 330KV Line and Substation   | Kogi          | Dec, 2007 /2011       | Dec., 2015                                | 695,939,096.83     | Elem & Elgo / Steers/Optic 1                  | 30                | Improvement in power supply to Obajana to meet the power demand of the Industrial area and environs, to boost socio-economic activity and generate employment |
| 79                                 | Ganmo-Shonga 132KV DC Line .   | Kwara         | Dec. 2010             | Dec. 2015                                 | 2,622,191,252.87   | Aster Infrac/Aster Teleservices               | 20                | Bulk power supply to Songa and environs. Stimulation of growth in socio-economic activity, generation of employment   |
| 80                                 | Obajana-Okeagbe 132KV DC line  | Kogi          | 2011                  | March, 2016                               | 1,969,973,210.18   | Everest Infra energy Ltd                      | 5                 | Bulk power supply to Okeagbe and environs. Stimulation of growth in socio-economic activity, generation of employment   |
| 81                                 | Keffi-Kwoi-Kachia 132kv DC line  | Kaduna        | 2011                  | March, 2016                               | 3,017,531,968.16   | Aster Infrac/Aster Teleservices               | 15                | Bulk power supply to Kwoi, Kachia and adjoining parts of Kaduna State. Stimulation of growth in socio-economic activity, generation of employment             |
| 82                                 | Omu Aran-Egbe 132kv DC line  | Kwara         | June, 2012            | Dec. 2016                                 | 1,086,539,157.35   | Aravali Infra Power Ltd                       | 5                 | Improvement of power supply to Kogi State. Boosting of socio-economic life of the people of the state   |
| 83                                 | 2x60MVA 132/33kv substation at Egbe  | Kwara         | June, 2012            | June, 2015                                | 1,633,321,632.56   | TBEA Hengyang Transformer Co. Ltd             | 60                | Improvement of power supply to Kogi State. Boosting of socio-economic life of the people of the state   |
| <b>Projects In North-East Zone</b> |  |               |                       |   |                    |   |                   |   |
| 84                                 | Construction of 2x150MVA, 330/132kv substation at Yola and 330kV Bay Extension at Gombe. | Adamawa/Gombe | May, 2001, Sept. 2008 | Dec., 2010                                | 5,991,019,162.16   | Siemens Ltd. MBH Power Ltd.                   | Completed         | Increase in power supply to Yola to meet the power demand in Adamawa State, boost in economic activity, employment generation.                                |
| 85                                 | 2 x 330KV Line bay extension at Kaduna, Jos and Onitsha                                  | Kaduna        | Nov, 2009             | Dec. 2015                                 | 1,240,589,916.19   | Valenz Holding Ltd                            | 30                | Improvement of power wheeling to Kaduna, Plateau and Anambra States   |
| 86                                 | Kaduna - Jos 330KV DC Line   | Kaduna        | July, 2010            | July, 2015                                | 8,714,447,318.27   | Dextron Engr. Ltd                             | 67                | Increase in power wheeling to the North-East Zone. Boost in socio-economic activity in the North East states.   |
| 87                                 | Jos - Kafanchan 132KV D/C Line .   | Kaduna        | Dec, 2007             | April, 2012                               | 1,407,774,047.57   | Energo Nig Limited                            | Completed         | Bulk power supply to Kafanchan and Southern parts of Kaduna State. Increase in economic activity, employment generation.                                      |
| 88                                 | Jalingo 2x30/40MVA, 132kv Substation   | Taraba        | September, 2002       | November, 2009                            | 693,836,117.08     | News Engineering Nig. Ltd.                    | Completed         | Increase in power supply to Jalingo and environs. Boost in socio-economic activity and employment in the entire Taraba State.                                 |
| 89                                 | Maiduguri 1x150MVA, 330/132kv Substation   | Borno         | May, 2003             | March, 2015                               | 2,811,394,650.71   | Charnel Engr. Co. Ltd. AY - KAY               | 80                | Increase in power supply to Borno State. Boost in socio-economic activity and employment in the entire state.   |
| 90                                 | Damaturu 330/132kv Substation  | Yobe          | April, 2006           | March, 2015                               | 2,502,960,280.52   | Parsian High Voltage Div./ Cartlark Int'l Ltd | 88                | Increase in power supply to Yobe State. Boost in socio-economic activity and employment in the entire state.  |

**Annex 4.2a**  
**CLASSIFICATION OF ON-GOING TCN AND NIPP CAPITAL PROJECTS BY ZONES**  
**TCN Projects**

| S/N                                | PROJECT TITLE  | STATE          | DATE OF COMMENCEMENT | EXPECTED DATE OF COMPLETION | TOTAL COST (NAIRA) | NAME OF CONTRACTOR                      | COMPLETION STATUS | IMPACT OF PROJECT  |
|------------------------------------|--|----------------|----------------------|-----------------------------|--------------------|---|-------------------|--|
| 91                                 | 1x28MVA Mobile Substation at Mayo Belwa  | Adamawa        | 14 July, 2011        | March, 2015                 | 224,918,522.80     | MBH Power Ltd                           | 80                | Increase in power supply to Mayo Belwa and environs. Boost in socio-economic activity and employment in the areas.                                       |
| 92                                 | Damaturu - Gashua 132kv DC Transmission Line (245km)   | Yobe           | Yet to commence      | Yet to commence             | 5,440,638,606.31   | Dextron Engr. Ltd                       | 0                 | Bulk power supply to Gashua and environs and adjoining parts of Yobe State. Boost in socio-economic activity and employment in the areas.                |
| 93                                 | Gashua - Hadejia 132kv DC Transmission Line (150km)  | Yobe/Jigawa    | Yet to commence      | Yet to commence             | 3,392,394,044.93   | Jyoti Structures Ltd                    | 0                 | Increase in power supply to Gashua, Hadejia and adjoining parts of Yobe and Jigawa States. Boost in socio-economic activity and employment in the areas. |
| 94                                 | 2x 60MVA, 132/33KV Substation at Gashua and 2x 132KV Line bays Extension at Damaturu and Hadejia       | Yobe           | Yet to commence      | Yet to commence             | 2,146,875,489.00   | Concept Eng./Chanref                    | 0                 | Bulk power supply to Gashua nad environs. Boost in socio-economic activity and employment in the areas.  |
| 95                                 | Yola-Song-Mubi-Gulak 132KV DC line   | Adamawa        | 2011                 | July, 2016                  | 7,457,033,255.05   | Skipper Electricals Ltd                 | 10                | Bulk power supply to various parts of Adamawa State. Boost in socio-economic activity and employment in the state.                                       |
| 96                                 | 2x60MVA, 132/33kV substations at Song  | Adamawa        | 2012                 | March, 2016                 | 1,691,183,805.43   | Qingado Wuxio/Ahmin Tech & Power System | 5                 | Bulk power supply to Song and environs. Boost in socio-economic activity and employment in the areas.  |
| 97                                 | 2x60MVA, 132/33kV substation at Little Gombi   | Adamawa        | 2013                 | March, 2016                 | 1,468,436,221.81   | Shandong Taikai                         | 10                | Bulk power supply to Little Gombi and environs. Boost in socio-economic activity and employment in the areas.  |
| 98                                 | 2x60MVA, 132/33kV substations at Mubi  | Adamawa        | 2014                 | March, 2016                 | 1,438,428,976.80   | Hyundai/Richfied Energy                 | 5                 | Bulk power supply to Mubi and environs. Boost in socio-economic activity and employment in the areas.  |
| 99                                 | 2x60MVA, 132/33kV substations at Gulak   | Adamawa        | 2015                 | March, 2016                 | 1,876,263,194.07   | Concept Eng/Chanref                     | 5                 | Bulk power supply to Gulak and environs. Boost in socio-economic activity and employment in the areas.   |
| <b>Projects In North-West Zone</b> |  |                |                      |                             |                    |   |                   |  |
| 100                                | Rehabilitation of Sokoto - Talatamafara 132KV DC line  | Sokoto/Zamfara | Dec, 2007            | Sept, 2012                  | 356,639,704.67     | Dextron                                 | Completed         | Improved powewr supply to Talata Mafara and environs. Boost in socio-economic activity and employment in the areas.                                      |
| 101                                | 1X30 MVA 132/33 KV SS at Kwanar Dangora  | Kano           | Oct. 2009            | Jun. 2012                   | 1,395,402,462.00   | MATALEC                                 | Completed         | Improved powewr supply to Kwanar Dangora and environs. Boost in socio-economic activity and employment in the areas.                                     |
| 102                                | Transmission & Supply of Substation at Tamburawa Water Facility  | Kano           | Oct 2009             | Sept, 2012                  | 1,739,004,380.94   | PEL/ NESPAK                             | Completed         | Improved powewr supply to Tamburawa and environs. Boost in socio-economic activity and employment in the areas.  |
| 103                                | Talata Mafara 2x30/40MVA 132/33kV substation   | Zamfara        | Nov,2001             | Feb., 2012                  | 559,871,093.20     | Continental Engr'g Nig. Ltd.            | Completed         | Improved powewr supply to Talata Mafara and environs. Boost in socio-economic activity and employment in the areas.                                      |
| 104                                | Kainji - New Bussa 132kv DC Transmission Line & 330KV SC River Crossing                                | Niger          | 2010                 | March, 2014                 | 308,108,608.21     | Dextron Engineering Ltd                 | Completed         | Bulk power supply to New Bussa and environs. Boost in socio-economic life and employment geration in the areas.  |
| 105                                | 1x150MVA 330/132kV transformer at Birnin Kebbi and Reinforcement at 330/132/33 kV substation, Kumbotso | Kebbi/Kano     | 2010                 | June, 2014                  | 3,559,832,143.76   | MBH Power                               | Completed         | Improvement in power supply to entire Kebbi and Kano States. Boost in socio-economic life and employment geration in the areas.                          |
| 106                                | Kainji 1x150MVA 330/132kV & 2 x 30/40MVA Substation at New Bussa                                       | Niger          | 2010                 | June, 2014                  | 4,599,287,900.03   | MBH Power                               | Completed         | Bulk power supply to New Bussa and environs. Boost in socio-economic life and employment geration in the areas.  |
| 107                                | Jos - Kafanchan 132KV D/C Line .   | Kaduna         | Dec, 2007            | April, 2012                 | 1,407,774,047.57   | Energro Nig Limited                     | Completed         | Bulk power supply to Kafanchan and environs. Boost in socio-economic life and employment geration in the areas.  |
| 108                                | Kafanchan 132kv 2 x 60mva Substation   | Kaduna         | Dec, 2007            | March, 2015                 | 1,225,704,689.74   | Valenz Holding Ltd                      | 80                | Bulk power supply to Kafanchan and environs. Boost in socio-economic life and employment geration in the areas.  |

**Annex 4.2a**  
**CLASSIFICATION OF ON-GOING TCN AND NIPP CAPITAL PROJECTS BY ZONES**  
**TCN Projects**

| S/N | PROJECT TITLE   | STATE                | DATE OF COMMENCEMENT           | EXPECTED DATE OF COMPLETION | TOTAL COST (NAIRA) | NAME OF CONTRACTOR                                 | COMPLETION STATUS | IMPACT OF PROJECT  |
|-----|---|----------------------|--------------------------------|-----------------------------|--------------------|--|-------------------|--|
| 109 | 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                 | Dec, 2007                      | April, 2015                 | 1,783,781,485.32   | GIT  | 67                | Bulk power supply to Walalambe and environs. Boost in socio-economic life and employment geration in the areas.                                    |
| 110 | Yelwa - Yauri 2 x 30/40MVA S/S and 100KM of 33KV Line   | Kebbi                | Dec, 2007                      | July, 2015                  | 1,067,910,710.00   | Valenz/<br>Electromontaz                           | 67                | Bulk power supply to Yelwa-Yauri and environs. Boost in socio-economic life and employment geration in the areas.                                  |
| 111 | 2 x 330KV Line bay extension at Kaduna, Jos and Onitsha   | Kaduna               | Nov, 2009                      | Dec. 2015                   | 1,240,589,916.19   | Valenz Holding Ltd                                 | 30                | Increased power wheeling to Kaduna, Plateau and Anambra States. Boost in socio-economic life and employment geration in the atates.                |
| 112 | Grid Rehabilitation And Reinforcement, Katsina, Hadejia, Kontagora.   | Katsina/Jigawa/Niger | Aug. 2010                      | March, 2015                 | 1,261,482,166.72   | Junot Construction                                 | 75                | Improvement in power supply to entire Katsina, Hadejia, Kontagora and environs. Boost in socio-economic life and employment geration in the areas. |
| 113 | Kaduna Power Plant-Mando Road 330kV D/C line and Substation Extension   | Kaduna               | Dec., 2010                     | Dec, 2015                   | 1,235,598,207.04   | Hundai Energy & Construction Ltd/ IPDC Ltd         | 15                | Increased power supply to entire Kaduna State. Improved socio-economic activity and employment generation.   |
| 114 | Daura 2 x 30/40MVA S/S and 2x 132kv line bay ext. at Katsina  | Katsina              | Dec, 2007 /Dec., 2011          | June, 2015                  | 1,686,967,544.11   | NCEP/Power Control & Appliances                    | 75                | Bulk power supply to Daura and environs. Boost in socio-economic life and employment geration in the areas.  |
| 115 | 2nd Kaduna-Kano 330kV DC line.  | Kaduna/Kano          | 2011                           | December, 2017              | 8,514,855,688.26   | National Power Construction                        | 0                 | Increased power wheeling to Kano and Katsina States. Improved socio-economic activity and employment generation.                                   |
| 116 | 1X30MVA, 132/33 kV Substation at Wudil  | Kano                 | Aug. 2010                      | June, 2015                  | 1,554,231,496.95   | CON Engineering                                    | 70                | Bulk power supply to Wudil and environs. Boost in socio-economic life and employment geration in the areas.  |
| 117 | Kaduna - Jos 330KV DC Line  | Kaduna               | July, 2010                     | July, 2015                  | 8,714,447,318.27   | Dextron Engr. Ltd                                  | 67                | Increased power wheeling to Kaduna and Plateau States. Improved socio-economic activity and employment geration in the states.                     |
| 118 | Kano-Katsina 330KV DC Transmission Line   | Kano/Katsina         | Dec. 2010                      | December, 2015              | 6,123,452,721.78   | Gammon India                                       | 35                | Increased power wheeling to Katsina State. Improved socio-economic activity and employment generation.   |
| 119 | 2x150MVA Substation at Katsina.   | Katsina              | Dec. 2010                      | December, 2015              | 3,998,689,080.02   | Barne/ESL  | 30                | Bulk power supply to entire Katsina State. Boost in socio-economic life and employment geration in the state.                                      |
| 120 | Katsina-Kurfi-Dutsinma-Kankara-Malumfashi 132KV Line  | Katsina              | Jan. 2011                      | Dec. , 2015                 | 2,990,230,818.96   | Skipper Electricals Ltd                            | 15                | Bulk power supply to various parts of Katsina State. Boost in socio-economic life and employment geration in the state.                            |
| 121 | 2x60MVA, 132/33kV substation at Kurfi   | Katsina              | Jan. 2011                      | Dec, 2015                   | 1,492,490,054.98   | Gracehill Energy Nig. Ltd                          | 5                 | Bulk power supply to Kurfi and environs. Boost in socio-economic life and employment geration in the areas.  |
| 122 | 2x60MVA, 132/33kV substation at Dutsinma  | Katsina              | Jan. 2011                      | Dec, 2015                   | 1,278,158,301.28   | Hoquado Limited                                    | 10                | Bulk power supply to Dutsinma and environs. Boost in socio-economic life and employment geration in the areas.                                     |
| 123 | 2x60MVA, 132/33kV substation at Kankara   | KATSINA              | Jan. 2011                      | Dec, 2015                   | 1,411,387,601.67   | PEL-NESPAK JV                                      | 10                | Bulk power supply to Kankara and environs. Boost in socio-economic life and employment geration in the areas.                                      |
| 124 | 2x60MVA, 132/33kV substation at Malumfashi  | Katsina              | Jan. 2011                      | Dec, 2015                   | 1,250,988,584.47   | Monotech Input/Bangladesh                          | 25                | Bulk power supply to Malumfashi and environs. Boost in socio-economic life and employment geration in the areas.                                   |
| 125 | Kumbotso (Daura)-Dambatta 132KV Line  | Kano                 | Dec. 2010                      | Dec, 2015                   | 1,533,623,568.20   | Icom Tele Ltd                                      | 5                 | Bulk power supply to Dambatta and environs. Boost in socio-economic life and employment geration in the areas.                                     |
| 126 | 2x60MVA, 132/33kV substation at Dambatta, Kano State.   | Kano                 | Dec. 2010                      | June, 2015                  | 1,533,623,568.20   | PEL-NESPAK JV                                      | 50                | Bulk power supply to Dambatta and environs. Boost in socio-economic life and employment geration in the areas.                                     |
| 127 | Katsina- Daura 132kv DC line Katsina State  | Katsina              | Dec, 2007<br>December 14, 2011 | June, 2015                  | 2,465,300,298.12   | Income Electrix Ltd. Reawarded to Optic 1 Nig. Ltd | 60                | Bulk power supply to Daura and environs. Boost in socio-economic life and employment geration in the areas.  |

**Annex 4.2a**  
**CLASSIFICATION OF ON-GOING TCN AND NIPP CAPITAL PROJECTS BY ZONES**  
**TCN Projects**

| S/N | PROJECT TITLE  | STATE       | DATE OF COMMENCEMENT | EXPECTED DATE OF COMPLETION | TOTAL COST (NAIRA) | NAME OF CONTRACTOR                  | COMPLETION STATUS | IMPACT OF PROJECT  |
|-----|--|-------------|----------------------|-----------------------------|--------------------|-------------------------------------|-------------------|--|
| 128 | 2x330kV line bay extensions at each of Kaduna and Kano substations | Kaduna/Kano | March, 2012          | Dec, 2015                   | 1,157,997,292.40   | Exenergia Power/Bigen Africa        | 20                | Increased power wheeling between Kaduna and Kano.  |
| 129 | Keffi-Kwoi-Kachia 132kV DC line                                    | Kaduna      | 2011                 | March, 2016                 | 3,017,531,968.16   | Aster Infrac/Aster Teleservices     | 15                | Bulk power supply to Kwoi, Kachia and environs. Boost in socio-economic life and employment generation in the areas. |
| 130 | 2x60MVA substation at Kwoi   | Kaduna      | 2011                 | Dec, 2015                   | 1,679,728,453.64   | Liaoning Efacec Elect Equipment Co. | 5                 | Bulk power supply to Kwoi and environs. Boost in socio-economic life and employment generation in the areas.         |
| 131 | 2x60MVA substation at Kachia                                       | Kadun       | March, 2012          | Sept. , 2015                | 1,355,044,933.35   | Esterbag Eng. Ltd                   | 30                | Bulk power supply to Kachia and environs. Boost in socio-economic life and employment generation in the areas.       |
| 132 | Gagarawa 2x60 MVA, 132/33 kV substation, Jigawa State              | Jigawa      | 2011                 | March, 2016                 | 1,108,202,022.55   | Power Control & Appliances          | 10                | Bulk power supply to Gagarawa and environs. Boost in socio-economic life and employment generation in the areas.     |

**Annex 4.2b**  
**CLASSIFICATION OF ON-GOING TCN AND NIPP CAPITAL PROJECTS BY ZONES**  
**NIPP Projects**

| S/N | PROJECT TITLE   | State | Date of Commencement | Expected Date of Completion      | Total Cost (Naira) | Name of Contractor | Completion Status   | IMPACTS OF PROJECT   |
|-----|---|-------|----------------------|----------------------------------|--------------------|--------------------|---------------------|--|
|     | <b>Projects In South-South Zone</b>                   |       |                      |                                  |                    |                    |                     |  |
| 1   | 330KV DC Ikot Ekpene-Ugwuaji (Line 1 -4)              |       | South South          | April, 2015                      |                    |                    | Yet to be completed | The project when completed will provide alternative path for bulk power evacuation to North West and North Central   |
| 2   | 330KV DC Afam -Ikot Ekpene                            |       | South South          | April, 2015                      |                    |                    | Yet to be completed | The project when completed will provide alternative path for bulk power evacuation to North West and North Central   |
| 3   | 330KV Afam SS (Line Bay Ext.)                         |       | South South          | April, 2015                      |                    |                    | Yet to be completed | The project when completed will provide power evacuation at Afam S/S   |
| 4   | 330KV Ikot Ekpene SS                                  |       | South South          | April, 2015                      |                    |                    | Yet to be completed | The project when completed will provide power evacuation at Ikot Ekpene S/S  |
| 5   | 330/132/33KV Ikot Abasi SS (New)                      |       | South South          | April, 2015                      |                    |                    | Yet to be completed | The project when completed will provide power evacuation at Ikot Ekpene S/S (New)  |
| 6   | 132KV DC Eket-Uyo (Reconductoring)                    |       | South South          | Commissioned                     |                    |                    | Completed           | The project when completed will provide alternative path for bulk power evacuation to Uyo , and the entire South - South region.                               |
| 7   | 132KV DC Uyo-Itu (Reconductoring)                     |       | South South          | Commissioned                     |                    |                    | Completed           | The project when completed will provide alternative path for bulk power evacuation to Itu, and the entire South - South region.                                |
| 8   | 132KV Uyo SS (Replacement of transformers)            |       | South South          | Commissioned                     |                    |                    | Completed           | The project when completed will provide power evacuation at Uyo S/S  |
| 9   | 132KV Itu SS (Replacement of transformers)            |       | South South          | Delivered to site, not energized |                    |                    | Yet to be completed | The project when completed will provide power evacuation at Itu S/S  |
| 10  | 330/132/33KV Omoku SS (Supervised by DECON for Steag) |       | South South          | April, 2015                      |                    |                    | Yet to be completed | The project when completed will provide power evacuation at Omoku S/S  |
| 11  | 330KV DC Omoku-Egbema                                 |       | South South          | April, 2015                      |                    |                    | Yet to be completed | The project when completed will provide alternative path for bulk power evacuation from Omoku-Egbema , and the entire South - east & South - South regions.    |
| 12  | 330KV DC Egbema-Owerri                                |       | South South          | April, 2015                      |                    |                    | Yet to be completed | The project when completed will provide alternative path for bulk power evacuation from Egbema - Owerri , and the entire South - east & South - South regions. |
| 13  | 132/33KV Ihovbor SS (New)                             |       | South South          | April, 2015                      |                    |                    | Yet to be completed | The project when completed will provide power evacuation at Ihovbor S/S  |

**Annex 4.2b**  
**CLASSIFICATION OF ON-GOING TCN AND NIPP CAPITAL PROJECTS BY ZONES**

**NIPP Projects**

|    |  |  |             |             |  |  |                     |  |
|----|--|--|-------------|-------------|--|--|---------------------|--|
| 14 | 132/33V Agbor SS (New)                         |  | South South | April, 2015 |  |  | Yet to be completed | The project when completed will provide power evacuation at Agbor S/S  |
| 15 | 132/33KV Asaba SS (New)                        |  | South South | April, 2015 |  |  | Yet to be completed | Grid Reinforcement   |
| 16 | 132KV DC Agbor-Asaba                           |  | South South | April, 2015 |  |  | Yet to be completed | Grid Reinforcement   |
| 17 | 330/132/33KV Onne SS (New)                     |  | South South | April, 2015 |  |  | Yet to be completed | Power Evacuation   |
| 18 | 330KV Afam SS (Ext.)                           |  | South South | April, 2015 |  |  | Yet to be completed | Power Evacuation   |
| 19 | 132/33KV Trans Amadi SS (Ext.)                 |  | South South | April, 2015 |  |  | Yet to be completed | Power Evacuation   |
| 20 | 330KV DC Afam-Onne                             |  | South South | April, 2015 |  |  | Yet to be completed | The project when completed will provide alternative path for bulk power evacuation in Port -Harcourt and the entire South-South region     |
| 21 | 132KV DC Onne-Trans Amadi                      |  | South South | April, 2015 |  |  | Yet to be completed | The project when completed will provide alternative path for bulk power evacuation in Port -Harcourt and the entire South-South region     |
| 22 | 330 DC Ikot Abasi-Ikot Ekpene                  |  | South South | April, 2015 |  |  | Yet to be completed | The project when completed will provide alternative path for bulk power evacuation in Akwa Ibom and the entire South-South region          |
| 23 | 132/33KV Okada SS (New)                        |  | South South | April, 2015 |  |  | Yet to be completed | Power Evacuation   |
| 24 | 132KV Ihovbor SS (Line Bay Ext.)               |  | South South | April, 2015 |  |  | Yet to be completed | The project when completed will provide alternative path for bulk power evacuation at Ihovbor S/S  |
| 25 | 330/132KV Ihovbor SS (New)                     |  | South South | April, 2015 |  |  | Yet to be completed | The project when completed will provide alternative path for bulk power evacuation at Ihovbor S/S  |
| 26 | 330KV DC Ihovbor-(Benin Main-Oshogbo) (Line A) |  | South South | April, 2015 |  |  | Yet to be completed | The project when completed will provide alternative path for bulk power evacuation to Osogbo and the entire South west region              |
| 27 | 330KV SC Ihovbor-(Benin Main/ Onitsha)         |  | South South | April, 2015 |  |  | Yet to be completed | The project when completed will provide alternative path for bulk power evacuation to Benin main, Onitsha and the entire South east region |
| 28 | 132KV DC Ihovbor-Okada                         |  | South South | April, 2015 |  |  | Yet to be completed |  |
| 29 | 132/33KV Ikom SS (New)                         |  | South South | April, 2015 |  |  | Yet to be completed | power evacuation   |

**Annex 4.2b**  
**CLASSIFICATION OF ON-GOING TCN AND NIPP CAPITAL PROJECTS BY ZONES**  
**NIPP Projects**

|    |  |  |             |              |  |  |                     |   |
|----|--|--|-------------|--------------|--|--|---------------------|---|
| 30 | 132/33KV Obudu SS (New)  |  | South South | April, 2015  |  |  | Yet to be completed | power evacuation  |
| 31 | 132KV DC Abakiliki-Ikom  |  | South South | April, 2015  |  |  | Yet to be completed | The project when completed will provide alternative path for bulk power evacuation to Cross River State , and environs.         |
| 32 | 132KV DC Ikom-Obudu  |  | South South | April, 2015  |  |  | Yet to be completed | The project when completed will provide alternative path for bulk power evacuation to Cross River State , and environs.         |
| 33 | 330KV Calabar SS (New)   |  | South South | April, 2015  |  |  | Yet to be completed | power evacuation  |
| 34 | 330KV DC Ikot Ekpene-Alaoji  |  | South South | 2015, April  |  |  | Yet to be completed | The project when completed will provide alternative path for bulk power evacuation to Alaoji , and the entire South east region |
| 35 | 330KV DC Calabar-Ikot Ekpene   |  | South South | April, 2015  |  |  | Yet to be completed | The project when completed will provide alternative path for bulk power evacuation from Calabar PS.                             |
| 36 | 330KV DC (Calabar PS-Calabar SS)                                       |  | South South | Commissioned |  |  | Completed           | The project provides alternative path for bulk power evacuation from Calabar P/S.   |
| 37 | 132/33KV Calabar SS (1x60MVA Ext.)                                     |  | South South | April, 2015  |  |  | Yet to be completed | power evacuation  |
| 38 | 132/33KV Adiabo SS (2x60MVA Ext.)                                      |  | South South | April, 2015  |  |  | Yet to be completed | power evacuation  |
| 39 | 132/33KV Calabar EPZ SS (2x60MVA New)                                  |  | South South | April, 2015  |  |  | Yet to be completed | power evacuation  |
| 40 | Construction of 5km 132KV DC OHTL & 8km SC Diversion                   |  | South South |              |  |  | Yet to be completed | power evacuation  |
| 41 | Restranging/Conversion of 4km 132KV SC to 132kV DC line                |  | South South |              |  |  | Yet to be completed | power evacuation  |
| 42 | 132KV DC Construction of two (2) 132kV DC lines each 5km               |  | South South | 2015, April  |  |  | Yet to be completed | power evacuation  |
| 43 | 132KV DC Construction of New Lines and Disconnection of diversion line |  | South South | April, 2015  |  |  | Yet to be completed | power evacuation  |
| 44 | 330KV Sapele SS (Rehab. & Ext.)  |  | South South | Commissioned |  |  | Completed           | Provides Power Evacuation   |
| 45 | 330KV Benin SS (Rehab.)  |  | South South | Commissioned |  |  | Completed           | Provides Power Evacuation   |

**Annex 4.2b**  
**CLASSIFICATION OF ON-GOING TCN AND NIPP CAPITAL PROJECTS BY ZONES**

**NIPP Projects**

|    |                                    |  |             |                           |  |  |                     |   |
|----|------------------------------------|--|-------------|---------------------------|--|--|---------------------|---|
| 46 | 330/132KV Asaba SS (New)           |  | South South | 2014, June                |  |  | Yet to be completed | Provides Power Evacuation   |
|    | <b>Projects In South-East Zone</b> |  |             |                           |  |  |                     |   |
| 47 | 330/132KV New Haven SS (Ext.)      |  | South East  | Commissioned              |  |  | Completed           | Provides Power Evacuation   |
| 48 | 330KV Ugwuaji SS (New)             |  | South East  | Commissioned              |  |  | Completed           | Provides Power Evacuation   |
| 49 | 330KV DC Ugwuaji-New Haven         |  | South East  | Commissioned              |  |  | Completed           | The project provides alternative path for bulk power evacuation to Enugun , and the entire South east region                  |
| 50 | 330/132/33KV Owerri SS (New)       |  | South East  |                           |  |  | Yet to be completed | The project will completed will provide power evacuation  |
| 51 | 330KV Alaoji SS (Line bay ext.)    |  | South East  | Commissioned              |  |  | Completed           | The project provides alternative path for bulk power evacuation at Alaoji , and the entire South east region                  |
| 52 | 330KV DC Owerri-Nnewi              |  | South East  | Stalled by Wayleave issue |  |  | Yet to be completed | The project when completed will provide alternative path for bulk power evacuation to Nnewi, and the entire South east region |
| 53 | 330KV DC Nnewi-Onitsha             |  | South East  | Stalled by Wayleave issue |  |  | Yet to be completed | The project when completed will provide alternative path for bulk power evacuation to Nnewi, and the entire South east region |
| 54 | 330KV Onitsha SS (Line bay ext.)   |  | South East  | April, 2015               |  |  | Yet to be completed | The project when completed will provide alternative path for bulk power evacuation at Onitsha S/S                             |
| 55 | 330KV DC Alaoji-Owerri             |  | South East  | April, 2015               |  |  | Yet to be completed | The project when completed will provide grid re-inforcement.  |
| 56 | 132/33KV Awka SS (New)             |  | South East  | April, 2016               |  |  | Yet to be completed | The project will completed will provide power evacuation  |
| 57 | 132KV DC Nnewi-Ihiala-Orlu         |  | South East  | April, 2015               |  |  | Yet to be completed | The project when completed will provide alternative path for bulk power evacuation to Ihiala, and environs.                   |
| 58 | 132/33KV Nkalagu SS (Ext.)         |  | South East  | July, 2015                |  |  | Yet to be completed | The project will completed will provide power evacuation  |
| 59 | 132KV Abakiliki SS (Ext.)          |  | South East  | July, 2015                |  |  | Yet to be completed | The project will completed will provide power evacuation  |
| 60 | 132KV DC Nkalagu-Abakiliki         |  | South East  | July, 2015                |  |  | Yet to be completed | The project when completed will provide alternative path for bulk power evacuation to Abakiliki , and environs.               |

**Annex 4.2b**  
**CLASSIFICATION OF ON-GOING TCN AND NIPP CAPITAL PROJECTS BY ZONES**  
**NIPP Projects**

|    |   |  |            |              |  |  |                     |   |
|----|---|--|------------|--------------|--|--|---------------------|---|
| 61 | 132/33KV Nsukka SS (New)                            |  | South East | July, 2015   |  |  | Yet to be completed | The project will completed will provide power evacuation  |
| 62 | 330/132/33KV New Haven North SS (Ext.)              |  | South East | July, 2015   |  |  | Yet to be completed | The project will completed will provide power evacuation  |
| 63 | 132KV New Haven North-Nsukka                        |  | South East | May, 2015    |  |  | Yet to be completed | The project when completed will provide alternative path for bulk power evacuation to Nsukka , and environs.          |
| 64 | 132/33KV Ubulusuzor (Ihiala) SS (New)               |  | South East | Dec ,2015    |  |  | Yet to be completed | The project will completed will provide power evacuation  |
| 65 | 132/33kv Orlu SS (New)                              |  | South East | June, 2015   |  |  | Yet to be completed | The project will completed will provide power evacuation  |
|    | <b>Projects In South-West Zone</b>                  |  |            |              |  |  |                     |   |
| 66 | 132KV DC Oke Aro-Alausa                             |  | South West | June, 2015   |  |  | Yet to be completed | The project when completed will provide alternative path for bulk power evacuation to Alausa , and environs.          |
| 67 | 132KV DC Oke Aro-(Ikorodu/Maryland)                 |  | South West | June, 2015   |  |  | Yet to be completed | The project when completed will provide alternative path for bulk power evacuation to Ikorodu/Maryland, and environs. |
| 68 | 132KV Alausa SS (Line bay ext.)                     |  | South West | June, 2015   |  |  | Yet to be completed | The project will completed will provide power evacuation  |
| 69 | 132/33KV Aiyede SS (Ext.)                           |  | South West | Commissioned |  |  | Completed           | The project provides power evacuation   |
| 70 | 330KV DC Ganmo-(Jebba/Osogbo SC - Turn in/Turn out) |  | South West | Commissioned |  |  | Completed           | The project provides power evacuation   |
| 71 | 132/33KV Agbara SS (Ext.)                           |  | South West | Commissioned |  |  | Completed           | The project provides power evacuation   |
| 72 | 132/33KV Ikeja West SS (Ext.)                       |  | South West | Commissioned |  |  | Completed           | The project provides power evacuation   |
| 73 | 132/33KV Ojo SS (Ext.)                              |  | South West | Commissioned |  |  | Completed           | The project provides power evacuation   |
| 74 | 132/33KV Oworonsoki SS (Ext.)                       |  | South West | Commissioned |  |  | Completed           | The project provides power evacuation   |
| 75 | 330/132KV Aja G.I.S. SS (Ext.)                      |  | South West | Commissioned |  |  | Completed           | The project provides power evacuation   |

**Annex 4.2b**  
**CLASSIFICATION OF ON-GOING TCN AND NIPP CAPITAL PROJECTS BY ZONES**

**NIPP Projects**

|    |   |  |            |              |  |  |                     |   |
|----|---|--|------------|--------------|--|--|---------------------|---|
| 76 | 132KV Aja G.I.S. SS (Ext.)                    |  | South West | Commissioned |  |  | Completed           | The project provides power evacuation   |
| 77 | 330/132/33KV Alagbon G.I.S. SS (New and Ext.) |  | South West | Oct, 2015    |  |  | Yet to be completed | The project when completed will provide power evacuation  |
| 78 | 132/33KV Lekki G.I.S. SS (New)                |  | South West | April, 2015  |  |  | Yet to be completed | The project when completed will provide power evacuation  |
| 79 | 330/132/33KV Lekki G.I.S. SS (New)            |  | South West | Nov, 2015    |  |  | Yet to be completed | The project when completed will provide power evacuation  |
| 80 | 132KV DC Otta-Ogba Junction-Papalanto         |  | South West | Dec , 2015   |  |  | Yet to be completed | The project when completed will provide alternative path for bulk power evacuation to Ogba, and environs.         |
| 81 | 132KV DC Papalanto-Old Abeokuta               |  | South West | Aug , 2015   |  |  | Yet to be completed | The project when completed will provide alternative path for bulk power evacuation to Old Abeokuta, and environs. |
| 82 | 132KV DC Old Abeokuta-New Abeokuta            |  | South West | April , 2015 |  |  | Yet to be completed | The project when completed will provide alternative path for bulk power evacuation to New Abeokuta, and environs. |
| 83 | 132KV DC Lekki-Aja                            |  | South West | April , 2015 |  |  | Yet to be completed | The project when completed will provide grid reinforcement.   |
| 84 | 132/33KV New Abeokuta SS (New)                |  | South West | June ,2015   |  |  | Yet to be completed | The project when completed will provide power evacuation  |
| 85 | 132/33KV Old Abeokuta SS (New)                |  | South West | Aug ,2015    |  |  | Yet to be completed | The project when completed will provide power evacuation  |
| 86 | 132/33KV Papalanto SS (Ext.)                  |  | South West | Aug ,2015    |  |  | Yet to be completed | The project when completed will provide power evacuation  |
| 87 | 132/33KV Otta SS (Ext.)                       |  | South West | Sept , 2015  |  |  | Yet to be completed | The project when completed will provide power evacuation  |
| 88 | 330/132KV Papalanto SS (New)                  |  | South West | Commissioned |  |  | Completed           | The project provides power evacuation   |
| 89 | 330KV DC Papalanto-(Ikeja West/Ayede)         |  | South West | Commissioned |  |  | Completed           | The project provides grid reinforcement and bulk power evacuation to Ikeja West, and environs.                    |
| 90 |   |  | South West | Commissioned |  |  | Completed           | The project provides power evacuation   |
| 91 | 330/132KV Omotosho SS (New)                   |  | South West | Commissioned |  |  | Completed           | The project provides power evacuation   |

**Annex 4.2b**  
**CLASSIFICATION OF ON-GOING TCN AND NIPP CAPITAL PROJECTS BY ZONES**

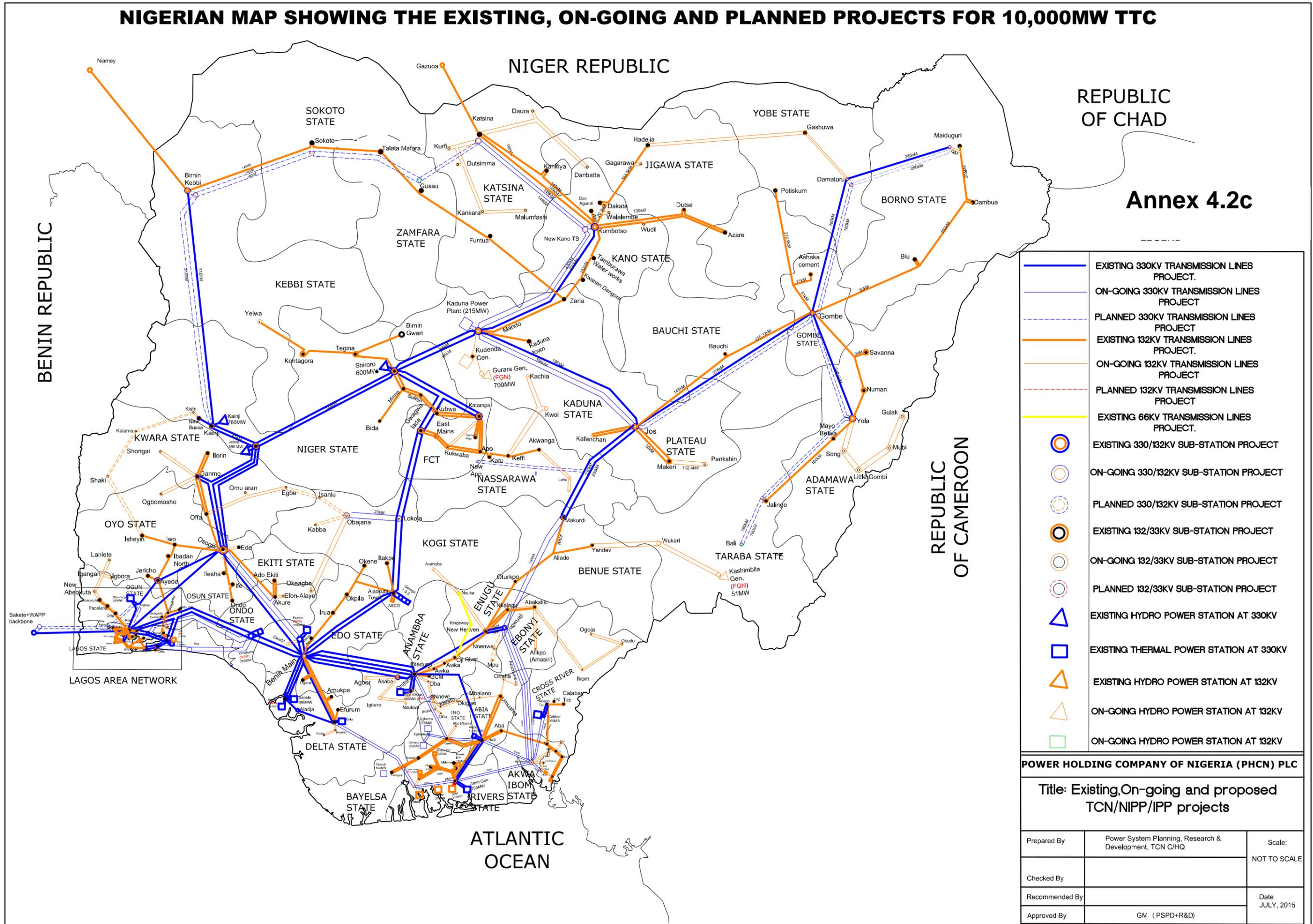
**NIPP Projects**

|     |   |  |               |              |  |  |                     |   |
|-----|---|--|---------------|--------------|--|--|---------------------|---|
| 92  | 330KV DC Omotosho - Ikeja West                      |  | South West    | Commissioned |  |  | Completed           | The project provides grid reinforcement and bulk power evacuation to Ikeja West, and environs.  |
|     | <b>Projects In North Central Zone</b>               |  |               |              |  |  |                     |   |
| 93  | 330KV DC Makurdi-Jos                                |  | North Central | Commissioned |  |  | Completed           | The project provides grid reinforcement and bulk power evacuation to Jos , and entire North-west and North-east regions.                          |
| 94  | 330/132/33KV Makurdi SS (New)                       |  | North Central | Commissioned |  |  | Completed           | The project provides bulk power evacuation to Makurdi, and environs.  |
| 95  | 330/132KV Jos SS (Ext)                              |  | North Central | Commissioned |  |  | Completed           | The project provides bulk power evacuation to Jos, and environs.  |
| 96  |   |  | North Central |              |  |  |                     |   |
| 97  | 330KV DC Makurdi-Aliade                             |  | North Central | April, 2015  |  |  | Yet to be completed | The project when completed will provide grid reinforcement and bulk power evacuation to Aliade , and entire North-central and North-east regions. |
| 98  | 330KV DC Aliade-Ugwuaji                             |  | North Central | August, 2015 |  |  | Yet to be completed | The project when completed will provide grid reinforcement and bulk power evacuation to Aliade , and entire North-central and South-east regions. |
| 99  | 330/132/33KV Ganmo SS (New)                         |  | North Central | Commissioned |  |  | Completed           | The project provides bulk power evacuation to Kwara state, and environs.  |
| 100 | 132KV DC Ganmo-(Ilorin/Oshogbo SC Turn in/Turn out) |  | North Central | Commissioned |  |  | Completed           | The project provides bulk power evacuation to Ilorin , and environs.  |
| 101 | 132/33KV Central Area SS (Ext.)                     |  | North Central | Commissioned |  |  | Completed           | The project provides bulk power evacuation to Central area , and environs.  |
| 102 | 330/132KV Katampe SS (Ext.)                         |  | North Central | Commissioned |  |  | Completed           | The project provides bulk power evacuation to Katampe, and environs.  |
| 103 | 330/132/33KV Gwagwalada SS (New)                    |  | North Central | Commissioned |  |  | Completed           | The project provides bulk power evacuation to Gwagwalada, and environs.   |
| 104 | 330KV DC Gwagwalada-Eastmain                        |  | North Central | Commissioned |  |  | Completed           | The project provides grid reinforcement and bulk power evacuation to East mains , and entire FCT.   |
| 105 | 132KV DC Eastmain-Kukwaba                           |  | North Central | Commissioned |  |  | Completed           | The project provides bulk power evacuation to Kukuaba.  |
| 106 | 132KV DC Kukwaba-Apo                                |  | North Central | Commissioned |  |  | Completed           | The project provides bulk power evacuation to Apo.  |

**Annex 4.2b**  
**CLASSIFICATION OF ON-GOING TCN AND NIPP CAPITAL PROJECTS BY ZONES**  
**NIPP Projects**

|     |   |  |               |              |  |  |                     |   |
|-----|---|--|---------------|--------------|--|--|---------------------|---|
| 107 | 132KV/33KV Apo SS (Ext.)                    |  | North Central | Commissioned |  |  | Completed           | The project provides bulk power evacuation to Apo, and environs.  |
| 108 | 132KV/33KV Kukwaba SS (Ext.)                |  | North Central | Commissioned |  |  | Completed           | The project provides bulk power evacuation to Kukuaba, and environs.                                      |
| 109 | 330/132/33KV Oke Aro SS (New)               |  | North Central | Commissioned |  |  | Completed           | The project provides bulk power evacuation to Oke-Aro, and environs.                                      |
| 110 | 330KV DC Oke Aro-(Oke Aro/Ikeja West/Egbin) |  | North Central | Commissioned |  |  | Completed           | The project provides grid reinforcement and bulk power evacuation to Oke-aro.                             |
| 111 | 330/132/33KV Lokoja SS (New)                |  | North Central | Dec, 2015    |  |  | Yet to be completed | The project when completed will provide bulk power evacuation to Lokoja, and entire North-central region. |
| 112 | 330KV Ajaokuta SS (Line Bay Ext.)           |  | North Central | Commissioned |  |  | Completed           | The project provides bulk power evacuation to Ajaokuta, and environs.                                     |
| 113 | 330KV DC Ajaokuta-Lokoja-Gwagwalada         |  | North Central | Commissioned |  |  | Completed           | The project provides grid reinforcement and bulk power evacuation to Ajaokuta.                            |
|     | <b>Projects In North West Zone</b>          |  |               |              |  |  |                     |   |
| 114 | 132/33KV Kumbotso SS (Ext.)                 |  | North West    | Commissioned |  |  | Completed           | The provides bulk power evacuation to Kumbotso, and environs.   |
| 115 | 330/132/33KV Mando SS (Ext.)                |  | North West    | Commissioned |  |  | Completed           | The provides bulk power evacuation to Mando, and environs.  |

# NIGERIAN MAP SHOWING THE EXISTING, ON-GOING AND PLANNED PROJECTS FOR 10,000MW TTC



REPUBLIC OF CHAD

## Annex 4.2c

- EXISTING 330KV TRANSMISSION LINES PROJECT.
- - - ON-GOING 330KV TRANSMISSION LINES PROJECT
- · - · - PLANNED 330KV TRANSMISSION LINES PROJECT
- EXISTING 132KV TRANSMISSION LINES PROJECT.
- - - ON-GOING 132KV TRANSMISSION LINES PROJECT
- · - · - PLANNED 132KV TRANSMISSION LINES PROJECT
- EXISTING 66KV TRANSMISSION LINES PROJECT.
- EXISTING 330/132KV SUB-STATION PROJECT
- ON-GOING 330/132KV SUB-STATION PROJECT
- PLANNED 330/132KV SUB-STATION PROJECT
- EXISTING 132/33KV SUB-STATION PROJECT
- ON-GOING 132/33KV SUB-STATION PROJECT
- PLANNED 132/33KV SUB-STATION PROJECT
- △ EXISTING HYDRO POWER STATION AT 330KV
- EXISTING THERMAL POWER STATION AT 330KV
- △ EXISTING HYDRO POWER STATION AT 132KV
- △ ON-GOING HYDRO POWER STATION AT 132KV
- ON-GOING HYDRO POWER STATION AT 132KV

**POWER HOLDING COMPANY OF NIGERIA (PHCN) PLC**

**Title: Existing, On-going and proposed TCN/NIPP/IPP projects**

|                |   |              |
|----------------|---|--------------|
| Prepared By    | Power System Planning, Research & Development, TCN C/HQ | Scale:       |
| Checked By     |   | NOT TO SCALE |
| Recommended By |   | Date         |
| Approved By    | GM (PSPD+R&D)   | JULY, 2015   |

## Annex 4.2d1

| <b>Proposed Abuja Transmission Ring Project to be financed by AFD</b> |               |          |                    |   |                    |
|---|---------------|----------|--------------------|---|--------------------|
| S/N   | REGION        | LOCATION | DESCRIPTION        | COST [USD]  |                    |
| <b>TRANSMISSION LINES</b>   |               |          |                    |   |                    |
| 1   | NORTH CENTRAL | ABUJA    | New Apo            | Construction of about 172km of new 330kV double circuit line from Lafia 330kV Substation (new) to the proposed New Apo 330/132/33kV Substation.   | 30,600,000         |
| 2   | NORTH CENTRAL | ABUJA    | Old Apo            | Construction of about 7km of new 132kV double circuit line from new Apo 330/132/33kV substation to Old Apo 132/33kV substation:   | 1,200,000          |
| 3   | NORTH CENTRAL | ABUJA    | Old Kuje           | Construction of 35km of new 132kV double circuit line from New Apo 330/132/33kV substation to the proposed Kuje 132/33kV substation.  | 8,700,000          |
| 4   | NORTH CENTRAL | ABUJA    | West Main Lugbe    | Construction of 29km of new 132kV double circuit line from the proposed Kuje 132/33kV Substation to West Main (Lugbe) 330/132/33V substation.   | 7,800,000          |
|   |               |          | <b>Sub-total</b>   |   | <b>48,300,000</b>  |
| <b>TRANSMISSION SUBSTATIONS</b>                                       |               |          |                    |   |                    |
| 5   | NORTH CENTRAL | ABUJA    | New Apo            | Construction of complete new 330/132/33kV substation at New Apo to be equipped with 2No.150MVA, 330/132kV transformers and 3No. 60MVA, 132/33kV transformers including 6 X 132kV line bay and 2 X 132kV line bay extension at Old Apo 132kV Substation.   | 29,800,000         |
| 6   | NORTH CENTRAL | ABUJA    | West Main Lugbe    | Construction of complete new 330/132/33kV substation at West Main (Lugbe) to be equipped with 2X150MVA, 330/132kV transformers and 3No. 60MVA, 132/33kV Transformers (with 132kV outdoor GIS Switchgear) including 2 x 330kV line bay, 4X132kV line bays. | 25,100,000         |
| 7   | NORTH CENTRAL | ABUJA    | Kuje               | Construction of complete new 132/33kV substation at Kuje to be equipped with 3No. 60MVA, 132/33kV transformers including 4 x 132kV Line Bay   | 7,700,000          |
| 8   | NORTH CENTRAL | ABUJA    | Wumba/Lokogoma     | Construction of complete new 132/33kV Substation at Wumba / Lokogoma to be equipped with 2No.60MVA, 132/33kV transformers, 2 X 132kV line bay including 5km underground 132kV XLPE Cable line, from New Apo to Wumba/Lokogoma                             | 19,900,000         |
| 9   | NORTH CENTRAL | ABUJA    | Gwarimpa           | Construction of complete new 132/33kV GIS substation at Gwarimpa to be equipped with 2No. 60MVA, 132/33kV transformers including OHL / Underground Cable termination of the existing 132KV Katampe – Suleja Transmission line.                            | 22,000,000         |
|   |               |          | <b>Sub-total</b>   |   | <b>104,500,000</b> |
|   | NORTH CENTRAL | ABUJA    | SCADA              |   | 2,000,000          |
|   | NORTH CENTRAL | ABUJA    | ERM                | Establishment of ERP in TCN for effective management of its assets  | 9,200,000          |
|   | NORTH CENTRAL | ABUJA    | Project Management | Consultancy and other Running cost  | 6,000,000          |
|   |               |          | Contingencies      |   | -                  |
|   |               |          | Contingencies      | Contingencies   | -                  |
|   |               |          | Sub-total          |   | <b>17,200,000</b>  |
|   |               |          | <b>TOTAL</b>       |   | <b>170,000,000</b> |

## Annex 4.2d2

| <b>Lagos/Ogun Transmission Project to be financed by JICA</b> |            |          |              |   |                    |
|---|------------|----------|--------------|---|--------------------|
| S/N   | REGION     | LOCATION | DESCRIPTION  | COST [USD]  |                    |
| <b>TRANSMISSION LINES</b>                                     |            |          |              |   |                    |
| 1   | SOUTH WEST | Lagos    | New Abeokuta | Arigbajo – New Abeokuta 132kV D/C Transmission Line (37.8km)                                  | 11,000,000         |
| 2   | SOUTH WEST | Lagos    | Arigbajo     | Olorunsogo – Arigbajo 330kV D/C Transmission Line (12.9km)                                    | 3,870,000          |
| 3   | SOUTH WEST | Lagos    | Ikeja West   | Arigbajo – Ikeja West / Osogbo 330kV D/C Turn in-out (5.9km)                                  | 3,120,000          |
| 4   | SOUTH WEST | Lagos    | Arigbajo     | Ogijo – Arigbajo D/C Transmission Line (43.7km)   | 3,120,000          |
| 5   | SOUTH WEST | Lagos    | Shagamu      | 132kV Quad Line (2.3km) from Ogijo – Existing Ikorodu/Shagamu 132 kV 2x D/C Transmission Line | 2,000,000          |
| 6   | SOUTH WEST | Lagos    | Redeem       | 132kV D/C Transmission Line (10.3km) from Ogijo – Redeem.                                     | 2,750,000          |
| 7   | SOUTH WEST | Lagos    | Ikeja West   | MFM – Existing Benin (Omosho)/Ikeja West 330kV 2 x D/C Transmission Line (4.2km)              | 1,200,000          |
| 8   | SOUTH WEST | Lagos    | New Agbara   | Arigbajo – New Agbara 330kV D/C Transmission Line (30.6km)                                    | 7,980,000          |
| 9   | SOUTH WEST | Lagos    | Agbara       | New Agbara – Agbara 132kv D/C Transmission Line (20.8km)                                      | 5,392,000          |
| 10  | SOUTH WEST | Lagos    | Badagry      | New Agbara – Badagry 132kv D/C Transmission Line (34.2km)                                     | 7,800,000          |
|   |            |          |              | <b>Sub-total</b>  | <b>48,232,000</b>  |
| <b>TRANSMISSION SUBSTATIONS</b>                               |            |          |              |   |                    |
| 11  | SOUTH WEST | Lagos    | Ogijo        | 2x300MVA 330/132kV + 2 x 100MVA 132/33kV Transformer capacity at Ogijo, Lagos                 | 37,000,000         |
| 12  | SOUTH WEST | Lagos    | Redeem       | 2x60MVA, 132/33kV Substation at Redeem.   | 12,500,000         |
| 13  | SOUTH WEST | Lagos    | MFM          | 2x150MVA, 330/132kV + 2x100MVA 132/33kV Substation at MFM                                     | 32,000,000         |
| 14  | SOUTH WEST | Lagos    | New Agbara   | 2x150MVA, 330/132kV + 2x100MVA 132/33kV Substation at New Agbara                              | 32,000,000         |
| 15  | SOUTH WEST | Lagos    | Badagry      | 2x60MVA, 132/33kV substation at Badagry.  | 14,500,000         |
| 16  | SOUTH WEST | Lagos    | Arigbajo     | Arigbajo +Olorunsogo+New Abeokuta line bay extensions   | 8,000,000          |
|   |            |          |              | <b>Sub-total</b>  | <b>136,000,000</b> |
|   |            |          |              | Contingencies   | 10,000,000         |
|   |            |          |              | Consultancies/Supervision   | 5,768,000          |
|   |            |          |              | <b>TOTAL</b>  | <b>200,000,000</b> |

## Annex 4.2d3

| Proposal for North East Transmission Infrastructure Project to be financed by AFDB |                             |            |  |  |                     |               |
|--|-----------------------------|------------|--|--|---------------------|---------------|
| S/N  | REGION                      | SUBSTATION | DESCRIPTION                                | COST [USD]   | Feasibility Studies |               |
| PACKAGE 1 - Substations  |                             |            |  |  |                     |               |
| Lot 1  |                             |            |  |  |                     |               |
| 1  | North East                  | Bauchi     | Manguno                                    | Construction of 2 x 60MVA 132/33kV Complete substation including 2 x 132kV Line Bay Extension at Old Maiduguri 132/33kV Substation.                                      | 7,000,000           | Not Available |
| 2  | North East                  | Bauchi     | Marte                                      | Construction of 2 x 60MVA 132/33kV Complete substation   | 7,000,000           | Not Available |
| 3  | North East                  | Bauchi     | Dikwa                                      | Construction of 1 x 60MVA 132/33kV Complete substation   | 3,500,000           | Not Available |
| 4  | North East                  | Bauchi     | Bama                                       | Construction of 2 x 60MVA 132/33kV Complete substation including 2 x 132kV Line Bay Extension at New Maiduguri 330/132kV Substation.                                     | 7,000,000           | Not Available |
| 5  | North East                  | Bauchi     | Gwoza                                      | Construction of 1 x 60MVA 132/33kV Complete substation including 2 x 132kV Line Bay Extension at Gulak 132/33kV Substation.  | 3,500,000           | Not Available |
| <b>SUB TOTAL LOT 1</b>   |                             |            |  | <b>28,000,000</b>  |                     |               |
| LOT 2  |                             |            |  |  |                     |               |
| 3  | North Central               | Bauchi     | Jada                                       | Construction of 2 x 60MVA 132/33kV Complete substation including 2 x 132kV Line Bay Extension at Mayo Belwa 330/132kV Substation.  | 7,000,000           | Not Available |
| 4  | North East                  | Bauchi     | Ganye                                      | Construction of 2 x 60MVA 132/33kV Complete substation including 2 x 132kV Line Bay Extension at Mayo Belwa 330/132kV Substation.  | 7,000,000           | Not Available |
| <b>SUB TOTAL LOT 2</b>   |                             |            |  | <b>14,000,000</b>  |                     |               |
| LOT 3  |                             |            |  |  |                     |               |
| 1  | North East                  | Bauchi     | Uba  | Construction of 2 x 60MVA 132/33kV Complete substation including 2 x 132kV Line Bay Extension at Mubi 132/33kV Substation.   | 7,000,000           | Not Available |
| 2  | North East                  | Bauchi     | Chibok                                     | Construction of 1 x 60MVA 132/33kV Complete substation   | 3,500,000           | Not Available |
| 4  | North Central               | Bauchi     | Biu  | Construction of 1x 60MVA 132/33kV Complete substation including 2 x 132kV Line Bay Extension at Biu 132/33kV Substation.   | 2,050,000           | Not Available |
| 5  | North East                  | Bauchi     | Bunyadi                                    | Construction of 1 x 60MVA 132/33kV Complete substation including 2 x 132kV Line Bay Extension each at Damaturu 330kV Substation and Biu 132/33kV Substation respectively | 3,500,000           | Not Available |
| 6  | North East                  | Bauchi     | Kwaya Kusar                                | Construction of 1 x 60MVA 132/33kV Complete substation including 2 x 132kV Line Bay Extension each at Damaturu 330kV Substation and Biu 132/33kV Substation respectively | 7,000,000           | Not Available |
| <b>SUB TOTAL LOT 3</b>   |                             |            |  | <b>23,050,000</b>  |                     |               |
| <b>TOTAL PACKAGE 1 = LOTS 1+ 2+ 3 + 4</b>  |                             |            |  |  | <b>65,050,000</b>   |               |
| PACKAGE 2 - New 132kV Double Circuit Transmission Lines                            |                             |            |  |  |                     |               |
| PACKAGE 2A   |                             |            |  |  |                     |               |
| 1  | North East                  | Bauchi     | Maiduguri - Manguno - Marte - Dikwa - Bama | Construction of a New 321km, 132kV Double Circuit Line Between Maiduguri - Manguno - Marte - Dikwa -Bama   | 45,903,000          | Not Available |
| 2  | North East                  | Bauchi     | Maiduguri - Bama - Goza - Gulak            | Construction of a New 165km, 132kV Double Circuit Line from Maiduguri - Bama - Goza - Gulak  | 23,595,000          | Not Available |
| <b>SUB TOTAL PACKAGE 2A</b>  |                             |            |  | <b>69,498,000</b>  |                     |               |
| PACKAGE 2B   |                             |            |  |  |                     |               |
| 1  | North East                  | Bauchi     | Mayo Belwa - Jada - Ganye                  | Construction of a New 78km, 132kV Double Circuit Line from Mayo Belwa - Jada - Ganye.  | 11,154,000          | Not Available |
| 2  | North East                  | Bauchi     | Biu - BuniYadi - Damaturu                  | Construction of a New 134km, 132kV Double Circuit Line from Biu - BuniYadi - Damaturu  | 19,162,000          | Not Available |
| 3  | North East                  | Bauchi     | Dambua - Chibok - Uba - Mubi               | Construction of a New 130km, 132kV Double Circuit Line from Dambua - Chibok - Uba - Mubi   | 18,590,000          | Not Available |
| <b>SUB TOTAL PACKAGE 2B</b>  |                             |            |  | <b>48,906,000</b>  |                     |               |
| <b>PACKAGE 2 = 2A + 2B</b>   |                             |            |  |  | <b>118,404,000</b>  |               |
| PACKAGE 3  |                             |            |  |  |                     |               |
| 1  | <b>Consultancy Services</b> |            |  | Project Management and Consultancy Services  | <b>4,000,000</b>    |               |
| <b>SUB TOTAL PACKAGE 3</b>   |                             |            |  | <b>4,000,000</b>   |                     |               |
|  |                             |            |  | <b>GRAND TOTAL (GOODS, WORKS, CONSULTANCY SERVICES COMPENSATION COST)</b>  | <b>187,454,000</b>  |               |
|  |                             |            |  | <b>CONTIGENCIES</b>  | <b>12,546,000</b>   |               |
|  |                             |            |  | <b>TOTAL</b>   | <b>200,000,000</b>  |               |

## Annex 4.2d4

| <b>PROPOSED NETAP PACKAGE to be financed by World Bank</b> |               |               |                    |   |                   |
|--|---------------|---------------|--------------------|---|-------------------|
| <b>SUBSTATION REINFORCEMENT AND REHABILITATION</b>         |               |               |                    |   |                   |
|  | REGION        | SUBSTATION    | SUBSTATION         | DESCRIPTION   | COST [USD]        |
| <b>Lot 1</b>   |               |               |                    |   |                   |
| 1  | North West    | Kaduna        | Kumbotso           | Reinforcement with 1 x 300MVA 330/132kV Power Transformer, High Voltage Switchgears and Associated Equipment, Replacement of Control and Relay Panel with Digital Control System  | 4,500,000         |
| 2  | North West    | Kaduna        | Dakata             | Reinforcement with 1 x 100MVA 132/33kV Power Transformer, Switchgears , Associated Equipment, Digital Control System. Supply & Installation of Additional 3 No. Feeders Bay and Rehabilitation of Control Room                          | 3,144,326         |
| 3  | North west    | Kaduna        | Kankia             | Replacement of Faulty 1 x 30MVA and Upgrading of 1 x 30MVA Transformers to 2 x 60MVA 132/33kV Transformers, High Voltage Switchgears and Associated Equipment Including Digital Control System.   | 3,960,000         |
| 4  | North west    | Kaduna        | Dan Agundi         | Reinforcement of 1 x100MVA 132/33kV Transformers, High Voltage Switchgears and Associated Equipemnt including Digital Control System and Rehabilitation of Control Room   | 2,920,000         |
| 5  | North West    | Shiroro       | Birnin Kebbi       | Reinforcement with 2 x150MVA 330/132kV and Installation of 1 x 60MVA 132/33kV Power Transformers with associated 3no. Outgoing 33kV Feeders and Rehabilitation of Control Room  | 10,715,669        |
| 5  | North Central | Shiroro       | Shiroro            | Replacement of Obsolate Control and Relay Pannels with Didital Control System, High Voltage 330kV Switchgears and Associated Equipment  | 4,840,000         |
| 6  | North Central | Shiroro       | Abuja Central Area | Upgrading of 2 x 45MVA with 2 x 100MVA 132/33kV Power Transformer, High Voltage Switchgears, Associated Equipment Including Gas Insulated Substation. Rehabilitation of Civil Structures of the Control Room and Digital Control Sytem. | 5,500,000         |
| 7  | North central | Shiroro       | Kainji             | Rehabilitation of the 330kV Substation, High Voltage Switchgears, Associated Equipment. Rehabilitation of Control Room including Digital onrol System.  | 5,500,000         |
| <b>SUB TOTAL LOT 1</b>                                     |               |               |                    |   | <b>41,079,995</b> |
|  | REGION        | SUBSTATION    | SUBSTATION         | DESCRIPTION   | COST [USD]        |
| <b>Lot 2</b>   |               |               |                    |   |                   |
| 1  | South East    | Port Harcourt | Alaoji             | Rehabilitation of 330kV Substation, 330kV Control room, Digital Control System and Replacement of High Voltage Switchgears and Associated Equipment.  | 3,905,445         |
| 2  | South East    | Port Harcourt | Aba                | Rehabilitation of 132kV Substation, 132kV Control room, Digital Control System and Replacement of High Voltage Switchgears.   | 2,750,000         |
| 3  | South East    | Port Harcourt | Port Harcourt Main | Reinforcement with 1 x 100MVA 132/33kV Power Transformers, Control Room, High Voltage Switchgears and Associated Equipment.   | 2,750,000         |
| 4  | South East    | Port Harcourt | Port Harcourt Town | Reinforcement with 1 x 100MVA 132/33kV Power Transformers, Control Room, High Voltage Switchgears and Associated Equipment.   | 2,750,000         |
| 5  | South south   | Port Harcourt | ItuTS              | Reinforcement with 1x 60MVA 132/33kV Power Transformers, High Voltage Switchgears, Associated Equipment. Rehabilitation of Control Room including Digital onrol System.   | 3,000,000         |
| 6  | South East    | Enugu         | New Haven, Enugu   | Reinforcement with 1 x 150MVA 330/132/33kV, 2 x 60MVA Transformers with Associated Equipment, Replacement of Hihg Voltage Switchgears and Rehabilitation of Control Room with Digital Control System.                                   | 10,780,000        |
| 7  | South East    | Enugu         | G C M TS, Onitsha  | Reinforcement of 1Nos. 60MVA 132/33kV Power Transformers, High Voltage Switchgears, and Associated equipment.   | 1,595,000         |
| 8  | South East    | Enugu         | Abakaliki          | Upgrade of 1x30MVA to 60MVA 132/33kV Power Transformer, High Voltage Switchgears, and Associated Equipment.   | 1,375,000         |
| 9  | South East    | Enugu         | Orji river         | Reinforcement of 1Nos. 60MVA 132/33kV power Transformers, Switchgears, associated equipment and devices.  | 1,595,000         |
| 10   | South East    | Enugu         | Ugwuaji            | Supply and Installation of 1x75MVar Reactor and 1 x 60MVA 132/33kV High Voltage Switchgears, and Associated Equipment.  | 3,300,000         |
| 11   | North Central | Enugu         | Otukpo             | Upgrading of 7.5MVA Power Transformer to 1x 60MVA 132/33kV Transformer, High Voltage Switchgears and Associated Equipment.  | 1,760,000         |
| 12   | North Central | Enugu         | Apir, Makurdi      | Reinforcement with 1x150MVA 330/132/33kV and 1x 60MVA 132/33kV Power Transformers High Voltage Switchgears and Associated Equipmnet.  | 4,950,000         |
| 13   | South East    | Enugu         | Umuahia            | Reinforcement with 100MVA 132/33kV Power Transformer and Extension of 132kV Bus with 3 No Additional Feeder Bays.   | 1,760,000         |
| <b>SUB TOTAL LOT 2</b>                                     |               |               |                    |   | <b>42,270,445</b> |
|  | REGION        | SUBSTATION    | SUBSTATION         | DESCRIPTION   | COST [USD]        |
| <b>Lot 3</b>   |               |               |                    |   |                   |
| 1  | North East    | Bauchi        | Yola               | Reinforcement with 1 x 150MVA 330/132kV and 2x 100MVA 132/33kV Power Transformers, High Voltage Switchgears, and Associated equipment with 3 No Additional Feeder Bays  | 10,450,000        |
| 2  | North East    | Bauchi        | Mayo Belwa         | Reinforcement with 1Nos. 150MVA 330/132kV power Transformers, High Voltage Switchgears, and Associated Equipment with 3 No Additional Feeder Bays   | 2,750,000         |

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| 3                      | North East    | Bauchi     | Jalingo       | Upgrading from 132kV to 330kV Substation with 1x150MVA, 330/132/33kV Power Transformers and 1 x 100MVA 132/33kV Transformer, High Voltage Swtichgears and Associated Equipment. Constuction of 330/132kV Control Room                      | 8,280,000         |
|------------------------|---------------|------------|---------------|--|-------------------|
| 4                      | North East    | Bauchi     | Damaturu      | Reinforcement with 1Nos. 150MVA 330/132kV power Transformers, High Voltage Switchgears, and Associated Equipment with 3 No Additional Feeder Bays  | 4,400,000         |
| 5                      | North East    | Bauchi     | Biu           | Reinforcement of 1 x 60MVA 132/33kV Power Transformers, High Voltage Switchgears, Associated Equipment.and Complete Rehabilitation of Substation   | 2,200,000         |
| <b>SUB TOTAL Lot 3</b> |               |            |               |  | <b>28,080,000</b> |
| REGION                 |               | SUBSTATION |               | DESCRIPTION  | COST [USD]        |
| <b>LOT 4</b>           |               |            |               |  |                   |
| 1                      | North East    | Bauchi     | Dambo         | Reinforcement of 2x 60MVA 132/33kV Power Transformers, High Voltage Switchgears, Associated Equipment.and Complete Rehabilitation of Substation  | 4,400,000         |
| 2                      | North East    | Bauchi     | Gombe         | Reinforcement with 1 x 300MVA 330/132kV and 1x 100MVA 132/33kV Transformers with High Voltage Switchgears, and Associated equipment Bus with 3 No Additional Feeder Bays.  | 9,900,000         |
| 3                      | North Central | Bauchi     | Jos TS        | Reinforcement of 1x 300MVA 330/132/33kV & 1 x 100MVA Power Transformers, 330kV High Voltage Switchgears and Associated Equipment. Rehabilitation of Civil Structures of the Control Room and Digital Control Sytem.                        | 11,000,000        |
| 4                      | North East    | Bauchi     | Maiduguri     | Reinforcement with 1Nos. 150MVA 330/132kV power Transformers, High Voltage Switchgears, and Associated Equipment with 3 No Additional Feeder Bays  | 4,400,000         |
| 5                      | North East    | Bauchi     | Bauchi        | Upgrading of 22.5MVA and 30MVA Transformers to 2X 60MVA 132/33kV Transformers, Rehabilitation of Control Room with Digital Control System and Associated High Voltage Switchgears.   | 4,015,000         |
| <b>SUB TOTAL LOT 4</b> |               |            |               |  | <b>33,715,000</b> |
| REGION                 |               | SUBSTATION |               | DESCRIPTION  | COST [USD]        |
| <b>LOT 5</b>           |               |            |               |  |                   |
| 1                      | South West    | Osogbo     | Osogbo        | Upgrading of 1x 90MVA with 1x300MVA 330/132kV and Reinforcement with 1x100MVA Power Transformers, High Voltage Switchgears and Associated Equipment and 75MX Reactor including the renovation of control room                              | 9,900,000         |
| 2                      | South West    | Osogbo     | Ilorin        | Reinforcement of 2 x100MVA 132/33kV Power Transformers, High Voltage Switchgears, and Associated Equipment. Construction of New Control Room with Digital Control System (DCS)   | 4,620,000         |
| 3                      | South West    | Osogbo     | Ondo          | Upgrading of 2x 30MVA with 2x 60MVA,132/33kV Power Transformers, Replacememnt of High Voltage Switchgears, Conversion of 6nos. 33kV Indoor to Outdoor. Rehabilitation oif Control Room with Digital Control System, and Perimeter Fencing. | 5,280,000         |
| 4                      | South South   | Benin      | Irrua         | Supply and installation of 100MVA 132/33KV power Transformer and associated Swtichgears.   | 2,420,000         |
| 5                      | South South   | Benin      | Delta IV TS   | Reinforcement with 1 x 150MVA 330/132kV Interbus Transformer, 1 x 100MVA Power Transformer, High Voltage Switchgears, and Associated Equipment. Replacement of Obsolate Control and Relay Pannels with Didital Control System              | 6,050,000         |
| 6                      | South South   | Benin      | Effurun       | Replacement of defective 1x 60MVA 132/33kV with a new 1x 100MVA 132/33KV Power Transformer, High Voltage Switchgears, and Associated Equipment with 4 No Additional Feeder Bays  | 2,200,000         |
| 7                      | South South   | Benin      | Benin TS      | Reinrcement with 1 x 150MVA 330/132kV Power Transformers and 100MVA 132/33KV Power Transformer, High Voltage Switchgears and Associated Equipment. Replacement of Obsolate Control and Relay Pannels with Didital Control System           | 6,000,000         |
| <b>SUB TOTAL LOT 5</b> |               |            |               |  | <b>36,470,000</b> |
| REGION                 |               | SUBSTATION |               | DESCRIPTION  | COST [USD]        |
| <b>LOT 6</b>           |               |            |               |  |                   |
| 1                      | Lagos Area    | Lagos      | Ijora         | Upgrading of 2 x 30MVA with 2 x 100MVA 132/33kV Rehabilitation of Civil Structures of the Control Room and Digital Control Sytem. Equipment.High Rehabilitation of Civil Structures of the Control Room and Digital Control Sytem.         | 4,950,000         |
| 2                      | Lagos Area    | Lagos      | Lekki         | Supply and installation of 1x 300MVA 330/132kV, 2 x 100MVA 132/33kV Power Transformer, High Voltage Switchgears and Associated Equipment .   | 4,950,000         |
| 3                      | Lagos Area    | Lagos      | Alagbon       | Supply and Installation of 1x 300MVA 330/132kV, 2x 100MVA 132/33kV Power Transformers, Switchgears, associated Equipment and Devices.  | 9,460,000         |
| <b>SUB TOTAL LOT 6</b> |               |            |               |  | <b>19,360,000</b> |
| REGION                 |               | SUBSTATION |               | DESCRIPTION  | COST [USD]        |
| <b>LOT 7</b>           |               |            |               |  |                   |
| 1                      | Lagos Area    | Lagos      | Alausa        | Reinforcement of 1x 100MVA 132/33kV Power Transformer, High Voltage Switchgears and Associated Equipment.  | 2,420,000         |
| 2                      | Lagos Area    | Lagos      | Akoka         | Complete Rehabilitation of the Gas Insulated Substation (GIS)  | 7,700,000         |
| 3                      | Lagos Area    | Lagos      | Amowu Odoffun | Complete Rehabilitation of the Gas Insulated Substation (GIS)  | 7,700,000         |

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|  |                                  |               |   |  |                    |
|--|----------------------------------|---------------|---|--|--------------------|
| 4  | Lagos Area                       | Lagos         | Itire   | Complete rehabilitation of the Gas Insulated Substation (GIS)  | 7,700,000          |
| 5  | Lagos Area                       | Lagos         | Otta TS   | Upgrading the 1x 30MVA and 1x40MVA with 2x 100MVA 132/33kV Power Transformers, High Voltage Switchgears and Associated Equipment.  | 4,455,000          |
| 6  | Lagos Area                       | Lagos         | Maryland  | Upgrading of 2 x 30MVA to 2 x 100MVA 132/33kV Power Transformers, High Voltage Switchgears and Associated Equipment.   | 4,950,000          |
| 7  | Lagos Area                       | Lagos         | Egbin   | Replacement of Obsolate Control and Relay Pannels with Didital Control System, Rehabilitation of Control Room , High Voltage Switchgears and Associated Equipment.   | 8,800,000          |
| <b>SUB TOTAL LOT 7</b>                                     |                                  |               |   |  | <b>43,725,000</b>  |
| <b>(PACKAGE) 1 Lots (1+2+3+4+5+6+7) =</b>                  |                                  |               |   |  | <b>244,700,440</b> |
| <b>132kV LINES RECONDUCTORING</b>                          |                                  |               |   |  |                    |
| <b>"A"</b>   |                                  |               |   |  |                    |
| 1  | South West                       | Osogbo        | Osogbo- Offa - Ganmo - Ilorin   | Reconductoring of 150km, 132kV Line Between Osogbo-Offa/Omuaran to Ganmo and Ilorin TS   | 3,149,750          |
| 2  | South West                       | Osogbo        | Ayede - Shagamu   | Reconstruction and Conversion of SC to Double Circuit of Ayede -Ajebo-Ishara-Shagamu 132kV Line (54km) and Creation of Additional Bays 132kV Line Bays at Ayede , Ajebo, Ishara and Shagamu.                     | 7,020,000          |
|  | South West                       | Osogbo        | Osogbo- lfe / Ilesha  | Reconstruction and Conversion to Double Circuit of Osogbo-lfe/Ilesha 132kV Line (39.21 km) and Osogbo-Ilesha 132kV Line <b>Tie-Off</b> (22.1km) and Creation of Additional 132kV Line Bays at Osogbo abd Ilesha. | 4,420,000          |
| 4  | South East                       | Port Harcourt | Afam - PH Main  | Reconstruction of Existing Double 132kV Line Circuit to 4 x 132kV Line Circuit Using the Same Right of Way from Afam to Port Harcourt Main (37.8km), and Creating Additional 3 x 132kV Line Bays                 | 6,804,000          |
| 5  | South East                       | Port Harcourt | PH Mian - PH Main   | Reconductoring of 132kV Double Circuit of Port Harcourt Main to Port Harcourt Town 132kV Line (6km)  | 2,310,000          |
| <b>SUB TOTAL A</b>   |                                  |               |   |  | <b>23,703,750</b>  |
| <b>"B"</b>   |                                  |               |   |  |                    |
| 1  | North West                       | Kaduna        | Kumbotso - Hadelja  | Reconductoring of Kumbotsho- Hadeji 132kV Line ( 165km)  | 4,125,000          |
| 2  | North West                       | Kaduna        | Kumbotso - Kankia   | Reconductoring of Kumbotsho- Kankia 132kV Line ( 100km)  | 2,500,000          |
| 3  | south East                       | Enugu         | Onitsha - Oji River   | Reconductoring of Onitsha- Orji 132kV Line (87km) with Turn In- Turn Out Tower at Nibo ( Agu Awka) in Awka 132kV Substation.   | 2,175,000          |
| 4  | south East                       | Enugu         | Alaoji to Aba Town  | Reconductoring of Alaoji - Aba Town Double Circuit 132kV line (8km) Including Rehabilitation of Two Nos. Towers along the Line.  | 315,000            |
| 5  | South South                      | Benin         | Irrua - Benin   | Reconductoring of Irrua - Benin 132kV line (81km)  | 4,375,000          |
| 6  | South South                      | Benin         | Irrua - Okpila  | Reconductoring of Irrua- Okpilai 132kV line (43km) .   | 1,075,000          |
| 7  | South South                      | Benin         | Okpila - Okene  | Reconductoring of Okpilai - Okene 132kV line (65km)  | 1,625,000          |
| 8  | South South                      | Benin         | Ajakuta-Okene   | Reconductoring of Ajakuta- Okene 132kV line (60km)   | 1,500,000          |
| 9  | North East                       | Bauchi        | Gombe-Biu- Damboa-Maiduguri   | Reconductering of the Entire Route Length from Gombe - Biu -Damboa - Maiduguri 132kV line of 356km Route Length  | 8,188,000          |
| <b>SUB TOTAL B</b>   |                                  |               |   |  | <b>25,878,000</b>  |
| <b>SUB TOTAL A+B</b>                                       |                                  |               |   |  | <b>49,581,750</b>  |
| <b>SUPPLY OF POWER EQUIPMENT</b>                           |                                  |               |   |  |                    |
| 1  | Supply of Power Equipment to Ojo |               |   | 3 x 150MVA,10 x100MVA, 10 x 60MVA and Earthing Transformers  | 21,400,000         |
| 2  | Additional supplies to OJO       |               |   | 330kV, 132kV and 33kv Instrument Transformers, Isolators, Circuit Breakers and Insulators  | 9,589,995          |
| <b>SUB TOTAL</b>   |                                  |               |   |  | <b>30,989,995</b>  |
| <b>SCADA PROJECT</b>                                       |                                  |               |   |  |                    |
| <b>SCADA Device</b>  |                                  |               |   |  | <b>65,000,596</b>  |
| <b>SUB TOTAL</b>   |                                  |               |   |  | <b>65,000,596</b>  |
| <b>SUPPLY AND INSTALLATION OF SVC</b>                      |                                  |               |   |  |                    |
| <b>SVC to Gombe</b>  |                                  |               |   |  | <b>14,000,000</b>  |
| <b>SUBTOTAL</b>  |                                  |               |   |  | <b>14,000,000</b>  |
| <b>CONSULTANCY SERVICES</b>                                |                                  |               |   |  |                    |
| Consultancy Services                                       |                                  |               | Consultancy Services on SCADA, SVC, Environmental and Social Related Studies, Contract Supervisions and other Studies (Such as Double Circuit Lines Quad Conductor from Bauchi - Gombe, Ugwuaji - Aliade - Makurdi - Jos, Omotosho - Akure - Oshogbo, Gashua - Hadejia - Damaturu, Delta - Benin, Benin - Omotosho, Zungeru - Shiroro, Onitsha - Aba and Kano - Kaduna) |  | <b>35,000,000</b>  |
| <b>SUB TOTAL</b>   |                                  |               |   |  | <b>35,000,000</b>  |
| <b>GRAND TOTAL (GOODS, WORKS AND CONSULTANCY SERVICES)</b> |                                  |               |   |  | <b>439,272,781</b> |
| <b>OPERATING COST</b>                                      |                                  |               |   |  | <b>7,000,000</b>   |
| <b>CONTIGENCIES</b>  |                                  |               |   |  | <b>39,727,219</b>  |
| <b>TOTAL VALUE</b>   |                                  |               |   |  | <b>486,000,000</b> |

## Annex 4.3d5

| <b>NIGERIA TRANSMISSION EXPANSION PROJECT to be financed by IDB</b> |             |                         |  |                      |                               |  |
|---|-------------|-------------------------|--|----------------------|-------------------------------|--|
| S/NO  | Region      | Station                 | SCOPE/BACKGROUND   | ESTIMATED COST [USD] | STATUS OF FEASIBILITY STUDIES |  |
| 1   | North West  | Kaduna                  | Construction of Quad 330KV on Kaduna-Kano 330KV Single DC Transmission Line            | 50,350,000           | Not Available                 |  |
| 2   | North West  | Kaduna                  | Zaria  | 19,000,000           | Not Available                 |  |
| 3   | North West  | Kaduna                  | Millenium City Kaduna  | 24,000,000           | Not Available                 |  |
| 4   | North West  | Kaduna                  | Rigasa town, Kaduna  | 7,000,000            | Not Available                 |  |
| 5   | North West  | Kaduna                  | Jaji, Kaduna   | 7,000,000            | Not Available                 |  |
| 6   | South South | Benin                   | Reconstruction of Delta to Benin 330kV Transmission Line                               | 41,650,000           | Not Available                 |  |
| 7   | South South | Port Harcourt           | Reconstruction of Alaoji to Onitsha 330kV  | 26,000,000           | Not Available                 |  |
| 8   | South South | Ahoda, Gilli and Sapele | Eviromental Impact Assessment and Resettlement Action Plan and Payment of Compensation | 1,500,000            | Not Applicable                |  |
| 9   | North East  | Bauchi                  | Eviromental Impact Assessment and Resettlement Action Plan and Payment of Compensation | 11,000,000           | Not Applicable                |  |
|   |             |                         | Project Management & Coordination  | 5,000,000            | Not Applicable                |  |
|   |             |                         | <b>SUBTOTAL</b>  | <b>192,500,000</b>   |                               |  |
|   |             |                         | <b>CONTINGENCY</b>   | <b>17,500,000</b>    |                               |  |
|   |             |                         | <b>GRAND TOTAL</b>   | <b>210,000,000</b>   |                               |  |

## Annex 4.2d6

### NORTHERN CORRIDOR TRANSMISSION PROJECT to be financed by AFD

| S/N   | REGION        |         | SUBSTATION   | DESCRIPTION  | COST [USD]         | STATUS OF FEASIBILITY STUDIES   |
|---|---------------|---------|--|--|--------------------|---|
| 1   | North West    | SHIRORO | Kainji - Birnin Kebbi 330kV Double Circuit (DC) Line (310km)           |  | 59,000,000         | Up-to-date Feasibility Studies is available. Feasibility studies was carried out by AF consult in July 2013 |
| 2   | North West    | SHIRORO | Birnin Kebbi-Sokoto 330kV Double Circuit (DC) Line (130km)             | (1) Birnin Kebbi-Sokoto 330kV DC Transmission Line on the existing 132KV Birnin-Kebbi Sokoto ROW and reconducting the existing 132kV Single circuit Birnin-Kebbi Line to double its capacity   | 22,100,000         | Brown field project. Feasibility Studies not Available  |
| 3   | North West    | Kaduna  | Katsina-Daura-Gwiwa-Minjibir-Kura (234KM)                              | Construction of length of 330kV DC Twin line between Katsina-Daura-Gwiwa-Jogana- Kura  | 39,312,000         | Green Field (partly financed through Euro 25 Million from EU)   |
| 4   | North Central | SHIRORO | Lambata (Mina-Suleja Rd)   | Turn in Turn out Mina - Suleja 132KV DC and Construction of 1 x 60MVA 132/33kV Complete substation   | 3,500,000          | Green Field   |
| 5   | North West    | SHIRORO | Fakon Sarki-Argungu  | Turn in Turn Out on Brinin Kebbi-Sokoto 132KV Line and Construction of 2 x 60MVA 132/33kV Complete substation  | 7,000,000          | Green Field   |
| 6   | North West    | SHIRORO | Yelwa- Yawuri  | Construction of 1 x 60MVA 132/33kV Complete substation and High Voltage Switchgears and Associated Equipment.  | 1,700,000          | Brown Field   |
| 7   | North Central | SHIRORO | Birnin Gwari   | Construction of 1 x 60MVA 132/33kV Complete substation and High Voltage Switchgears and Associated Equipment.  | 2,000,000          | Brown Field (Existing 33KV Substation)  |
| 8   | North West    | Kaduna  | Daura-Katsina State  | Installation of 2x150MVA 330/132/33KV Double Circuit Substation and with associated 132kV bay extension and Installation of 2x60MVA 132/33kV transformers, 6number outgoing 33kV feeder bays   | 19,000,000         | Green Field   |
| 9   | North West    | Kaduna  | Jogana-Kano  | Installation of 2x150MVA 330/132/33KV Double Circuit Substation and with associated 132kV bay extension and Installation of 2x60MVA 132/33kV transformers, 6 number outgoing 33kV feeder bays  | 19,000,000         | Green Field   |
| 10  | North West    | SHIRORO | 330kV Sokoto Transmission Substation                                   | Installation of 2x150MVA 330/132/33KV Transformers at Sokoto New 330 Double Circuit Substation and with associated 132kV bay extension and Installation of 2x60MVA 132/33kV transformers, 6number outgoing 33kV feeder bays                              | 19,000,000         | Semi-Brown Feasibility studies required   |
| 11  | North Central | SHIRORO | Shiroro –Kaduna (Mando) 330KV Lines 1 & 2 SC Transmission Lines (96km) | Reconstruction and upgrading of 2 Single Circuit 330kV Transmission Lines 1 & 2 from Shiroro PS to Mando (Kaduna) to a 2 Double Circuit, Quad conductor Shiroro-Mando (Kaduna) Transmission lines 1 and 2. The line bay extension at Mando and Shiroro   | 26,688,000         | Semi Brown field project. Feasibility Studies not Available   |
| 12  | NORTH EAST    | BAUCHI  | Bauchi 330kV Transmission Substation (2km)                             | Turn in-out of the existing 330kV SC Jos-Gombe line at Bauchi, and installation of 2x150MVA 330/132/33kV Transformers with associated 132kV bay extension and 2x60MVA 132/33kV transformers, 6number outgoing 33kV feeder bays                           | 19,000,000         | Semi green field project. Feasibility Studies not Available   |
| 13  | North Central | SHIRORO | Rehabilitation work at Kainji TS                                       | Urgent Replacement of Kainji/Jebba 330kV line 1 - 330kV Circuit Breaker at Kainji TS.  | 148,000            | Brown field project. Feasibility Studies not Applicable   |
| 14  | North Central | SHIRORO | Rehabilitation Work at Jebba TS  | Replacing the existing very old(1968) Marilli 80MVA 330/132/13.8kV, 2T1 transformer with 1x150MVA 330/132/33kV plus 1X60MVA, 132/33kV transformer and 3 number 33KV Feeder Control and protection  | 3,800,000          | Brown field project. Feasibility Studies not Applicable   |
| 15  | North Central | SHIRORO | Rehabilitation Work at Jebba TS  | Urgent Replacement of 1nos. Jebba T/S 75MX reactor 2R2 CB - that exploded.   | 235,000            | Brown field project. Feasibility Studies not Applicable   |
| 16  | North Central | SHIRORO | Rehabilitation Work at Jebba TS  | Replacement of 11nos. 330KV Circuit Breakers at Jebba 330kV Switchyard. The existing CB's are obsolete no parts and spares available.  | 160,000            | Brown field project. Feasibility Studies not Applicable   |
| 17  | North Central | SHIRORO | Rehabilitation Work at Jebba TS  | Replacement of 9 spans of Sky wire for 330kV Jebba-Osogbo lines 1 & 2 and 330kV Jebba- Ganmo line  | 15,000             | Brown field project. Feasibility Studies not Applicable   |
| 18  | North Central | SHIRORO | Rehabilitation work at Jebba Power Station Transmission Switch yard.   | Replacement of 8nos. 330KV obsolete Circuit Breakers.. The existing CB's are obsolete no parts and spares available.   | 1,200,000          | Brown field project. Feasibility Studies not Applicable   |
| 19  | North Central | SHIRORO | Rehabilitation work at Shiroro TS                                      | Replacement of 330KV obsolete hydraulic SF6, Circuit Breakers and associated motorized Isolators at Shiroro TS   | 150,000            | Brown field project. Feasibility Studies not Applicable   |
| 20  | North Central | SHIRORO | Rehabilitation work at Shiroro TS                                      | Replacement of 28 spans of Sky wire for 330kV 330kV Shiroro- Jebba line 2  | 15,000             | Brown field project. Feasibility Studies not Applicable   |
| 21  | North Central | SHIRORO | Rehabilitation work at Minna TS  | Reinforcement of Minna with 1x60MVA 132/33kV Transformer to relief the existing overloaded 1x30MVA 132/33kV Transformer with complete 132kV Bay extension and additional 3 number 33kV Feeder Control and protection panels. Control room rehabilitation | 1,800,000          | Brown field project. Feasibility Studies not Applicable   |
| 22  | North Central | SHIRORO | Rehabilitation work at Minna TS  | Replacement of 32 spans of Sky wire for 132kV Minna- Bida line   | 13,000             | Brown field project. Feasibility Studies not Applicable   |
| 23  | North Central | SHIRORO | Karu -Keffi -Akwanga 132kV Transmission line ( 103km)                  | Reconductoring of 132kV SC Karu-Keffi-Akwanga transmission Line  | 1,035,000          | Brown field project. Feasibility Studies not Applicable   |
| 24  | North Central | SHIRORO | Keffi TS Transmission Line Rehabilitation                              | Replacement of 36 spans of Sky wire for 132kV Apo-Keffi line   | 14,000             | Brown field project. Feasibility Studies not Applicable   |
| <b>SUBTOTAL</b>   |               |         |  |  | <b>245,885,000</b> |   |
| <b>CONTINGENCY</b>  |               |         |  |  | <b>21,613,000</b>  |   |
| <b>TECHNICAL ASSISTANCE AND CAPACITY DEVELOPMENT/PROJECT MANAGEMENT</b> |               |         |  |  | <b>5,000,000</b>   |   |
| <b>GRAND TOTAL</b>  |               |         |  |  | <b>272,498,000</b> |   |

## Transmission Lines - Technical Data

Annex 4.3

### Kaduna Region

#### 330kV OHL

| Node    |           | Numen- clature | Line Length (km) | Circuit Type (Sc or, Dc ) | Conductor Type | No. of Conductor per Phase | Conductor Cross-Section (mm <sup>2</sup> ) | No. of Towers | Year Built | Skywire (Status) | Rating (MVA) | +ve Sequence Impedance |                  |                     | Zero Sequence Impedance |                  |                     |
|---------|-----------|----------------|------------------|---------------------------|----------------|----------------------------|--|---------------|------------|------------------|--------------|------------------------|------------------|---------------------|-------------------------|------------------|---------------------|
| From    | To        |                |                  |                           |                |                            |  |               |            |                  |              | Resistance (Ω/km)      | Reactance (Ω/km) | Susceptance (μS/km) | Resistance (Ω/km)       | Reactance (Ω/km) | Susceptance (μS/km) |
| Shiroro | Kaduna I  | R1M            | 96               | Single Circuit            | Bison Twin     | 2                          | 350mm <sup>2</sup>                         | 110           | 1969       |                  | 777          | 0.0390                 | 0.3310           | 3.4900              | 0.2760                  | 0.9850           | 2.4900              |
| Shiroro | Kaduna II | R2M            | 96               | Single Circuit            | Bison Twin     | 2                          | 350mm <sup>2</sup>                         | 117           | 1969       |                  | 777          | 0.0390                 | 0.3310           | 3.4900              | 0.2760                  | 0.9850           | 2.4900              |
| Kaduna  | Kano      | M6N            | 250              | Single Circuit            | Bison Twin     | 2                          | 350mm <sup>2</sup>                         | 481           | 1976       |                  | 777          | 0.0390                 | 0.3310           | 3.4900              | 0.2760                  | 0.9850           | 2.4900              |
| Kaduna  | Jos       | M2S            | 197              | Single Circuit            | Bear Twin      | 2                          | 350mm <sup>2</sup>                         | 230           | 1977       |                  | 777          | 0.0390                 | 0.3310           | 3.4900              | 0.2760                  | 0.9850           | 2.4900              |

#### 132kV OHL

| Node     |               | Numen- clature       | Line Length (km) | Circuit Type (Sc or, Dc ) | Conductor Type   | No. of Conductor per Phase | Conductor Cross-Section (mm <sup>2</sup> ) | No. of Towers | Year Built | Skywire (Status) | Rating (MVA) | +ve Sequence Impedance |                  |                     | Zero Sequence Impedance |                  |                     |
|----------|---------------|----------------------|------------------|---------------------------|------------------|----------------------------|--|---------------|------------|------------------|--------------|------------------------|------------------|---------------------|-------------------------|------------------|---------------------|
| From     | To            |                      |                  |                           |                  |                            |  |               |            |                  |              | Resistance (Ω/km)      | Reactance (Ω/km) | Susceptance (μS/km) | Resistance (Ω/km)       | Reactance (Ω/km) | Susceptance (μS/km) |
| Kano     | Zaria         | Kano-Zaria           | 145              | Single Circuit            | Wolf, Single     | 1                          | 150mm <sup>2</sup>                         | 436           | 1968       |                  | 90           | 0.2220                 | 0.4181           | 2.7368              | 0.4639                  | 1.2986           | 1.7435              |
| Kano     | Hadeija       | Kano-Hadeija         | 188              | Single Circuit            | Hyena, Single    | 1                          | 100mm <sup>2</sup>                         | 470           | 1980       |                  | 65.6         | 0.2712                 | 0.4640           | 0.0701              | 0.5620                  | 1.6020           | 0.0480              |
| Kano     | Kankia        | Kano-Kankia          | 113.2            | Single Circuit            | Wolf, Single     | 1                          | 150mm <sup>2</sup>                         | 375           | 1985       |                  | 90           | 0.2220                 | 0.4181           | 2.7368              | 0.4639                  | 1.2986           | 1.7435              |
| Kankia   | Katsina       | Kankia-Katsina       | 60               | Single Circuit            | Wolf, Single     | 1                          | 150mm <sup>2</sup>                         | 194           | 1985       |                  | 90           | 0.2220                 | 0.4181           | 2.7368              | 0.4639                  | 1.2986           | 1.7435              |
| Katsina  | Gazadua       | Katsina-Gazaoa       | 43.75            | Single Circuit            | Wolf, Single     | 1                          | 150mm <sup>2</sup>                         | 140           | 1994       |                  | 90           | 0.2220                 | 0.4181           | 2.7368              | 0.4639                  | 1.2986           | 1.7435              |
| Kano     | Dan Agundi    | Kunmbotso-Dan Agundi | 8.75             | Single Circuit            | Wolf, Single     | 1                          | 150mm <sup>2</sup>                         | 28            | 1968       |                  | 90           | 0.2220                 | 0.4181           | 2.7368              | 0.4639                  | 1.2986           | 1.7435              |
| Kumbotso | Dakata        | Kunmbotso-Dakata     | 18               | Double Circuit            | Wolf, Single     | 1                          | 150mm <sup>2</sup>                         | 58            | 1080       |                  | 180          | 0.2223                 | 0.4058           | 2.8285              | 0.4591                  | 1.3263           | 1.7866              |
| Kaduna   | Kaduna town   | Kaduna-Kaduna Town   | 14               | Single Circuit            | Wolf, Single     | 1                          | 150mm <sup>2</sup>                         | 42            | 1968       |                  | 90           | 0.2220                 | 0.4181           | 2.7368              | 0.4639                  | 1.2986           | 1.7435              |
| Kaduna   | Zaria         | Kaduna-Zaria         | 72               | Single Circuit            | HI-TACSR, Single | 1                          | 160mm <sup>2</sup>                         | 271           | 1968       |                  | 161          | 0.2272                 | 0.2002           | 5.4886              |                         |                  |                     |
| Zaria    | Funtua        | Zaria-Funtua         | 70               | Single Circuit            | Wolf, Single     | 1                          | 150mm <sup>2</sup>                         | 558           | 1975       |                  | 90           | 0.2220                 | 0.4181           | 2.7368              | 0.4639                  | 1.2986           | 1.7435              |
| Funtua   | Gusau         | Funtua-Gusau         | 120              | Single Circuit            | Wolf, Single     | 1                          | 150mm <sup>2</sup>                         |               |            |                  | 90           | 0.2220                 | 0.4181           | 2.7368              | 0.4639                  | 1.2986           | 1.7435              |
| Gusau    | Talata Mafara | Gusau-Talata Mafara  | 93               | Single Circuit            | Wolf, Single     | 1                          | 150mm <sup>2</sup>                         | 366           | 1988       |                  | 90           | 0.2220                 | 0.4181           | 2.7368              | 0.4639                  | 1.2986           | 1.7435              |
| Tegina   | Birnin Gwari  | Tegina-Birnin Gwari  | 70               | Single Circuit            | Wolf, Single     | 1                          | 150mm <sup>2</sup>                         | 235           | 1989       |                  | 90           | 0.2220                 | 0.4181           | 2.7368              | 0.4639                  | 1.2986           | 1.7435              |

# Transmission Lines - Technical Data

Annex 4.3

## Osogbo Region

**330kV OHL**

| Node   |         | Numen- clature |     | Circuit Type (Sc or, Dc ) |            | No. of Conductor per Phase |                    | No. of Towers |      | Skywire (Status) |     | +ve Sequence Impedance |       |                     |       |                  |      |
|--------|---------|----------------|-----|---------------------------|------------|----------------------------|--------------------|---------------|------|------------------|-----|------------------------|-------|---------------------|-------|------------------|------|
| From   |         |                |     |                           |            |                            |                    |               |      |                  |     | Resistance (Ω/km)      |       | Susceptance (μS/km) |       | Reactance (Ω/km) |      |
| Osogbo | Ayede   | H2A            | 119 | Single Circuit            | Bison Twin | 2                          | 350mm <sup>2</sup> | 234           | 1968 |                  | 777 | 0.039                  | 0.331 | 3.49                | 0.276 | 0.985            | 2.49 |
| Jebba  | Osogbo  | J1H            | 157 | Single Circuit            | Bison Twin | 2                          | 350mm <sup>2</sup> | 170           | 1968 |                  | 777 | 0.039                  | 0.331 | 3.49                | 0.276 | 0.985            | 2.49 |
| Jebba  | Osogbo  | J2H            | 157 | Single Circuit            | Bison Twin | 2                          | 350mm <sup>2</sup> | 184           | 1976 |                  | 777 | 0.039                  | 0.331 | 3.49                | 0.276 | 0.985            | 2.49 |
| Jebba  | Ganmo   | J3G            | 70  | Single Circuit            | Bison Twin | 2                          | 350mm <sup>2</sup> |               |      |                  | 777 | 0.039                  | 0.331 | 3.49                | 0.276 | 0.985            | 2.49 |
| Ganmo  | Osogbo  | H3G            | 87  | Single Circuit            | Bison Twin | 2                          | 350mm <sup>2</sup> |               |      |                  | 777 | 0.039                  | 0.331 | 3.49                | 0.276 | 0.985            | 2.49 |
| Osogbo | Ihobvor | H7V            | 226 | Single Circuit            | Bison Twin | 2                          | 350mm <sup>2</sup> |               |      |                  | 777 | 0.039                  | 0.331 | 3.49                | 0.276 | 0.985            | 2.49 |

0.335      2

**132kV OHL**

| Node         |              | Numen- clature   | Line Length (km) | Circuit Type (Sc or, Dc ) | Conductor Type  | No. of Conductor per Phase | Conductor Cross-Section (mm <sup>2</sup> ) | No. of Towers | Year Built | Skywire (Status) | Rating (MVA) | +ve Sequence Impedance |                  |                     | Zero Sequence Impedance |                  |                     |
|--------------|--------------|------------------|------------------|---------------------------|-----------------|----------------------------|--|---------------|------------|------------------|--------------|------------------------|------------------|---------------------|-------------------------|------------------|---------------------|
| From         | To           |                  |                  |                           |                 |                            |  |               |            |                  |              | Resistance (Ω/km)      | Reactance (Ω/km) | Susceptance (μS/km) | Resistance (Ω/km)       | Reactance (Ω/km) | Susceptance (μS/km) |
| Ganmo        | Ilorin       | Ganmo-Ilorin     | 10.5             | Single Circuit            | Hyena, single   | 1                          | 100mm <sup>2</sup>                         | 63            |            |                  |              | 0.2712                 | 0.4640           | 0.0701              | 0.5620                  | 1.6020           | 0.0480              |
| Ganmo        | Offa         | Ganmo-Offa       | 44.73            | Double Circuit            |                 | 1                          | 100mm <sup>2</sup>                         | 267           |            |                  |              |                        |                  |                     |                         |                  |                     |
| Offa         | Osogbo       | Offa-Osogbo      | 47.6             | Single Circuit            | Hyena, single   | 1                          | 100mm <sup>2</sup>                         | 284           |            |                  | 65.6         | 0.2712                 | 0.4640           | 0.0701              | 0.5620                  | 1.6020           | 0.0480              |
| Osogbo       | Iwo road     | Osogbo-Iwo road  | 80               | Single Circuit            | Hyena, single   | 1                          | 100mm <sup>2</sup>                         | 478           |            |                  | 65.6         | 0.2712                 | 0.4640           | 0.0701              | 0.5620                  | 1.6020           | 0.0480              |
| Iwo road     | Isheyin      | Iwo-Isheyin      | 91               | Single Circuit            | Wolf, Single    | 1                          | 150mm <sup>2</sup>                         | 543           |            |                  | 90           | 0.2220                 | 0.4181           | 2.7368              | 0.4639                  | 1.2986           | 1.7435              |
| Iwo road     | Ibadan North | Iwo-Ibadan North | 36               | Single Circuit            | Wolf, Single    | 1                          | 150mm <sup>2</sup>                         | 215           |            |                  | 90           | 0.2220                 | 0.4181           | 2.7368              | 0.4639                  | 1.2986           | 1.7435              |
| Ibadan North | Aiyede       | Ibadan-Aiyede    | 14               | Single Circuit            | Wolf, Single    | 1                          | 150mm <sup>2</sup>                         | 84            |            |                  | 90           | 0.2220                 | 0.4181           | 2.7368              | 0.4639                  | 1.2986           | 1.7435              |
| Aiyede       | Jericho road | Ayede-Jericho    | 6                | Single Circuit            | Wolf, Single    | 1                          | 150mm <sup>2</sup>                         | 36            |            |                  | 90           | 0.2220                 | 0.4181           | 2.7368              | 0.4639                  | 1.2986           | 1.7435              |
| Osogbo       | Ilesha       | Osogbo-Ilesha    | 17               | Single Circuit            | Wolf, Single    | 1                          | 150mm <sup>2</sup>                         | 101           |            |                  | 90           | 0.2220                 | 0.4181           | 2.7368              | 0.4639                  | 1.2986           | 1.7435              |
| Ilesha       | Ife          | Ilesha-Ife       | 19               | Single Circuit            | Wolf, Single    | 1                          | 150mm <sup>2</sup>                         | 113           |            |                  | 90           | 0.2220                 | 0.4181           | 2.7368              | 0.4639                  | 1.2986           | 1.7435              |
| Ife          | Ondo         | Ife-Ondo         | 58               | Single Circuit            | Wolf, Single    | 1                          | 150mm <sup>2</sup>                         | 346           |            |                  | 90           | 0.2220                 | 0.4181           | 2.7368              | 0.4639                  | 1.2986           | 1.7435              |
| Osogbo       | Akure        | Osogbo-Akure     | 200              | Single Circuit            | Hyena, single   | 1                          | 100mm <sup>2</sup>                         | 1194          |            |                  | 65.6         | 0.2712                 | 0.4640           | 0.0701              | 0.5620                  | 1.6020           | 0.0480              |
| Akure        | Ado Ekiti    | Akure-Ado Ekiti  | 35               | Double Circuit            | Panther, Double | 1                          | 250mm <sup>2</sup>                         | 209           |            |                  | 192.5        | 0.1363                 | 0.3920           | 4.0312              | 0.3150                  | 1.3490           | 1.3511              |

## Transmission Lines - Technical Data

Annex 4.3

### Lagos Region

**330kV OHL**

| Node       |            | Numen-<br>clature | Line<br>Length<br>(km) | Circuit Type<br>(Sc or, Dc ) | Conductor<br>Type | No. of<br>Conductor<br>per Phase | Conductor Cross<br>Section (mm2) | No. of<br>Towers | Year Built | Skywire<br>(Status) | Rating<br>(MVA) | +ve Sequence Impedance |                     |                        | Zero Sequence Impedance |                     |                        |
|------------|------------|-------------------|------------------------|------------------------------|-------------------|----------------------------------|----------------------------------|------------------|------------|---------------------|-----------------|------------------------|---------------------|------------------------|-------------------------|---------------------|------------------------|
| From       | To         |                   |                        |                              |                   |                                  |                                  |                  |            |                     |                 | Resistance<br>(Ω/km)   | Reactance<br>(Ω/km) | Susceptance<br>(μS/km) | Resistance<br>(Ω/km)    | Reactance<br>(Ω/km) | Susceptance<br>(μS/km) |
| Benin      | Egbin      | B6N               | 218                    | Single Circuit               | Bison Twin        | 2                                | 350mm <sup>2</sup>               |                  | 1978       |                     | 777             | 0.0390                 | 0.3310              | 3.4900                 | 0.2760                  | 0.9850              | 2.4900                 |
| Egbin      | Ikeja West | N6W               | 62                     | Single Circuit               | Bison Twin        | 2                                | 350mm <sup>2</sup>               |                  |            |                     | 777             | 0.0390                 | 0.3310              | 3.4900                 | 0.2760                  | 0.9850              | 2.4900                 |
| Benin      | Omotosho   | B5M               | 120                    | Single Circuit               | Bison Twin        | 2                                | 350mm <sup>2</sup>               |                  |            |                     | 777             | 0.0390                 | 0.3310              | 3.4900                 | 0.2760                  | 0.9850              | 2.4900                 |
| Omotosho   | Ikeja West | M5W &             | 160                    | Single Circuit               | Bison Twin        | 2                                | 350mm <sup>2</sup>               |                  |            |                     | 777             | 0.0390                 | 0.3310              | 3.4900                 | 0.2760                  | 0.9850              | 2.4900                 |
| Egbin      | Oke Aro    | N7K &<br>Ngk      | 55.8                   | Double Circuit               | Bison Twin        | 2                                | 350mm <sup>2</sup>               | 124              | 1980       |                     | 1554            | 0.0394                 | 0.3030              | 3.8120                 | 0.2614                  | 1.0019              | 2.2773                 |
| Oke Aro    | Ikeja West | K7W<br>K6W        | 27.9                   | Double Circuit               | Bison Twin        | 2                                | 350mm <sup>2</sup>               |                  | 2012       |                     | 1554            | 0.0394                 | 0.3030              | 3.8120                 | 0.2614                  | 1.0019              | 2.2773                 |
| Egbin      | Aja        | N3J&N4J           | 15                     | Double Circuit               | Bison Twin        | 2                                | 350mm <sup>2</sup>               | 32               | 1984       |                     | 1554            | 0.0394                 | 0.3030              | 3.8120                 | 0.2614                  | 1.0019              | 2.2773                 |
| Ikeja West | Akangba    | W3L&W4            | 17.34                  | Single Circuit               | Bison Twin        | 2                                | 350mm <sup>2</sup>               | 36               | 1968       |                     | 777             | 0.0390                 | 0.3310              | 3.4900                 | 0.2760                  | 0.9850              | 2.4900                 |
| Osogbo     | Ikeja West | H1W               | 256.67                 | Single Circuit               | Bison Twin        | 2                                | 350mm <sup>2</sup>               | 552              | 1975       |                     | 777             | 0.0390                 | 0.3310              | 3.4900                 | 0.2760                  | 0.9850              | 2.4900                 |
| Ikeja West | Olorunsogo | R1W               | 77                     | Single Circuit               | Bison Twin        | 2                                | 350mm <sup>2</sup>               |                  |            |                     | 777             | 0.0390                 | 0.3310              | 3.4900                 | 0.2760                  | 0.9850              | 2.4900                 |
| Olorunsogo | Ayede      | R2A               | 60                     | Single Circuit               | Bison Twin        | 2                                | 350mm <sup>2</sup>               |                  |            |                     | 777             | 0.0390                 | 0.3310              | 3.4900                 | 0.2760                  | 0.9850              | 2.4900                 |
| Ayede      | Osogbo     | H2A               | 119                    | Single Circuit               | Bison Twin        | 2                                | 350mm <sup>2</sup>               |                  |            |                     | 777             | 0.0390                 | 0.3310              | 3.4900                 | 0.2760                  | 0.9850              | 2.4900                 |

**132kV OHL**

| Node        |             | Numen-<br>clature | Line<br>Length<br>(km) | Circuit Type<br>(Sc or, Dc ) | Conductor<br>Type | No. of<br>Conductor<br>per Phase | Conductor Cross<br>Section (mm2) | No. of<br>Towers | Year Built | Skywire<br>(Status) | Rating<br>(MVA) | +ve Sequence Impedance |                     |                        | Zero Sequence Impedance |                     |                        |
|-------------|-------------|-------------------|------------------------|------------------------------|-------------------|----------------------------------|----------------------------------|------------------|------------|---------------------|-----------------|------------------------|---------------------|------------------------|-------------------------|---------------------|------------------------|
| From        | To          |                   |                        |                              |                   |                                  |                                  |                  |            |                     |                 | Resistance<br>(Ω/km)   | Reactance<br>(Ω/km) | Susceptance<br>(μS/km) | Resistance<br>(Ω/km)    | Reactance<br>(Ω/km) | Susceptance<br>(μS/km) |
| Aja         | Alagbon     |                   | 26                     | Double Circuit               | Bear, Double      | 2                                | 250mm <sup>2</sup>               | 69               | 1985       |                     | 242             | 0.0666                 | 0.2728              | 4.2237                 | 0.3034                  | 1.1932              | 2.3160                 |
| Ikeja West  | Oworonshiki |                   | 49                     | Double Circuit               | Bear, single      | 1                                | 250mm <sup>2</sup>               | 107              | 1982       |                     | 242             | 0.1328                 | 0.4000              | 2.8750                 | 0.3806                  | 1.2824              | 1.9266                 |
| Oworonshiki | Akoka       |                   | 4                      | Double Circuit               | Bear, single      | 1                                | 250mm <sup>2</sup>               | 11               | 1982       |                     | 242             | 0.1328                 | 0.4000              | 2.8750                 | 0.3806                  | 1.2824              | 1.9266                 |
| Akoka       | Alagbon     |                   | 12.7                   | Double Circuit               | Bear, single      | 1                                | 250mm <sup>2</sup>               | 38               | 1982       |                     | 242             | 0.1328                 | 0.4000              | 2.8750                 | 0.3806                  | 1.2824              | 1.9266                 |
| Akangba     | Amuwo       |                   | 5                      | Double Circuit               | Bear, single      | 1                                | 250mm <sup>2</sup>               | 28               | 1977       |                     | 242             | 0.1328                 | 0.4000              | 2.8750                 | 0.3806                  | 1.2824              | 1.9266                 |
| Amuwo       | Ojo         |                   | 12.5                   | Double Circuit               | Bear, single      | 1                                | 250mm <sup>2</sup>               | 46               | 1977       |                     | 242             | 0.1328                 | 0.4000              | 2.8750                 | 0.3806                  | 1.2824              | 1.9266                 |
| Akangba     | Apapa Road  |                   | 8.3                    | Double Circuit               | Wolf, Twin        | 2                                | 150mm <sup>2</sup>               | 24               | 1968       |                     | 180             | 0.1113                 | 0.2809              | 4.0947                 | 0.3481                  | 1.2013              | 2.2723                 |
| Ijora       | Akangba     |                   | 8.3                    | Double Circuit               | Wolf, Twin        | 2                                | 150mm <sup>2</sup>               | 18               | 1968       |                     | 180             | 0.1113                 | 0.2809              | 4.0947                 | 0.3481                  | 1.2013              | 2.2723                 |
| Ayede       | Shagamu     |                   | 53.91                  | Single Circuit               | Wolf, Single      | 1                                | 150mm <sup>2</sup>               | 355              | 1958       |                     | 90              | 0.2220                 | 0.4181              | 2.7368                 | 0.4639                  | 1.2986              | 1.7435                 |
| Shagamu     | Ijebu Ode   |                   | 40.32                  | Single Circuit               | Bear, Single      | 1                                | 250mm <sup>2</sup>               | 114              | 1982       |                     | 121             | 0.1328                 | 0.3895              | 2.9432                 | 0.2504                  | 1.0133              | 1.6979                 |
| Ogba        | Papalanto   |                   | 44.28                  | Single Circuit               | Wolf, Single      | 1                                | 150mm <sup>2</sup>               | 125              | 1966       |                     | 90              | 0.2220                 | 0.4181              | 2.7368                 | 0.4639                  | 1.2986              | 1.7435                 |

## Transmission Lines - Technical Data

Annex 4.3

### Lagos Region

| Node       |            | Numen-<br>clature | Line<br>Length<br>(km) | Circuit Type<br>(Sc or, Dc ) | Conductor<br>Type | No. of<br>Conductor<br>per Phase | Conductor Cross<br>Section (mm <sup>2</sup> ) | No. of<br>Towers | Year Built  | Skywire<br>(Status) | Rating<br>(MVA) | +ve Sequence Impedance |                     |                        | Zero Sequence Impedance |                     |                        |
|------------|------------|-------------------|------------------------|------------------------------|-------------------|----------------------------------|---|------------------|-------------|---------------------|-----------------|------------------------|---------------------|------------------------|-------------------------|---------------------|------------------------|
| From       | To         |                   |                        |                              |                   |                                  |   |                  |             |                     |                 | Resistance<br>(Ω/km)   | Reactance<br>(Ω/km) | Susceptance<br>(μS/km) | Resistance<br>(Ω/km)    | Reactance<br>(Ω/km) | Susceptance<br>(μS/km) |
| Ikeja West | Agbara     |                   | 32.04                  | Double Circuit               | Bear, Single      | 1                                | 250mm <sup>2</sup>                            | 89               | 1988        |                     | 242             | 0.1328                 | 0.4000              | 2.8750                 | 0.3806                  | 1.2824              | 1.9266                 |
| Ikeja West | Alimosho   |                   | 18.36                  | Double Circuit               | Bear, Single      | 1                                | 250mm <sup>2</sup>                            | 51               | 1976        |                     | 242             | 0.1328                 | 0.4000              | 2.8750                 | 0.3806                  | 1.2824              | 1.9266                 |
| Ikeja West | Ejigbo     |                   | 13.32                  | Double Circuit               | Bear, Single      | 1                                | 250mm <sup>2</sup>                            | 34               | 1975        |                     | 242             | 0.1328                 | 0.4000              | 2.8750                 | 0.3806                  | 1.2824              | 1.9266                 |
| Ikeja West | Otta       |                   | 11.88                  | Double Circuit               | Bear, Single      | 1                                | 250mm <sup>2</sup>                            | 34               | 1989        |                     | 242             | 0.1328                 | 0.4000              | 2.8750                 | 0.3806                  | 1.2824              | 1.9266                 |
| Otta       | Papalanto  |                   | 11.88                  | Double Circuit               | Bear, Single      | 1                                | 250mm <sup>2</sup>                            | 34               | 1989        |                     | 242             | 0.1328                 | 0.4000              | 2.8750                 | 0.3806                  | 1.2824              | 1.9266                 |
| Egbin GS   | Ikorodu    |                   | 19.96                  | Double Circuit               | Bear, Single      | 1                                | 250mm <sup>2</sup>                            | 55               | 1987        |                     | 242             | 0.1328                 | 0.4000              | 2.8750                 | 0.3806                  | 1.2824              | 1.9266                 |
| Ikorodu    | Egbin      |                   | 19.5                   | Double Circuit               | Bear, Single      | 1                                | 250mm <sup>2</sup>                            | 79               | 1995        |                     | 242             | 0.1328                 | 0.4000              | 2.8750                 | 0.3806                  | 1.2824              | 1.9266                 |
| Ikorodu    | Shagamu    |                   | 35.16                  | Single, Circuit              | Wolf, Single      | 1                                | 250mm <sup>2</sup>                            | 192              | 1968        |                     | 180             | 0.2220                 | 0.3943              | 2.7878                 | 0.4625                  | 1.3128              | 1.5533                 |
| Agbara     | Ojo        |                   | 16.37                  | Single Circuit               | Bear, Single      | 1                                | 250mm <sup>2</sup>                            | 62               | 1989        |                     | 121             | 0.1328                 | 0.3895              | 2.9432                 | 0.2504                  | 1.0133              | 1.6979                 |
| Akangba    | Itire      |                   | 3                      | Double Circuit               | Bear, Single      | 1                                | 250mm <sup>2</sup>                            | 30               | 1975        |                     | 242             | 0.1328                 | 0.4000              | 2.8750                 | 0.3806                  | 1.2824              | 1.9266                 |
| Itire      | Ejigbo     |                   | 8                      | Double Circuit               | Bear, Single      | 1                                | 250mm <sup>2</sup>                            |                  |             |                     | 242             | 0.1328                 | 0.4000              | 2.8750                 | 0.3806                  | 1.2824              | 1.9266                 |
| Ejigbo     | Ikeja West |                   | 13                     | Double Circuit               | Bear, Single      | 1                                | 250mm <sup>2</sup>                            |                  |             |                     | 242             | 0.1328                 | 0.4000              | 2.8750                 | 0.3806                  | 1.2824              | 1.9266                 |
| Akangba    | Isolo      |                   | 9                      | Double Circuit               | Wolf, Single      | 1                                | 150mm <sup>2</sup>                            | 34               | 1968        |                     | 180             | 0.2223                 | 0.4058              | 2.8285                 | 0.4591                  | 1.3263              | 1.7866                 |
| Ikeja West | Ilupeju,   |                   | 17                     | Double Circuit               | Bear, single      | 1                                | 250mm <sup>2</sup>                            | 97               | 1996 (1-86) |                     | 242             | 0.1328                 | 0.4000              | 2.8750                 | 0.3806                  | 1.2824              | 1.9266                 |
| Ilupeju    | Maryland   |                   | 3                      | Double Circuit               | Wolf, single      | 1                                | 150mm <sup>2</sup>                            |                  |             |                     | 180             | 0.2220                 | 0.4181              | 2.7368                 | 0.4639                  | 1.2986              | 1.7435                 |
| Maryland   | Ikorodu    |                   | 20                     | Double Circuit               | Bear, single      | 1                                | 250mm <sup>2</sup>                            |                  |             |                     | 242             | 0.1328                 | 0.4000              | 2.8750                 | 0.3806                  | 1.2824              | 1.9266                 |
| Papalanto  | Abeokuta   |                   | 35                     | Single Circuit               | Bear, Single      | 1                                | 250mm <sup>2</sup>                            | 101              | 1980        |                     | 121             | 0.1328                 | 0.3895              | 2.9432                 | 0.2504                  | 1.0133              | 1.6979                 |
| Alimosho   | Ogba       |                   | 19                     | Double Circuit               | Bear, Single      | 1                                | 250mm <sup>2</sup>                            | 65               | 1976        |                     | 242             | 0.1328                 | 0.4000              | 2.8750                 | 0.3806                  | 1.2824              | 1.9266                 |
| Ayede      | Jericho    |                   | 2                      | Single Circuit               | Wolf, Single      | 1                                | 150mm <sup>2</sup>                            |                  |             |                     | 90              | 0.2220                 | 0.4181              | 2.7368                 | 0.4639                  | 1.2986              | 1.7435                 |
| Ogba       | Alausa     |                   | 7.5                    | Double Circuit               | Bear, Single      | 1                                | 250mm <sup>2</sup>                            | 30               | 1999        |                     | 242             | 0.1328                 | 0.4000              | 2.8750                 | 0.3806                  | 1.2824              | 1.9266                 |
| Osogbo     | Ilorin     |                   | 78.46                  | Single Circuit               | Wolf, Single      | 1                                | 150mm <sup>2</sup>                            | 284              | 1976        |                     | 90              | 0.2220                 | 0.4181              | 2.7368                 | 0.4639                  | 1.2986              | 1.7435                 |
| Osogbo     | Omuaran    |                   | 47.53                  | Single Circuit               | Wolf, Single      | 1                                | 150mm <sup>2</sup>                            | 164              | 1977        |                     | 90              | 0.2220                 | 0.4181              | 2.7368                 | 0.4639                  | 1.2986              | 1.7435                 |
| Osogbo     | Ayede      |                   | 37.15                  | Single Circuit               | Bear, Single      | 1                                | 250mm <sup>2</sup>                            | 61               | 1977        |                     | 121             | 0.1328                 | 0.4019              | 2.8523                 | 0.3746                  | 1.2824              | 1.7896                 |
| Osogbo     | Ife        |                   | 33.13                  | Single Circuit               | Wolf, Single      | 1                                | 150mm <sup>2</sup>                            | 113              | 1981        |                     | 90              | 0.2220                 | 0.4181              | 2.7368                 | 0.4639                  | 1.2986              | 1.7435                 |
| Ife        | Ondo       |                   | 58.05                  | Single Circuit               | Wolf, Single      | 1                                | 150mm <sup>2</sup>                            | 198              | 1984        |                     | 90              | 0.2220                 | 0.4181              | 2.7368                 | 0.4639                  | 1.2986              | 1.7435                 |
| Osogbo     | Illesa     |                   | 16.4                   | Single Circuit               | Wolf, Single      | 1                                | 150mm <sup>2</sup>                            | 64               | 1999        |                     | 90              | 0.2220                 | 0.4181              | 2.7368                 | 0.4639                  | 1.2986              | 1.7435                 |
| Osogbo     | Akure      |                   | 95                     | Single Circuit               | Wolf, Single      | 1                                | 150mm <sup>2</sup>                            | 366              | 1999        |                     | 90              | 0.2220                 | 0.4181              | 2.7368                 | 0.4639                  | 1.2986              | 1.7435                 |

## Transmission Lines - Technical Data

Annex 4.3

### Shiroro Region

#### 330kV Circuit

| Node       |                    | Numen-<br>clature    | Line Length<br>(km) | Circuit Type (Sc<br>or, Dc ) | Conductor Type   | No. of<br>Conduct<br>or per<br>Phase | Conductor<br>Cross-Section<br>(mm <sup>2</sup> ) | No. of<br>Towers | Year<br>Built | Skywire<br>(Status) | Rating<br>(MVA) | +ve Sequence Impedance |                     |                        | Zero Sequence Impedance |                     |                        |
|------------|--------------------|----------------------|---------------------|------------------------------|------------------|--------------------------------------|--|------------------|---------------|---------------------|-----------------|------------------------|---------------------|------------------------|-------------------------|---------------------|------------------------|
| From       | To                 |                      |                     |                              |                  |                                      |  |                  |               |                     |                 | Resistance<br>(Ω/km)   | Reactance<br>(Ω/km) | Susceptance<br>(μS/km) | Resistance<br>(Ω/km)    | Reactance<br>(Ω/km) | Susceptance<br>(μS/km) |
| Shiroro    | Kaduna             | R1M                  | 96                  | Single Circuit               | Bison Twin       | 2                                    | 350mm <sup>2</sup>                               | 225              | 1969          |                     | 777             | 0.0390                 | 0.3310              | 3.4900                 | 0.2760                  | 0.9850              | 2.4900                 |
| Shiroro    | Kaduna             | R2M                  | 96                  | Single Circuit               | Bison Twin       | 2                                    | 350mm <sup>2</sup>                               | 225              | 1969          |                     | 777             | 0.0390                 | 0.3310              | 3.4900                 | 0.2760                  | 0.9850              | 2.4900                 |
| Jebba      | Shiroro            | J3R                  | 230.43              | Single Circuit               | Bear Twin (Lion) | 2                                    | 250mm <sup>2</sup>                               | 557              | 1969          |                     | 240             | 0.0390                 | 0.3310              | 3.4900                 | 0.2760                  | 0.9850              | 2.4900                 |
| Jebba      | Shiroro            | J7R                  | 230.43              | Single Circuit               | Bear Twin (Lion) | 2                                    | 250mm <sup>2</sup>                               | 581              | 1969          |                     | 240             | 0.0390                 | 0.3310              | 3.4900                 | 0.2760                  | 0.9850              | 2.4900                 |
| Kainji GS  | Jebba              | K2J &                | 81                  | Single Circuit               | Bear Twin (Lion) | 2                                    | 250mm <sup>2</sup>                               | 183              | 1969          |                     | 240             | 0.0390                 | 0.3310              | 3.4900                 | 0.2760                  | 0.9850              | 2.4900                 |
| Kainji GS  | Jebba              | Kainji –<br>Jebba II | 81                  | Single Circuit               | Bear Twin (Lion) | 2                                    | 250mm <sup>2</sup>                               | 189              | 1979          |                     | 240             | 0.0390                 | 0.3310              | 3.4900                 | 0.2760                  | 0.9850              | 2.4900                 |
| Jebba GS   | Jebba TS           | B8J                  | 8                   | Double Circuit               | Bear Twin (Lion) | 2                                    | 250mm <sup>2</sup>                               | 12               | 1984          |                     | 480             | 0.0394                 | 0.3030              | 3.8120                 | 0.2614                  | 1.0019              | 2.2773                 |
| Jebba GS   | Jebba TS           | B9J                  | 8                   | Double Circuit               | Bear Twin (Lion) | 2                                    | 250mm <sup>2</sup>                               | 12               | 1984          |                     | 480             | 0.0394                 | 0.3030              | 3.8120                 | 0.2614                  | 1.0019              | 2.2773                 |
| Jebba      | Osogbo             | J1H                  | 157                 | Single Circuit               | Bison Twin       | 2                                    | 350mm <sup>2</sup>                               | 182              | 1968          |                     | 777             | 0.0390                 | 0.3310              | 3.4900                 | 0.2760                  | 0.9850              | 2.4900                 |
| Jebba      | Osogbo             | J2H                  | 157                 | Single Circuit               | Bison Twin       | 2                                    | 350mm <sup>2</sup>                               | 189              | 1976          |                     | 777             | 0.0390                 | 0.3310              | 3.4900                 | 0.2760                  | 0.9850              | 2.4900                 |
| Jebba      | Ganmo              | J3G                  | 70                  | Single Circuit               | Bison Twin       | 2                                    | 350mm <sup>2</sup>                               |                  |               |                     | 777             | 0.0390                 | 0.3310              | 3.4900                 | 0.2760                  | 0.9850              | 2.4900                 |
| Oshogbo    | Ganmo              | H3G                  | 83.81               | Single Circuit               | Bison Twin       | 2                                    | 350mm <sup>2</sup>                               | 182              | 1984          |                     | 777             | 0.0390                 | 0.3310              | 3.4900                 | 0.2760                  | 0.9850              | 2.4900                 |
| Kainji     | Birnin Kebbi       | K3R                  | 310                 | Single Circuit               | Bear Twin (Lion) | 2                                    | 250mm <sup>2</sup>                               | 734              | 1976          |                     | 240             | 0.0390                 | 0.3310              | 3.4900                 | 0.2760                  | 0.9850              | 2.4900                 |
| Shiroro    | Abuja<br>(Katampe) | R4B                  | 144                 | Single Circuit               | Bison Twin       | 2                                    | 350mm <sup>2</sup>                               | 345              | 2003          |                     | 777             | 0.0390                 | 0.3310              | 3.4900                 | 0.2760                  | 0.9850              | 2.4900                 |
| Shiroro    | Gwagwalada         | R5G                  | 144                 | Single Circuit               | Bison Twin       | 2                                    | 350mm <sup>2</sup>                               | 345              |               |                     | 777             | 0.0390                 | 0.3310              | 3.4900                 | 0.2760                  | 0.9850              | 2.4900                 |
| Gwagwalada | Katampe            | G5B                  | 60                  | Single Circuit               | Bison Twin       | 2                                    | 350mm <sup>2</sup>                               |                  |               |                     | 777             | 0.0390                 | 0.3310              | 3.4900                 | 0.2760                  | 0.9850              | 2.4900                 |
| Gwagwalada | Eastmain           |                      | 42                  | Double Circuit               | Bison Twin       | 2                                    | 350mm <sup>2</sup>                               | 133              | 2013          |                     | 1554            | 0.0394                 | 0.3030              | 3.8120                 | 0.2614                  | 1.0019              | 2.2773                 |

#### 132kV Circuit

| Node    |        | Numen-<br>clature | Line Length<br>(km) | Circuit Type (Sc<br>or, Dc ) | Conductor Type | No. of<br>Conduct<br>or per<br>Phase | Conductor<br>Cross-Section<br>(mm <sup>2</sup> ) | No. of<br>Towers | Year<br>Built | Skywire<br>(Status) | Rating<br>(MVA) | +ve Sequence Impedance |                     |                        | Zero Sequence Impedance |                     |                        |
|---------|--------|-------------------|---------------------|------------------------------|----------------|--------------------------------------|--|------------------|---------------|---------------------|-----------------|------------------------|---------------------|------------------------|-------------------------|---------------------|------------------------|
| From    | To     |                   |                     |                              |                |                                      |  |                  |               |                     |                 | Resistance<br>(Ω/km)   | Reactance<br>(Ω/km) | Susceptance<br>(μS/km) | Resistance<br>(Ω/km)    | Reactance<br>(Ω/km) | Susceptance<br>(μS/km) |
| Shiroro | Minna  | Shiroro-<br>Minna | 68                  | Double Circuit               | Wolf, Single   | 1                                    | 150mm <sup>2</sup>                               | 187              | 1981          |                     | 180             | 0.2223                 | 0.4058              | 2.8285                 | 0.4591                  | 1.3263              | 1.7866                 |
| Minna   | Suleja | Minna-<br>Suleja  | 99                  | Double Circuit               | Wolf, Single   | 1                                    | 150mm <sup>2</sup>                               | 283              | 1981          |                     | 180             | 0.2223                 | 0.4058              | 2.8285                 | 0.4591                  | 1.3263              | 1.7866                 |

## Transmission Lines - Technical Data

Annex 4.3

### Shiroro Region

| Node         |               | Numen-<br>clature           | Line Length<br>(km) | Circuit Type (Sc<br>or, Dc ) | Conductor Type  | No. of<br>Conduct<br>or per<br>Phase | Conductor<br>Cross-Section<br>(mm <sup>2</sup> ) | No. of<br>Towers | Year<br>Built | Skywire<br>(Status) | Rating<br>(MVA) | +ve Sequence Impedance |                     |                        | Zero Sequence Impedance |                     |                        |
|--------------|---------------|-----------------------------|---------------------|------------------------------|-----------------|--------------------------------------|--|------------------|---------------|---------------------|-----------------|------------------------|---------------------|------------------------|-------------------------|---------------------|------------------------|
| From         | To            |                             |                     |                              |                 |                                      |  |                  |               |                     |                 | Resistance<br>(Ω/km)   | Reactance<br>(Ω/km) | Susceptance<br>(μS/km) | Resistance<br>(Ω/km)    | Reactance<br>(Ω/km) | Susceptance<br>(μS/km) |
| Suleja       | Katampe       | Suleja-<br>Abuja            | 55                  | Double Circuit               | Wolf, Single    | 1                                    | 150mm <sup>2</sup>                               | 158              | 1981          |                     | 180             | 0.2223                 | 0.4058              | 2.8285                 | 0.4591                  | 1.3263              | 1.7866                 |
| Karu         | Keffi         | Abuja-<br>Keffi             | 67                  | Single Circuit               | Wolf, Single    | 1                                    | 150mm <sup>2</sup>                               | 156              | 1983          |                     | 90              | 0.2220                 | 0.4181              | 2.7368                 | 0.4639                  | 1.2986              | 1.7435                 |
| Tegina       | Birnin gwari  | Tegina-<br>Birnin<br>Gwari  | 80                  | Single Circuit               | Wolf, Single    | 1                                    | 150mm <sup>3</sup>                               | 236              | 1990          |                     | 90              | 0.2220                 | 0.4181              | 2.7368                 | 0.4639                  | 1.2986              | 1.7435                 |
| Keffi        | Akwanga       | Keffi-<br>Akwanga           | 62.5                | Single Circuit               | Wolf, Single    | 1                                    | 150mm <sup>2</sup>                               | 178              | 1983          |                     | 90              | 0.2220                 | 0.4181              | 2.7368                 | 0.4639                  | 1.2986              | 1.7435                 |
| Akwanga      | Lafia         | Akwanga-<br>Lafia           | 60                  | Double Circuit               | Bear, Double    | 1                                    | 250mm <sup>2</sup>                               |                  |               |                     | 242             | 0.1328                 | 0.4000              | 2.8750                 | 0.3806                  | 1.2824              | 1.9266                 |
| Shiroro      | Tegina        | Shiroro-<br>Tegina          | 90                  | Single Circuit               | Wolf, Single    | 1                                    | 150mm <sup>2</sup>                               | 272              | 1990          |                     | 180             | 0.2220                 | 0.4181              | 2.7368                 | 0.4639                  | 1.2986              | 1.7435                 |
| Birnin Kebbi | Niamey        | Birnin<br>Kebbi-<br>Niamey  | 250                 | Single Circuit               | Wolf, Single    | 1                                    | 150mm <sup>2</sup>                               | 159              | 1976          |                     | 90              | 0.2220                 | 0.4181              | 2.7368                 | 0.4639                  | 1.2986              | 1.7435                 |
| Birnin Kebbi | Sokoto        | Birnin<br>Kebbi-<br>Sokoto  | 130                 | Single Circuit               | Wolf, Single    | 1                                    | 150mm <sup>2</sup>                               | 405              | 1976          |                     | 90              | 0.2220                 | 0.4181              | 2.7368                 | 0.4639                  | 1.2986              | 1.7435                 |
| Sokoto       | Talata Mafara | Sokoto-<br>Talata<br>Mafara | 142                 | Single Circuit               | Wolf, Single    | 1                                    | 150mm <sup>2</sup>                               | 441              | 1990          |                     | 90              | 0.2220                 | 0.4181              | 2.7368                 | 0.4639                  | 1.2986              | 1.7435                 |
| Minna        | Bida          | Minna-<br>Bida              | 78.38               | Single Circuit               | Wolf, Single    | 1                                    | 150mm <sup>2</sup>                               | 288              | 1990          |                     | 90              | 0.2220                 | 0.4181              | 2.7368                 | 0.4639                  | 1.2986              | 1.7435                 |
| Tegina       | Kontagora     | Tegina<br>Kotangora         | 84.44               | Single Circuit               | Wolf, Single    | 1                                    | 150mm <sup>2</sup>                               | 266              | 1990          |                     | 90              | 0.2220                 | 0.4181              | 2.7368                 | 0.4639                  | 1.2986              | 1.7435                 |
| Eastmain     | Kukwaba       | East-<br>Kukwaba            | 24                  | Double Circuit               | Bear, Single    | 1                                    | 250mm <sup>2</sup>                               |                  |               |                     | 242             | 0.1328                 | 0.4000              | 2.8750                 | 0.3806                  | 1.2824              | 1.9266                 |
| Katampe      | Kukwaba       | Katampe-<br>Kukwaba         | 8.9                 | Double Circuit               | Cu/XLPE, Single | 1                                    | 400mm <sup>2</sup>                               |                  | 2012          |                     | 141             | 0.0470                 | 0.1413              | 50.272                 | 0.1410                  | 0.4239              | 16.74686               |
| Kukwaba      | Apo           | Kukwaba-<br>Apo             | 24                  | Double Circuit               | Bear, Single    | 1                                    | 250mm <sup>2</sup>                               | 93               | 2012          |                     | 242             | 0.1328                 | 0.4000              | 2.8750                 | 0.3806                  | 1.2824              | 1.9266                 |
| Apo          | Katampe       | Apo-<br>Katampe             | 25                  | Double Circuit               | Bear, Single    | 1                                    | 250mm <sup>2</sup>                               |                  |               |                     | 242             | 0.1328                 | 0.4000              | 2.8750                 | 0.3806                  | 1.2824              | 1.9266                 |
| Katampe      | Central Area  | Katampe-<br>Central<br>Area | 15                  | Double Circuit               | Bear, Single    | 1                                    | 250mm <sup>2</sup>                               |                  |               |                     | 242             | 0.1328                 | 0.4000              | 2.8750                 | 0.3806                  | 1.2824              | 1.9266                 |
| Karu         | Apo           | Karu-Apo                    | 10                  | Single Circuit               | Bear, Single    | 1                                    | 250mm <sup>2</sup>                               |                  |               |                     | 121             | 0.1328                 | 0.3895              | 2.9432                 | 0.2504                  | 1.0133              | 1.6979                 |
| Eastmain     | Kukwaba       | Eastmain-<br>Kukwaba        | 24                  | Double Circuit               | Bear, Single    | 1                                    | 250mm <sup>2</sup>                               | 112              | 2013          |                     | 242             | 0.1328                 | 0.4000              | 2.8750                 | 0.3806                  | 1.2824              | 1.9266                 |

## Transmission Lines - Technical Data

Annex 4.3

### Benin Region

#### 330kV OHL

| Node                |                     | Numen-<br>clature | Line<br>Length<br>(km) | Circuit Type<br>(Sc or, Dc ) | Conductor<br>Type | No. of<br>Conductor<br>per Phase | Conductor<br>Cross-Section<br>(mm <sup>2</sup> ) | No. of<br>Towers | Year Built | Skywire<br>(Status) | Rating<br>(MVA) | +ve Sequence Impedance |                     |                        | Zero Sequence Impedance |                     |                        |
|---------------------|---------------------|-------------------|------------------------|------------------------------|-------------------|----------------------------------|--|------------------|------------|---------------------|-----------------|------------------------|---------------------|------------------------|-------------------------|---------------------|------------------------|
| From                | To                  |                   |                        |                              |                   |                                  |  |                  |            |                     |                 | Resistance<br>(Ω/km)   | Reactance<br>(Ω/km) | Susceptance<br>(μS/km) | Resistance<br>(Ω/km)    | Reactance<br>(Ω/km) | Susceptance<br>(μS/km) |
| Benin               | Onitsha             | B1T & B2T         | 137                    | Double Circuit               | Bison Twin        | 2                                | 350mm <sup>2</sup>                               | 155              | 1964       |                     | 1554            | 0.0394                 | 0.3030              | 3.8120                 | 0.2614                  | 1.0019              | 2.2773                 |
| Benin               | Omotosho<br>Phase I | B5M               | 120                    | Single Circuit               | Bison Twin        | 2                                | 350mm <sup>2</sup>                               |                  |            |                     | 777             | 0.039                  | 0.3310              | 3.4900                 | 0.2760                  | 0.9850              | 2.4900                 |
| Omotosho<br>Phase I | Ikeja West          | M5W               | 160                    | Single Circuit               | Bison Twin        | 2                                | 350mm <sup>2</sup>                               |                  | 2014       |                     | 777             | 0.039                  | 0.3310              | 3.4900                 | 0.2760                  | 0.9850              | 2.4900                 |
| Benin               | Egbin G.S           | B6N               | 218                    | Single Circuit               | Bison Twin        | 2                                | 350mm <sup>2</sup>                               |                  |            |                     | 777             | 0.039                  | 0.3310              | 3.4900                 | 0.2760                  | 0.9850              | 2.4900                 |
| Osogbo              | Ihovbor NIPP        | H7V               | 251                    | Single Circuit               | Bison Twin        | 2                                | 350mm <sup>2</sup>                               |                  |            |                     | 777             | 0.039                  | 0.3310              | 3.4900                 | 0.2760                  | 0.9850              | 2.4900                 |
| Ihovbor NIPP        | Benin               | V7B               | 17.7                   | Single Circuit               | Bison Twin        | 2                                | 350mm <sup>2</sup>                               | 51               | 2013       |                     | 777             | 0.039                  | 0.3310              | 3.4900                 | 0.2760                  | 0.9850              | 2.4900                 |
| Benin               | Ajaokuta            | B11J & B12J       | 205.15                 | Double Circuit               | Bison Twin        | 2                                | 350mm <sup>2</sup>                               | 446              | 1981       |                     | 1554            | 0.0394                 | 0.3030              | 3.8120                 | 0.2614                  | 1.0019              | 2.2773                 |
| Sapele              | Aladja              | S4G               | 61.25                  | Single Circuit               | Bison Twin        | 2                                | 350mm <sup>2</sup>                               | 145              | 1983       |                     | 777             | 0.039                  | 0.3310              | 3.4900                 | 0.2760                  | 0.9850              | 2.4900                 |
| Delta GS            | Benin               | G3B               | 52.65                  | Single Circuit               | Bison Twin        | 2                                | 350mm <sup>2</sup>                               | 118              | 1985       |                     | 777             | 0.039                  | 0.3310              | 3.4900                 | 0.2760                  | 0.9850              | 2.4900                 |
| Delta GS            | Aladja              | G1W               | 29.5                   | Double Circuit               | Bison Twin        | 2                                | 350mm <sup>2</sup>                               | 27               | 1983       |                     | 1554            | 0.0394                 | 0.3030              | 3.8120                 | 0.2614                  | 1.0019              | 2.2773                 |
| Sapele              | Benin               | S3B & S4B         | 52.65                  | Double Circuit               | Bison Twin        | 2                                | 350mm <sup>2</sup>                               | 118              | 1983       |                     | 1554            | 0.0394                 | 0.3030              | 3.8120                 | 0.2614                  | 1.0019              | 2.2773                 |
| Sapele              | Benin               | S5B               | 52.65                  | Double Circuit               | Bison Twin        | 2                                | 350mm <sup>2</sup>                               | 118              | 1983       |                     | 1554            | 0.0394                 | 0.3030              | 3.8120                 | 0.2614                  | 1.0019              | 2.2773                 |
| Lokoja              | Gwagwalada          | L6G               | 160                    | Single Circuit               | Bison Twin        | 2                                | 350mm <sup>2</sup>                               |                  | 2013       |                     | 777             | 0.039                  | 0.3310              | 3.4900                 | 0.2760                  | 0.9850              | 2.4900                 |
| Ajaokuta            | Geregu              | R1J               | 80                     | Single Circuit               | Bison Twin        | 2                                | 350mm <sup>2</sup>                               |                  | 2013       |                     | 777             | 0.039                  | 0.3310              | 3.4900                 | 0.2760                  | 0.9850              | 2.4900                 |
| Ajaokuta            | Geregu              | R2J               | 80                     | Single Circuit               | Bison Twin        | 2                                | 350mm <sup>2</sup>                               |                  | 2013       |                     | 777             | 0.039                  | 0.3310              | 3.4900                 | 0.2760                  | 0.9850              | 2.4900                 |
| Ajaokuta            | Lokoja              | J1L&J2L           | 38                     | Double Circuit               | Bison Twin        | 2                                | 350mm <sup>2</sup>                               |                  |            |                     | 1554            | 0.0394                 | 0.3030              | 3.8120                 | 0.2614                  | 1.0019              | 2.2773                 |

#### 132kV OHL

| Node     |         | Numen-<br>clature | Line<br>Length<br>(km) | Circuit Type<br>(Sc or, Dc ) | Conductor<br>Type | No. of<br>Conductor<br>per Phase | Conductor<br>Cross-Section<br>(mm <sup>2</sup> ) | No. of<br>Towers | Year Built                          | Skywire<br>(Status) | Rating<br>(MVA) | +ve Sequence Impedance |                     |                        | Zero Sequence Impedance |                     |                        |
|----------|---------|-------------------|------------------------|------------------------------|-------------------|----------------------------------|--|------------------|-------------------------------------|---------------------|-----------------|------------------------|---------------------|------------------------|-------------------------|---------------------|------------------------|
| From     | To      |                   |                        |                              |                   |                                  |  |                  |                                     |                     |                 | Resistance<br>(Ω/km)   | Reactance<br>(Ω/km) | Susceptance<br>(μS/km) | Resistance<br>(Ω/km)    | Reactance<br>(Ω/km) | Susceptance<br>(μS/km) |
| Delta GS | Benin   | Delta-Benin       | 102.41                 | Single circuit               | Bear,<br>Single   | 1                                | 250mm <sup>2</sup>                               | 331              | Built 1966;<br>Refurbishe<br>d 2001 |                     | 121             | 0.1328                 | 0.3895              | 2.9432                 | 0.2504                  | 1.0133              | 1.6979                 |
| Delta GS | Benin   | Delta-Benin       | 102.41                 | Double Circuit               | Bear,<br>Single   | 1                                | 250mm <sup>2</sup>                               | 331              | Built 1966;<br>Refurbishe<br>d 2001 |                     | 242             | 0.1330                 | 0.3897              | 2.9523                 | 0.3698                  | 1.3101              | 1.8392                 |
| Benin    | Irrua   | Benin-Irrua       | 81                     | Single Circuit               | Wolf,<br>Single   | 1                                | 150mm <sup>2</sup>                               |                  |                                     |                     | 90              | 0.2220                 | 0.4181              | 2.7368                 | 0.4639                  | 1.2986              | 1.7435                 |
| Irrua    | Ukpilla | Irrua-Ukpilla     | 43                     | Single Circuit               | Wolf,<br>Single   | 1                                | 150mm <sup>2</sup>                               |                  |                                     |                     | 90              | 0.2220                 | 0.4181              | 2.7368                 | 0.4639                  | 1.2986              | 1.7435                 |

## Transmission Lines - Technical Data

Annex 4.3

### Benin Region

| Node     |                         | Numen-<br>clature             | Line<br>Length<br>(km) | Circuit Type<br>(Sc or, Dc ) | Conductor<br>Type | No. of<br>Conductor<br>per Phase | Conductor<br>Cross-Section<br>(mm <sup>2</sup> ) | No. of<br>Towers | Year Built | Skywire<br>(Status) | Rating<br>(MVA) | +ve Sequence Impedance |                     |                        | Zero Sequence Impedance |                     |                        |
|----------|-------------------------|-------------------------------|------------------------|------------------------------|-------------------|----------------------------------|--|------------------|------------|---------------------|-----------------|------------------------|---------------------|------------------------|-------------------------|---------------------|------------------------|
| From     | To                      |                               |                        |                              |                   |                                  |  |                  |            |                     |                 | Resistance<br>(Ω/km)   | Reactance<br>(Ω/km) | Susceptance<br>(μS/km) | Resistance<br>(Ω/km)    | Reactance<br>(Ω/km) | Susceptance<br>(μS/km) |
| Ukpilla  | Okene                   | Ukpilla-<br>Okene             | 33                     | Single Circuit               | Wolf,<br>Single   | 1                                | 150mm <sup>2</sup>                               |                  |            |                     | 90              | 0.2220                 | 0.4181              | 2.7368                 | 0.4639                  | 1.2986              | 1.7435                 |
| Okene    | Ajaokuta                | Okene-<br>Ajaokuta            | 60                     | Single Circuit               | Wolf,<br>Single   | 1                                | 150mm <sup>2</sup>                               | 172              | 1973       |                     | 90              | 0.2220                 | 0.4181              | 2.7368                 | 0.4639                  | 1.2986              | 1.7435                 |
| Okene    | Itakpe                  | Tee-off/Itakpe                | 41.7                   | Single Circuit               | Wolf,<br>Single   | 1                                | 150mm <sup>2</sup>                               | 50               | 1992       |                     | 90              | 0.2220                 | 0.4181              | 2.7368                 | 0.4639                  | 1.2986              | 1.7435                 |
| Delta II | Effurun                 | Delta-Efurun                  | 32.04                  | Single circuit               | Wolf, single      | 1                                | 150mm <sup>2</sup>                               | 89               | 1988       |                     | 90              | 0.2220                 | 0.4181              | 2.7368                 | 0.4639                  | 1.2986              | 1.7435                 |
| Ajaokuta | Itakpe                  | Ajaokuta-<br>Itakpe           | 45                     | Single Circuit               | Wolf,<br>Single   | 1                                | 150mm <sup>2</sup>                               | 19               | 1992       |                     | 90              | 0.2220                 | 0.4181              | 2.7368                 | 0.4639                  | 1.2986              | 1.7435                 |
| Ajaokuta | Ajaokuta<br>Steel Works | Ajaokuta-<br>Steel Works      | 3.9                    | Single Circuit               | Wolf,<br>Single   | 1                                | 150mm <sup>2</sup>                               | 13               | 1992       |                     | 90              | 0.2220                 | 0.4181              | 2.7368                 | 0.4639                  | 1.2986              | 1.7435                 |
| Ajaokuta | Ajaokuta<br>Town        | ajaokuta-<br>Ajaokuta<br>Town | 10                     | Single Circuit               | Wolf,<br>Single   | 1                                | 150mm <sup>2</sup>                               |                  |            |                     | 90              | 0.2220                 | 0.4181              | 2.7368                 | 0.4639                  | 1.2986              | 1.7435                 |

## Transmission Lines - Technical Data

Annex 4.3

### Port Harcourt Region

#### 330kV OHL

| Node       |            | Numen- clature | Line Length (km) | Circuit Type (Sc or, Dc ) | Conductor Type | No. of Conductor per Phase | Conductor Cross-Section (mm2) | No. of Towers | Year Built | Skywire (Status) | Rating (MVA) | +ve Sequence Impedance |                  |                     | Zero Sequence Impedance |                  |                     |
|------------|------------|----------------|------------------|---------------------------|----------------|----------------------------|-------------------------------|---------------|------------|------------------|--------------|------------------------|------------------|---------------------|-------------------------|------------------|---------------------|
| From       | To         |                |                  |                           |                |                            |                               |               |            |                  |              | Resistance (Ω/km)      | Reactance (Ω/km) | Susceptance (μS/km) | Resistance (Ω/km)       | Reactance (Ω/km) | Susceptance (μS/km) |
| Afam       | Alaoji     | F1A & F2A      | 28.8             | Double Circuit            | Bison Twin     | 2                          | 350mm <sup>2</sup>            | 65            | 1980       |                  | 1554         | 0.0394                 | 0.3030           | 3.8120              | 0.2614                  | 1.0019           | 2.2773              |
| Onitsha    | Alaoji     | T4A            | 138              | Single Circuit            | Bison Twin     | 2                          | 350mm <sup>2</sup>            | 306           | 1982       |                  | 777          | 0.0390                 | 0.3310           | 3.4900              | 0.2760                  | 0.9850           | 2.4900              |
| Calabar PS | Calabar SS |                | 17.7             | Double Circuit            | Bison Twin     | 2                          | 350mm <sup>2</sup>            | 43            | 2013       |                  | 1554         | 0.0394                 | 0.3030           | 3.8120              | 0.2614                  | 1.0019           | 2.2773              |

#### 132kV OHL

| Node               |                    | Numen- clature          | Line Length (km) | Circuit Type (Sc or, Dc ) | Conductor Type   | No. of Conductor per Phase | Conductor Cross-Section (mm2) | No. of Towers | Year Built | Skywire (Status) | Rating (MVA) | +ve Sequence Impedance |                  |                     | Zero Sequence Impedance |                  |                     |
|--------------------|--------------------|-------------------------|------------------|---------------------------|------------------|----------------------------|-------------------------------|---------------|------------|------------------|--------------|------------------------|------------------|---------------------|-------------------------|------------------|---------------------|
| From               | To                 |                         |                  |                           |                  |                            |                               |               |            |                  |              | Resistance (Ω/km)      | Reactance (Ω/km) | Susceptance (μS/km) | Resistance (Ω/km)       | Reactance (Ω/km) | Susceptance (μS/km) |
| Alaoji             | Aba                | Alaoji-Aba              | 7.7              | Double Circuit            | Wolf, Single     | 1                          | 150mm <sup>2</sup>            | 23            | 1960       |                  | 180          | 0.2223                 | 0.4058           | 2.8285              | 0.4591                  | 1.3263           | 1.7866              |
| Afam GS            | Alaoji             | Afam-Alaoji             | 28.7             | Double Circuit            | HI-TACSR, Single | 1                          | 160mm <sup>2</sup>            | 83            | 1960       |                  | 322          | 0.2681                 | 0.2002           | 5.4886              |                         |                  |                     |
| Afam GS            | Port-Harcourt Main | Afam-Port Harcourt Main | 37.8             | Double Circuit            | HI-TACSR, Single | 1                          | 160mm <sup>2</sup>            | 109           | 1960       |                  | 322          | 0.2681                 | 0.2002           | 5.4886              |                         |                  |                     |
| Port-Harcourt Main | Port-Harcourt Town | PH Mains-PH Town        | 3                | Double Circuit            | Wolf, Single     | 1                          | 150mm <sup>2</sup>            |               |            |                  | 180          | 0.2223                 | 0.4058           | 2.8285              | 0.4591                  | 1.3263           | 1.7866              |
| Trans Amadi        | Ahoada             | Trans Amadi-Ahoada      |                  | Double Circuit            |                  | 1                          |                               |               |            |                  |              |                        |                  |                     |                         |                  |                     |
| Aba                | Itu                | Aba-Itu                 | 85.4             | Single Circuit            | Wolf, Single     | 1                          | 150mm <sup>2</sup>            | 245           | 1986       |                  | 90           | 0.2220                 | 0.4181           | 2.7368              | 0.4639                  | 1.2986           | 1.7435              |
| Uyo                | Eket               | Itu-Eket                | 74.55            | Single Circuit            | ZTACIR, Single   | 1                          | 189.1mm <sup>2</sup>          | 214           | 2012       |                  | 188          | 0.2898                 | 0.3168           | 3.4688              |                         |                  |                     |
| Uyo                | Itu                | Uyo-Itu                 | 18               | Single Circuit            | ZTACIR, Single   | 1                          | 189.1mm <sup>2</sup>          |               | 2012       |                  | 188          | 0.2898                 | 0.3168           | 3.4688              |                         |                  |                     |
| Itu                | Calabar            | Itu-Calabar             | 47.36            | Single Circuit            | Wolf, Single     | 1                          | 150mm <sup>2</sup>            | 156           | 1986       |                  | 90           | 0.2220                 | 0.4181           | 2.7368              | 0.4639                  | 1.2986           | 1.7435              |
| Alaoji             | Owerri             | Alaoji-Owerri           | 60               | Double Circuit            | Wolf, Single     | 1                          | 150mm <sup>2</sup>            | 175           | 1983       |                  | 180          | 0.2223                 | 0.4058           | 2.8285              | 0.4591                  | 1.3263           | 1.7866              |
| Owerri             | Ahoada             | Owerri-Ahoada           | 73               | Double Circuit            | Bear, Single     | 1                          | 250mm <sup>2</sup>            | 219           | 2005       |                  | 242          | 0.1328                 | 0.4000           | 2.8750              | 0.3806                  | 1.2824           | 1.9266              |
| Aba                | Alaoji             | Aba-Alaoji              | 15               | Double Circuit            | Bear, Single     | 1                          | 250mm <sup>2</sup>            |               |            |                  | 242          | 0.1328                 | 0.4000           | 2.8750              | 0.3806                  | 1.2824           | 1.9266              |
| Alaoji             | Umuahia            | Alaoji-Umuahia          | 50               | Double Circuit            | Bear, Single     | 1                          | 250mm <sup>2</sup>            |               |            |                  | 242          | 0.1328                 | 0.4000           | 2.8750              | 0.3806                  | 1.2824           | 1.9266              |
| Alaoji             | Owerri             | Alaoji-Owerri           | 10               | Double Circuit            | Panther, Single  | 1                          | 250mm <sup>2</sup>            |               |            |                  | 380          | 0.1363                 | 0.3920           | 4.0312              | 0.3150                  | 1.3490           | 1.35106             |
| Ahoada             | Yenagoa            | Ahoada-Yenagoa          | 40               | Double, Circuit           | Panther, Single  | 1                          | 250mm <sup>2</sup>            |               |            |                  | 380          | 0.1363                 | 0.3920           | 4.0312              | 0.3150                  | 1.3490           | 1.35106             |
| IBOM G.S           | Eket               | Ibom-Eket               | 45               | Double, Circuit           | Poplar, single   | 1                          | 200mm <sup>2</sup>            |               |            |                  | 136.7        | 0.1800                 | 0.2060           | 5.3348              |                         |                  |                     |

## Transmission Lines - Technical Data

Annex 4.3

### Enugu Region

**330kV OHL**

| Node    |           | Numen- clature | Line Length (km) | Circuit Type (Sc or, Dc ) | Conductor Type | No. of Conductor per Phase | Conductor Cross-Section (mm <sup>2</sup> ) | No. of Towers | Year Built | Skywire (Status) | Rating (MVA) | +ve Sequence Impedance |                  |                     | Zero Sequence Impedance |                  |                     |
|---------|-----------|----------------|------------------|---------------------------|----------------|----------------------------|--|---------------|------------|------------------|--------------|------------------------|------------------|---------------------|-------------------------|------------------|---------------------|
| From    | To        |                |                  |                           |                |                            |  |               |            |                  |              | Resistance (Ω/km)      | Reactance (Ω/km) | Susceptance (μS/km) | Resistance (Ω/km)       | Reactance (Ω/km) | Susceptance (μS/km) |
| Onitsha | New Haven | T3H            | 96               | Single Circuit            | Bison Twin     | 2                          | 350mm <sup>2</sup>                         | 237           | 1982       |                  | 777          | 0.0390                 | 0.3310           | 3.4900              | 0.2760                  | 0.9850           | 2.4900              |
| Okpai   | Onitsha   | K1T & K2T      | 56               | Double Circuit            | Bison, Twin    | 2                          | 350mm <sup>2</sup>                         | 130           | 2005       |                  | 1554         | 0.0394                 | 0.3030           | 3.8120              | 0.2614                  | 1.0019           | 2.2773              |
| Ugwuaji | New Haven |                | 7                | Double Circuit            | Bison, Twin    | 2                          | 350mm <sup>2</sup>                         | 17            | 2014       |                  | 1554         | 0.0394                 | 0.3030           | 3.8120              | 0.2614                  | 1.0019           | 2.2773              |

**132kV OHL**

| Node      |           | Numen- clature      | Line Length (km) | Circuit Type (Sc or, Dc ) | Conductor Type | No. of Conductor per Phase | Conductor Cross-Section (mm <sup>2</sup> ) | No. of Towers | Year Built     | Skywire (Status) | Rating (MVA) | +ve Sequence Impedance |                  |                     | Zero Sequence Impedance |                  |                     |
|-----------|-----------|---------------------|------------------|---------------------------|----------------|----------------------------|--|---------------|----------------|------------------|--------------|------------------------|------------------|---------------------|-------------------------|------------------|---------------------|
| From      | To        |                     |                  |                           |                |                            |  |               |                |                  |              | Resistance (Ω/km)      | Reactance (Ω/km) | Susceptance (μS/km) | Resistance (Ω/km)       | Reactance (Ω/km) | Susceptance (μS/km) |
| Onitsha   | Oji River | Onitsha-Oji River   | 63.85            | Single Circuit            | Wolf, Single   | 1                          | 150mm <sup>2</sup>                         | 182           | 1966           |                  | 90           | 0.2220                 | 0.4181           | 2.7368              | 0.4639                  | 1.2986           | 1.7435              |
| Onitsha   | Awka      | Onitsha-Awka        | 30               | Single Circuit            | Wolf, Single   | 1                          | 150mm <sup>2</sup>                         |               |                |                  | 90           | 0.2220                 | 0.4181           | 2.7368              | 0.4639                  | 1.2986           | 1.7435              |
| Awka      | Oji River | Awka-Oji River      | 33               | Single Circuit            | Wolf, Single   | 1                          | 150mm <sup>2</sup>                         |               |                |                  | 90           | 0.2220                 | 0.4181           | 2.7368              | 0.4639                  | 1.2986           | 1.7435              |
| Onitsha   | GCM       | Onitsha-GCM         | 8.05             | Single Circuit            | Wolf, Single   | 1                          | 150mm <sup>2</sup>                         | 24            | 1974           |                  | 90           | 0.2220                 | 0.4181           | 2.7368              | 0.4639                  | 1.2986           | 1.7435              |
| New Haven | Oji River | New Haven-Oji River | 44.1             | Single Circuit            | Wolf, Single   | 1                          | 150mm <sup>2</sup>                         | 126           | Built 1976;Ref |                  | 90           | 0.2220                 | 0.4181           | 2.7368              | 0.4639                  | 1.2986           | 1.7435              |
| New Haven | Oturkpo   | New Haven-Oturkpo   | 160.3            | Single Circuit            | Wolf, Single   | 1                          | 150mm <sup>2</sup>                         | 458           | 1978           |                  | 90           | 0.2220                 | 0.4181           | 2.7368              | 0.4639                  | 1.2986           | 1.7435              |
| Oturkpo   | Aliade    | Oturkpo-Aliade      | 39               | Single Circuit            | Wolf, Single   | 1                          | 150mm <sup>2</sup>                         | 121           | 2001           |                  | 90           | 0.2220                 | 0.4181           | 2.7368              | 0.4639                  | 1.2986           | 1.7435              |
| Aliade    | Markudi   | Aliade-Makurdi      | 50               | Single Circuit            | Bear, single   | 1                          | 250mm <sup>2</sup>                         |               |                |                  | 121          |                        |                  |                     |                         |                  |                     |
| Aliade    | Yandev    | Aliade-Yandev       | 60               | Single Circuit            | Wolf, Single   | 1                          | 150mm <sup>2</sup>                         | 208           | 1978           |                  | 90           | 0.2220                 | 0.4181           | 2.7368              | 0.4639                  | 1.2986           | 1.7435              |
| New Haven | Nkalagu   | New Haven-Nkalagu   | 38.85            | Double Circuit            | Wolf, Single   | 1                          | 150mm <sup>2</sup>                         | 111           | 1976           |                  | 180          | 0.2223                 | 0.4058           | 2.8285              | 0.4591                  | 1.3263           | 1.7866              |
| Nkalagu   | Abakaliki | Nkalagu-Abakaliki   | 54.25            | Single Circuit            | Wolf, Single   | 1                          | 150mm <sup>2</sup>                         | 155           | 1976           |                  | 90           | 0.2220                 | 0.4181           | 2.7368              | 0.4639                  | 1.2986           | 1.7435              |

## Transmission Lines - Technical Data

Annex 4.3

### Bauchi Region

#### 330kV OHL

| Node               |           | Numen- clature | Line Length (km) | Circuit Type (Sc or, Dc ) | Conductor Type | No. of Conductor per Phase | Conductor Cross-Section (mm <sup>2</sup> ) | No. of Towers | Year Built | Skywire (Status) | Rating (MVA) | +ve Sequence Impedance |                  |                     | Zero Sequence Impedance |                  |                     |
|--------------------|-----------|----------------|------------------|---------------------------|----------------|----------------------------|--|---------------|------------|------------------|--------------|------------------------|------------------|---------------------|-------------------------|------------------|---------------------|
| From               | To        |                |                  |                           |                |                            |  |               |            |                  |              | Resistance (Ω/km)      | Reactance (Ω/km) | Susceptance (μS/km) | Resistance (Ω/km)       | Reactance (Ω/km) | Susceptance (μS/km) |
| Jos                | Gombe     | SIE            | 265              | Single Circuit            | Bison, twin    | 2                          | 350mm <sup>2</sup>                         | 619           | 1981       |                  | 777          | 0.039                  | 0.331            | 3.49                | 0.276                   | 0.985            | 2.49                |
| Kaduna             | Jos       | M2S            | 197              | Single Circuit            | Bison, twin    | 2                          | 350mm <sup>2</sup>                         | 220           | 1977       |                  | 777          | 0.039                  | 0.331            | 3.49                | 0.276                   | 0.985            | 2.49                |
| Gombe              | Damaturu  | E1D            | 160              | Single Circuit            | Bison, twin    | 2                          | 350mm <sup>2</sup>                         |               |            |                  | 777          | 0.039                  | 0.331            | 3.49                | 0.276                   | 0.985            | 2.49                |
| Damaturu           | Maiduguri |                | 260              | Single Circuit            | Bison, twin    | 2                          | 350mm <sup>2</sup>                         |               |            |                  | 777          | 0.039                  | 0.331            | 3.49                | 0.276                   | 0.985            | 2.49                |
| Gombe              | Yola      | E1Y            | 240              | Single Circuit            | Bison, twin    | 2                          | 350mm <sup>2</sup>                         |               |            |                  | 777          | 0.039                  | 0.331            | 3.49                | 0.276                   | 0.985            | 2.49                |
| Yola               | Jalingo   |                | 140              | Single Circuit            | Bison, twin    | 2                          | 350mm <sup>2</sup>                         |               |            |                  | 777          | 0.039                  | 0.331            | 3.49                | 0.276                   | 0.985            | 2.49                |
| Operated as 132 kV |           |                |                  |                           |                |                            |  |               |            |                  |              |                        |                  |                     |                         |                  |                     |

#### 132kV OHL

| Node       |                | Numen- clature      | Line Length (km) | Circuit Type (Sc or, Dc ) | Conductor Type | No. of Conductor per Phase | Conductor Cross-Section (mm <sup>2</sup> ) | No. of Towers | Year Built | Skywire (Status) | Rating (MVA) | +ve Sequence Impedance |                  |                     | Zero Sequence Impedance |                  |                     |
|------------|----------------|---------------------|------------------|---------------------------|----------------|----------------------------|--|---------------|------------|------------------|--------------|------------------------|------------------|---------------------|-------------------------|------------------|---------------------|
| From       | To             |                     |                  |                           |                |                            |  |               |            |                  |              | Resistance (Ω/km)      | Reactance (Ω/km) | Susceptance (μS/km) | Resistance (Ω/km)       | Reactance (Ω/km) | Susceptance (μS/km) |
| Jos        | Bauchi, Gombe  | Jos-Bauchi-Gombe    | 320              | Single Circuit            | Wolf, Single   | 1                          | 150mm <sup>2</sup>                         | 941           | 1977       |                  |              | 0.2220                 | 0.4181           | 2.7368              | 0.4639                  | 1.2986           | 1.7435              |
| Jos        | Bauchi         | Jos-Bauchi          | 118              | Single Circuit            | Wolf, Single   | 1                          | 150mm <sup>2</sup>                         |               | 1977       |                  |              | 0.2220                 | 0.4181           | 2.7368              | 0.4639                  | 1.2986           | 1.7435              |
| Bauchi     | Gombe          | Bauchi-Gombe        | 146              | Single Circuit            | Wolf, Single   | 1                          | 150mm <sup>2</sup>                         |               | 1977       |                  |              | 0.2220                 | 0.4181           | 2.7368              | 0.4639                  | 1.2986           | 1.7435              |
| Gombe      | Dadin Kowa     | Gombe-Dadin Kowa    | 49               | Single Circuit            | Wolf, Single   | 1                          | 150mm <sup>2</sup>                         | 154           | 1977       |                  |              | 0.2220                 | 0.4181           | 2.7368              | 0.4639                  | 1.2986           | 1.7435              |
| Dadin Kowa | Biu            | Dadin Kowa-Biu      |                  | Single Circuit            |                | 1                          | 150mm <sup>2</sup>                         |               |            |                  |              | 0.2220                 | 0.4181           | 2.7368              | 0.4639                  | 1.2986           | 1.7435              |
| Biu        | Damboa         | Biu-Damboa          | 142              | Single Circuit            | Hyena, Single  | 1                          | 100mm <sup>2</sup>                         | 878           | 1977       |                  |              | 0.2712                 | 0.4640           | 0.0701              | 0.5620                  | 1.6020           | 0.0480              |
| Damboa     | Maiduguri      | Damboa-Maiduguri    | 71               | Single Circuit            | Hyena, Single  | 1                          | 100mm <sup>2</sup>                         |               | 1977       |                  |              | 0.2712                 | 0.4640           | 0.0701              | 0.5620                  | 1.6020           | 0.0480              |
| Gombe      | Ashaka         | Gombe-Ashaka        | 84               | Single Circuit            | Wolf, Single   | 1                          | 150mm <sup>2</sup>                         |               | 1977       |                  |              | 0.2220                 | 0.4181           | 2.7368              | 0.4639                  | 1.2986           | 1.7435              |
| Ashaka     | Potiskum       | Ashaka-Potiskum     | 94               | Single Circuit            | Wolf, Single   | 1                          | 150mm <sup>2</sup>                         |               | 1977       |                  |              | 0.2220                 | 0.4181           | 2.7368              | 0.4639                  | 1.2986           | 1.7435              |
| Gombe      | Ashaka         | Ashaka-(Tee-off)    | 11               | Single Circuit            | Wolf, Single   | 1                          | 150mm <sup>2</sup>                         | 33            | 1977       |                  |              | 0.2220                 | 0.4181           | 2.7368              | 0.4639                  | 1.2986           | 1.7435              |
| Gombe      | Savannah, Yola | Gombe-Savannah-Yola | 258.65           | Single Circuit            | Wolf, Single   | 1                          | 150mm <sup>2</sup>                         | 733           | 1977       |                  |              | 0.2220                 | 0.4181           | 2.7368              | 0.4639                  | 1.2986           | 1.7435              |
| Gombe      | Savannah       | Gombe-Savannah      | 92               | Single Circuit            | Hyena, Single  | 1                          | 100mm <sup>2</sup>                         |               | 1977       |                  |              | 0.2712                 | 0.4640           | 0.0002              | 0.5620                  | 1.6020           | 0.0002              |
| Savannah   | Numan          | Savannah-Numan      | 85               | Single Circuit            | Hyena, Single  | 1                          | 100mm <sup>2</sup>                         |               | 1977       |                  |              | 0.2712                 | 0.4640           | 0.0002              | 0.5620                  | 1.6020           | 0.0002              |
| Numan      | Yola           | Numan-Yola          | 50               | Single Circuit            | Wolf, Single   | 1                          | 150mm <sup>2</sup>                         |               | 1977       |                  |              | 0.2220                 | 0.4181           | 2.7368              | 0.4639                  | 1.2986           | 1.7435              |
| Gombe      | Savannah       | Savannah-(Tee-off)  | 3                | Single Circuit            | Dog, Single    | 1                          | 150mm <sup>2</sup>                         | 8             | 1977       |                  |              |                        |                  |                     |                         |                  |                     |
| Jos        | Mekeri         | Jos-Makeri          | 28.5             | Double Circuit            | Wolf, Single   | 1                          | 150mm <sup>2</sup>                         | 98            | 1984       |                  |              | 0.2223                 | 0.4058           | 2.8285              | 0.4591                  | 1.3263           | 1.7866              |
| Makeri     | Pankshin       | Makeri-Pankshin     | 109.5            | Single Circuit            | Wolf, Single   | 1                          | 150mm <sup>2</sup>                         | 365           | 1984       |                  |              | 0.2220                 | 0.4181           | 2.7368              | 0.4639                  | 1.2986           | 1.7435              |

## Transmission Lines - Technical Data

Annex 4.3

### International Lines

#### 330kV OHL

| Node       |        | Numen- clature | Line Length (km) | Circuit Type (Sc or, Dc ) | Conductor Type | No. of Conductor per Phase | No. of Towers | Year Built | Skywire (Status) | Rating (MVA) | +ve Sequence Impedance |                  |                     | Zero Sequence Impedance |                  |                     |
|------------|--------|----------------|------------------|---------------------------|----------------|----------------------------|---------------|------------|------------------|--------------|------------------------|------------------|---------------------|-------------------------|------------------|---------------------|
| From       | To     |                |                  |                           |                |                            |               |            |                  |              | Resistance (Ω/km)      | Reactance (Ω/km) | Susceptance (μS/km) | Resistance (Ω/km)       | Reactance (Ω/km) | Susceptance (μS/km) |
| Ikeja West | Sakete |                |                  | Single, Circuit           | Bison, Twin    | 2                          |               |            |                  | 777          |                        |                  |                     |                         |                  |                     |

#### 132kV OHL

| Node         |        | Numen- clature      | Line Length (km) | Circuit Type (Sc or, Dc ) | Conductor Type | No. of Conductor per Phase | No. of Towers | Year Built | Skywire (Status) | Rating (MVA) | +ve Sequence Impedance |                  |                     | Zero Sequence Impedance |                  |                     |
|--------------|--------|---------------------|------------------|---------------------------|----------------|----------------------------|---------------|------------|------------------|--------------|------------------------|------------------|---------------------|-------------------------|------------------|---------------------|
| From         | To     |                     |                  |                           |                |                            |               |            |                  |              | Resistance (Ω/km)      | Reactance (Ω/km) | Susceptance (μS/km) | Resistance (Ω/km)       | Reactance (Ω/km) | Susceptance (μS/km) |
| Birnin-Kebbi | Niamey | Birnin Kebbi-Niamey | 264              | Single, Circuit           | Areo Z, Single | 1                          |               |            |                  | 90           |                        |                  |                     |                         |                  |                     |
| Katsina      | Gazuoa | Katsina-Gazuoa      | 72               | Single, Circuit           | Wolf, Single   | 1                          |               |            |                  | 90           | 0.2220                 | 0.4181           | 2.7368              | 0.4639                  | 1.2986           | 1.7435              |

# Transformer Data

| STATION    | RATINGS(MVA ) | Vrated(kV)   | COOLING          | VECTOR GROUP | NOMENCL.   | MAKE             | TYPE       | POS. SEQ. IMPEDANCE (%) |       |         | ZERO SEQ. IMPEDANCE |         |         | Estimated R & X Value for Positive Sequence Impedance (% on Machine Base) |        | Estimated R & X Value for Zero Sequence Impedance (% on Machine Base) |        | LOSSES (kW) | Imag (pry) | NO. OF TAPS | NOM. TAP | REG. ABOVE | REG. BELOW | REG. STEP | COMPENSATING WINDING | EARTHING |        |        |          |
|------------|---------------|--------------|------------------|--------------|------------|------------------|------------|-------------------------|-------|---------|---------------------|---------|---------|---|--------|---|--------|-------------|------------|-------------|----------|------------|------------|-----------|----------------------|----------|--------|--------|----------|
|            |               |              |                  |              |            |                  |            | Z12                     | Z13   | Z23     | Z1N                 | Z2N     | Z3N     | R   | X      | R   | X      |             |            |             |          |            |            |           |                      |          | Pcu    | Pfe    | POSITION |
| AJA        | 150           | 330/132/33   |                  | YNy0d11      | T3         | MITSUBISHI       |            | 8.96                    | 12    | 4.21    | 7.8                 | 10.44   | 3.7     |   |        |   |        |             |            |             |          |            |            |           |                      |          |        |        |          |
|            | 150           | 330/132/33   |                  | YNy0d11      | T4         | PAUWELS          |            |                         |       |         |                     |         |         |   |        |   |        |             |            |             |          |            |            |           |                      |          |        |        |          |
|            | 150           | 330/132/33   |                  | YNy0d11      | T5         | AREVA            |            | 9.49                    | 9.71  | 10.9    | 8.3                 | 8.5     | 9.483   |   |        |   |        |             |            |             |          |            |            |           |                      |          |        |        |          |
|            | 100           | 132/33       |                  | YNy0d11      | T1         |                  |            |                         |       |         |                     |         |         |   |        |   |        |             |            |             |          |            |            |           |                      |          |        |        |          |
|            | 60/40/20      | 132/33       |                  | YNy0d11      | T1         | MITSUBISHI       |            |                         |       |         |                     |         |         |   |        |   |        |             |            |             |          |            |            |           |                      |          |        |        |          |
|            | 20            | 132/11       |                  | YNy0d11      | T1         | MITSUBISHI       |            |                         |       |         |                     |         |         |   |        |   |        |             |            |             |          |            |            |           |                      |          |        |        |          |
| 60         | 132/33        |              | YNd11            | T2           | PAUWELS    |                  | 15.53      | 14.55                   | 13.95 | 13.511  | 12.6585             | 12.1365 |         |   |        |   |        |             |            |             |          |            |            |           |                      |          |        |        |          |
| AJAOKUTA   | 30            | 132/33       | ONAN/ONAF        | YNd11        | T1         | ABB TECH.        |            | 10.10                   |       |         | 8.787               |         |         | 0.559   | 10.085 | 0.486   | 8.774  | 168         |            |             |          |            |            |           |                      |          |        |        |          |
|            | 60            | 132/33       | ONAN/ONAF        | YNd11        | T2         | EMCO             |            | 10.41                   |       |         | 9.0567              |         |         | 0.459   | 10.4   | 0.399   | 9.048  |             |            |             |          |            |            |           |                      |          |        |        |          |
|            | 162           | 330/132/33   | ONAN/ONAF        | YNy0d11      | T1         | MITSUBISHI       |            | 11.28                   |       |         | 9.8136              |         |         | 0.363   |        | 0.316   | 9.809  |             |            |             |          |            |            |           |                      |          |        |        |          |
|            | 162           | 330/132/33   | ONAN/ONAF        | YNy0d11      | T2         | MITSUBISHI       |            | 11.28                   |       |         | 9.8136              |         |         | 0.363   | 11.274 | 0.316   | 9.809  |             |            |             |          |            |            |           |                      |          |        |        |          |
|            | 162           | 330/132/33   | ONAN/ONAF        | YNy0d11      | T3         | MITSUBISHI       |            | 11.28                   |       |         | 9.8136              |         |         | 0.363   | 11.274 | 0.316   | 9.809  |             |            |             |          |            |            |           |                      |          |        |        |          |
| AKANGBA    | 90            | 330/132/13.8 | OB               | Yy0Yd1       | 5T1A       | ASGEN            | CORE       |                         |       |         |                     |         |         |   |        |   |        |             |            | 17          | 9b       |            |            |           |                      |          | DIRECT |        |          |
|            | 90            | 330/132/13.8 | ON/OFB           | Yy0Yd1       | 5T2A       | Mitsubishi       | Shell      |                         |       |         |                     |         |         |   |        |   |        |             |            | 17          | 9b       |            |            |           |                      |          | GT     |        |          |
|            | 90            | 330/132/13.8 | ON/OFB           | Yy0Yd1       | 5T1B       | Mitsubishi       | Shell      |                         |       |         |                     |         |         |   |        |   |        |             |            | 17          | 9b       |            |            |           |                      |          | GT     |        |          |
|            | 150           | 330/132/33   |                  |              | 5T4A       | INDIA            |            |                         |       |         |                     |         |         |   |        |   |        |             |            |             |          |            |            |           |                      |          |        |        |          |
|            | 60            | 132/33       |                  |              | 10T1A      | A.B.B.           |            |                         |       |         |                     |         |         |   |        |   |        |             |            |             |          |            |            |           |                      |          |        |        |          |
|            | 60            | 132/33       | ONAN/ONAF        | YNd11        | 10T2A      | LIAONING EFACEC  |            | 10.2                    |       |         | 8.874               |         |         | 0.45  | 10.19  | 0.391   | 8.865  |             |            | 17          | 5        | 5          | -15        | 1.18      |                      |          |        |        |          |
|            | 60            | 132/33       | ONAN/ONAF        | YNd11        | 10T2B      | MITSUBISHI       |            | 10.22                   |       |         | 8.8714              |         |         | 0.45  | 10.19  | 0.391   | 8.865  |             |            | 17          | 3        | 5          | -15        | 1.18      |                      |          |        |        |          |
| 90         | 330/132/13.8  | OB           | Yy0Yd1           | 5T2B         | ASGEN      | CORE             |            |                         |       |         |                     |         |         |   |        |   |        |             | 17         | 9b          |          |            |            |           |                      | DIRECT   |        |        |          |
| 150        | 330/132/33    | ONAN/ONAF    | ONAN/ONAF        | Yy0Yd1       | 5T4A       | Mitsubishi       | Shell      |                         |       |         |                     |         |         |   |        |   |        |             | 17         | 9b          |          |            |            |           |                      | GT       |        |        |          |
| ALAOJI     | 150           | 330/132/33   | ONAN/ONAF        | Yd11         | T1A        | MITSUBISHI       | Shell      | 11.51                   | 10.45 | 5.17    | 10.0137             | 9.0915  | 4.4979  |   |        |   |        |             |            | 17          | 5        | -1.25      | 1.25       | ±1.25     |                      |          | GT     |        |          |
|            | 150           | 330/132/33   | ONAN/ONAF        | YNa0d11      | T3A        | AREVA            |            | 11.94                   | 8.9   | 4.18    | 10.3878             | 7.743   | 3.6366  |   |        |   |        |             |            |             |          |            |            |           |                      |          |        |        |          |
|            | 150           | 330/132/33   | ONAN/ONAF        | Yd11         | T2A        | MITSUBISHI       | Shell      | 11.51                   | 10.45 | 5.17    | 10.0137             | 9.0915  | 4.4979  |   |        |   |        |             |            | 17          | 5        | -1.25      | 1.25       | ±1.25     |                      |          | GT     |        |          |
| AYEDE      | 150           | 330/132/33   | ONAN/ONAF        | YNa0d11      | T1B        | AREVA            |            | 11.29                   |       |         | 10.26               |         |         | 0.372   | 11.284 | 0.338   | 10.254 |             |            | 17          | 5        | 5          | -15        | 1.18      |                      |          |        |        |          |
|            | 150           | 330/132/34.5 | ONAN/ONAF1/ONAF2 | YNa0d11      | T2B        | CROMPTON GREAVES |            |                         |       |         |                     |         |         |   |        |   |        |             |            | 17          | 5        | 5          | -15        | 1.18      |                      |          |        |        |          |
|            | 100           | 132/33       |                  |              | T1         | GET              |            |                         |       |         |                     |         |         | 0.45  | 10.19  | 0.39  | 8.86   |             |            |             |          |            |            |           |                      |          |        |        |          |
|            | 60            | 132/33       |                  |              | T3         | PAUWEL TRA       |            |                         |       |         |                     |         |         | 0.64  | 14.62  | 0.56  | 12.72  |             |            |             |          |            |            |           |                      |          |        |        |          |
| 150/150/30 | 330/132/33    | ONAN/OFAF    | Yd11             | T2A          | MITSUBISHI | SHELL            | 11.73      | 6.38                    | 3.32  | 10.2051 | 5.5506              | 2.888   |         |   |        |   |        |             | 17         | 5           | 5        | 12.27      | 1.25       |           |                      | GT       |        |        |          |
|            | 150           | 330/132/33   | ONAN/ONAF        | Yd11         | 6T1        | MITSUBISHI       |            | 12.25                   |       |         | 10.6575             |         |         | 0.403   | 12.243 | 0.351   | 10.652 |             |            |             |          |            |            |           |                      |          |        |        |          |
|            | 150           | 330/132/33   | ONAN/ONAF        | Yd11         | 6T2        | MITSUBISHI       |            | 12.21                   |       |         | 10.6227             |         |         | 0.402   | 12.203 | 0.35  | 10.617 |             |            |             |          |            |            |           |                      |          |        |        |          |
|            | 60            | 132/33       | ONAN/ONAF        | YNd11        | T21        | INDIAN T & R     |            | 10.42                   |       |         | 9.0654              |         |         | 0.459   | 10.41  | 0.4   | 9.057  |             |            |             |          |            |            |           |                      |          |        |        |          |
|            | 60            | 132/33       | ONAN/ONAF        | YNd11        | T22        | ABB-TECH         |            | 10.6                    |       |         | 9.222               |         |         | 0.467   | 10.59  | 0.406   | 9.213  |             |            |             |          |            |            |           |                      |          |        |        |          |
|            | 60            | 132/33       | ONAN/ONAF        | YNd11        | T23        | PAUWELLS         |            | 15.6                    |       |         | 13.572              |         |         | 0.688   | 15.585 | 0.598   | 13.559 |             |            |             |          |            |            |           |                      |          |        |        |          |
|            | 60            | 132/33       | ONAN/ONAF        | YNd11        | T24        | SPECO            |            | 9.95                    |       |         | 8.6565              |         |         | 0.439   | 9.94   | 0.382   | 8.648  |             |            |             |          |            |            |           |                      |          |        |        |          |
|            | 150           | 330/132/33   | ONAN/OFAF        | YNd11        | T2A        | MELCO            | Shell      | 11.86                   | 6.42  | 3.32    | 10.3182             | 5.5854  | 2.8884  |   |        |   |        |             |            | 17          | 5        | 5          | 15         | 1.25      |                      |          | GT     |        |          |
|            | BIRNIN-KEBBI  | 90           | 330/132/33       | ONAN/ONAF    | Yy0Yd1,Yd2 | 19T1             | Savigliano | CORE                    | 11.77 | 19.65   | 18                  | 10.179  | 17.0955 | 15.66   |        |   |        |             |            |             | 17       | 5          | 15         | -5        | 1.25                 | NO       |        | DIRECT |          |
| 150        |               | 330/132/33   |                  |              | MBH        | MBH POWER        |            |                         |       |         |                     |         |         |   |        |   |        |             |            |             |          |            |            |           |                      |          |        |        |          |
| 30         |               | 132/33       |                  |              | T7         | HAWKER SYDNEY    |            | 10.3                    |       |         | 8.96                |         |         | 0.57  | 10.284 | 0.496   | 8.946  |             |            |             |          |            |            |           |                      |          |        |        |          |
| 60         |               | 132/33       |                  |              | T8         | PAULWELS         |            |                         |       |         |                     |         |         |   |        |   |        |             |            |             |          |            |            |           |                      |          |        |        |          |
| 60         |               | 132/33       |                  |              | MBH        | MBH POWER        |            |                         |       |         |                     |         |         |   |        |   |        |             |            |             |          |            |            |           |                      |          |        |        |          |
| 109/90/30  | 330/132/33    | ONAN/ONAF    | Yy0Yd1           | 19T2         | ASGEN      | CORE             | 12.27      | 6.73                    | 2.23  | 10.6749 | 5.8551              | 1.9401  |         |   |        |   |        |             | 17         | 9           | 10       | -10        | 1.25       | NO        |                      | DIRECT   |        |        |          |
| EGBIN      | 150           | 330/132      | ONAN/OFAF        | YyOd1        | 18TR1      | MITSUBISHI       | SHELL      | 11                      | 9     | 4       | 9.57                | 7.83    | 3.48    |   |        |   |        |             |            | 17          | 0        | 10         | 10         | 1         |                      |          | GT     |        |          |
|            | 150           | 330/132      | ONAN/OFAF        | YyOd1        | 18TR2      | MITSUBISHI       | SHELL      | 11                      | 9     | 4       | 9.57                | 7.83    | 3.48    |   |        |   |        |             |            | 17          | 0        | 10         | 10         | 1         |                      |          | GT     |        |          |
| GOMBE      | 131/262       | 330/132/33   | ONAN/ONAF        | Yd11         | T1A        | MELCO            | CORE       | 11.53                   | 10.23 | 5.2     | 10.0311             | 8.9001  | 4.524   |   |        |   |        |             |            | 17          | 5        |            |            |           |                      |          | GT     |        |          |
|            | 150           | 330/132/33   |                  |              | T1A        | MITSUBISHI       |            |                         |       |         |                     |         |         |   |        |   |        |             |            |             |          |            |            |           |                      |          |        |        |          |
|            | 30/45         | 132/33/11    |                  |              | T3         | HYUNDAI          |            |                         |       |         |                     |         |         |   |        |   |        |             |            |             |          |            |            |           |                      |          |        |        |          |
|            | 60            | 132/33       |                  |              | T4         | LEEC             |            |                         |       |         |                     |         |         |   |        |   |        |             |            |             |          |            |            |           |                      |          |        |        |          |
| 90/150     | 330/132/33    | ONAN/ONAF    | YNd11            | T2A          | ABB        | CORE             |            |                         |       |         |                     |         |         |   |        |   |        |             |            |             |          |            |            |           |                      | GT       |        |        |          |
| IKEJA WEST | 150           | 330/132/33   | ONAN/OFAF        | Yd11         | T2A        | MITSUBISHI       | SHELL      | 11.73                   | 6.38  | 3.32    | 10.2051             | 5.5506  | 2.8884  |   |        |   |        |             |            | 17          | 5        | 5          | 12.27      | 1.25      |                      |          | GT     |        |          |
|            | 150           | 330/132/33   | ONAN/OFAF        | Yd11         | T2B        | MITSUBISHI       | SHELL      | 11.73                   | 6.38  | 3.32    | 10.2051             | 5.5506  | 2.8884  |   |        |   |        |             |            | 17          | 5        | 5          | 12.27      | 1.25      |                      |          | GT     |        |          |
|            | 150           | 330/132/33   | ONAN/OFAF        | Yd11         | T1A        | MITSUBISHI       | SHELL      | 11.73                   | 6.38  | 3.32    | 10.2051             | 5.5506  | 2.8884  |   |        |   |        |             |            | 17          | 5        | 5          | 12.27      | 1.25      |                      |          | GT     |        |          |
|            | 150           | 330/132/33   |                  |              | T1B        | AREVA            |            |                         |       |         |                     |         |         |   |        |   |        |             |            |             |          |            |            |           |                      |          |        |        |          |
|            | 150           | 330/132/33   |                  |              | T3A        | AREVA            |            |                         |       |         |                     |         |         |   |        |   |        |             |            |             |          |            |            |           |                      |          |        |        |          |
|            | 150           | 330/132/33   | ONAN/OFAF        | Yd11         | T1B        | MITSUBISHI       | SHELL      | 11.73                   | 6.38  | 3.32    | 10.2051             | 5.5506  | 2.8884  |   |        |   |        |             |            | 17          | 5        | 5          | 12.27      | 1.25      |                      |          | GT     |        |          |
| JEBBA T.S. | 90/60/30      | 330/132/33   | ONAN/ONAF        | Yy0Yd1       | T1         | MARELLI          | CORE       | 12.05                   | 19.8  | 6.87    | 10.4835             | 17.226  | 5.9769  |   |        |   |        |             |            | 17          | 9        | 10         | -10        | 1.25      | NO                   |          | GT     |        |          |
|            | 30            | 132/33       |                  |              | T2         | ABB P. TECH      |            |                         |       |         |                     |         |         |   |        |   |        |             |            |             |          |            |            |           |                      |          |        |        |          |
| JOS        | 150           | 330/132/33   | ONAN/ONAF        | Yd11         | T1A        | MITSUBISHI       | SHELL      | 11.51                   | 10.19 | 5.17    | 10.0137             | 8.8653  | 4.4979  |   |        |   |        |             |            |             |          |            |            |           |                      |          |        |        |          |

# Transformer Data

| STATION      | RATINGS(MVA ) | Vrated(kV)   | COOLING                      | VECTOR GROUP | NOMENCL. | MAKE  | TYPE  | POS. SEQ. IMPEDANCE (%) |           |           | ZERO SEQ. IMPEDANCE |         |         | Estimated R & X Value for Positive Sequence Impedance (% on Machine Base) |        | Estimated R & X Value for Zero Sequence Impedance (% on Machine Base) |        | LOSSES (kW) | Imag (prr) | NO. OF TAPS | NOM. TAP | REG. ABOVE | REG. BELOW | REG. STEP | COMPENSATING WINDING | EARTHING |        |     |          |          |          |
|--------------|---------------|--------------|------------------------------|--------------|----------|---|-------|-------------------------|-----------|-----------|---------------------|---------|---------|---|--------|---|--------|-------------|------------|-------------|----------|------------|------------|-----------|----------------------|----------|--------|-----|----------|----------|----------|
|              |               |              |                              |              |          |   |       | Z12                     | Z13       | Z23       | Z1N                 | Z2N     | Z3N     | R   | X      | R   | X      |             |            |             |          |            |            |           |                      |          | Pcu    | Pfe | POSITION | NOM. (%) | NOM. (%) |
| KUMBOTSO     | 150           | 330/132/33   |                              |              | T4A      | MBH POWER                                       |       |                         |           |           |                     |         |         |   |        |   |        |             |            |             |          |            |            |           |                      |          |        |     |          |          |          |
|              | 30            | 132/33       |                              |              | T1       | TOSHIBA   |       |                         |           |           |                     |         |         |   |        |   |        |             |            |             |          |            |            |           |                      |          |        |     |          |          |          |
|              | 30/40         | 132/33       |                              |              | T2       | ABB   |       |                         |           |           |                     |         |         |   |        |   |        |             |            |             |          |            |            |           |                      |          |        |     |          |          |          |
|              | 60            | 132/33       |                              |              | T4       | ABB   |       |                         |           |           |                     |         |         |   |        |   |        |             |            |             |          |            |            |           |                      |          |        |     |          |          |          |
| KATAMPE      | 150           | 330/132/33   | ONAF/ONAN                    | YNa0d1       | T1       | ABB   | CORE  | 11.6                    | 45.4      | 33.4      | 37                  | 34.8    | 9.6     |   |        |   |        |             |            | 21          | 6        | 346.5      | 280.5      | 330       |                      | NO       | GT     |     |          |          |          |
|              | 150           | 330/132/33   | ONAF/ONAN                    | YNa0d1       | T2       | ABB   | CORE  | 11.6                    | 45.4      | 33.4      | 37                  | 34.88   | 9.6     |   |        |   |        |             |            | 21          | 6        | 345.5      | 280.5      | 330       |                      | NO       | GT     |     |          |          |          |
|              | 60            | 132/34.5     | ONAN/ONAF1/ONAF2             | YNd11        | T1       | SIEMENS   |       | 14.7                    |           |           | 12.789              |         |         | 0.648   | 14.686 | 0.564   | 12.777 |             |            | 17          | 5        | 138.6      | 118.8      | 132       |                      | NO       | GT     |     |          |          |          |
|              | 60            | 132/33       | ONAN/ONAF                    | YNd11        | T2       | ABB   |       | 10.1                    |           |           | 8.787               |         |         | 0.445   | 10.09  | 0.387   | 8.778  |             |            | 17          | 9        | 145.2      | 112.2      | 132       |                      | NO       | GT     |     |          |          |          |
| NEW HAVEN    | 150           | 330/132/33   | ONAN/ONAF1/ONAF2             | YNa0d11      | T3       | AREVA   |       | 11.29                   |           |           | 9.8223              |         |         | 0.372   | 11.284 | 0.323   | 9.817  | 53.3        | 368        | 21          | 6        | 345.5      | 280.5      | 330       |                      | NO       | GT     |     |          |          |          |
|              | 150           | 330/132/33   | ONAN/ONAF                    | Yd11         | T1A      | mitsubishi                                      | SHELL | 11.32                   | 11.45     | 12.01     | 10.57               | 10.32   | 9.42    |   |        |   |        |             |            | 17          | 5        | -1.25      | 1.25       | ±1.25     |                      |          | GT     |     |          |          |          |
|              | 30            | 132/33       |                              |              | TR1      | LEE CHUM  |       |                         |           |           |                     |         |         |   |        |   |        |             |            |             |          |            |            |           |                      |          |        |     |          |          |          |
|              | 30            | 132/33       |                              |              | TR2      | LEE CHUM  |       |                         |           |           |                     |         |         |   |        |   |        |             |            |             |          |            |            |           |                      |          |        |     |          |          |          |
|              | 60            | 132/33       |                              |              | TR3      | LEE CHUM  |       |                         |           |           |                     |         |         |   |        |   |        |             |            |             |          |            |            |           |                      |          |        |     |          |          |          |
| ONITSHA      | 150           | 330/132/33   | ONAN/ONAF                    | Yd11         | T2A      | mitsubishi                                      | SHELL | 11.32                   | 11.45     | 12.01     | 10.57               | 10.32   | 9.42    |   |        |   |        |             |            | 17          | 5        | -1.25      | 1.25       | ±1.25     |                      |          | GT     |     |          |          |          |
|              | 90            | 330/132/13.8 | ON/OFB                       | YyOvd1       | T1A      | mitsubishi                                      | CORE  | 11.35                   | 5.92      | 2.2       | 9.8745              | 5.1504  | 1.914   |   |        |   |        |             |            | 17          | 5        | -1.25      | 1.25       | ±1.25     |                      |          | GT     |     |          |          |          |
|              | 150           | 330/132/33   | ONAN/ONAF                    | YNad1        | T3       | SIEMENS   |       | 12.18                   | 49.97     | 35.16     | 10.5966             | 43.4739 | 30.5892 |   |        |   |        |             |            | 17          | 5        | 5          | -15        | 1.18      |                      |          |        |     |          |          |          |
|              | 150           | 330/132/33   | ONAN/ONAF                    | YNa0d11      | T4       | AVERA   |       | 11.93                   | 8.88      | 4.16      | 9.96                | 7.7256  | 3.6192  |   |        |   |        |             |            | 17          | 5        | 5          | -15        | 1.18      |                      |          |        |     |          |          |          |
|              | 30            | 132/33       |                              |              | MOB      | mitsubishi                                      |       |                         |           |           |                     |         |         |   |        |   |        |             |            |             |          |            |            |           |                      |          |        |     |          |          |          |
|              | 15            | 132/11       |                              |              | MOB      | mitsubishi                                      |       |                         |           |           |                     |         |         |   |        |   |        |             |            |             |          |            |            |           |                      |          |        |     |          |          |          |
|              | 60            | 132/33       |                              |              | GCM      | LEEC  |       |                         |           |           |                     |         |         |   |        |   |        |             |            |             |          |            |            |           |                      |          |        |     |          |          |          |
|              | 60            | 132/33       |                              |              | TR11     | HYUNDAI   |       |                         |           |           |                     |         |         |   |        |   |        |             |            |             |          |            |            |           |                      |          |        |     |          |          |          |
|              | 15            | 132/11       |                              |              | TR12     | TRAFU-UNION                                     |       |                         |           |           |                     |         |         |   |        |   |        |             |            |             |          |            |            |           |                      |          |        |     |          |          |          |
|              | 60            | 132/33       |                              |              | TR13     | PAUWEL  |       |                         |           |           |                     |         |         |   |        |   |        |             |            |             |          |            |            |           |                      |          |        |     |          |          |          |
| OSHOGBO      | 90            | 330/132/13.8 | OB                           | YyoYd1       | T2A      | ASGEN   | CORE  | 12.2                    | 6.7       | 2.26      | 10.614              | 5.829   | 1.9662  |   |        |   |        |             |            | 17          | 5        | -1.25      | 1.25       | ±1.25     |                      |          | GT     |     |          |          |          |
|              | 150           | 330/132/33   | ONAN/ONAF1/ONAF2             | YNa0d11      | 4T1      | TBEA  |       | 10.31                   | 47.84     | 33.81     | 8.9697              | 41.6208 | 29.4147 |   |        |   |        |             |            | 17          | 5        | -1.25      | 1.25       | ±1.18     |                      |          |        |     |          |          |          |
|              | 150           | 330/132/33   | ONAN/ONAF1/ONAF2             | YNa0d11      | 4T6      | AREVA   |       | 11.97                   | 26.5      | 12.45     | 10.4139             | 23.055  | 10.8315 |   |        |   |        |             |            | 17          | 5        | -1.25      | 1.25       | ±1.18     |                      |          |        |     |          |          |          |
|              | 60            | 132/33       | ONAN/ONAF                    | YNd11        | 4T3      | T & R   |       |                         |           |           |                     |         |         |   |        |   |        |             |            | 17          |          |            |            |           |                      |          |        |     |          |          |          |
|              | 60            | 132/33       | ONAN/ONAF                    | YNd11        | 4T4      | T&R   |       |                         |           |           |                     |         |         |   |        |   |        |             |            | 17          |          |            |            |           |                      |          |        |     |          |          |          |
| SHIRORO      | 30            | 132/33       | ONAN/ONAF                    | YNd11        | 4T5      | mitsubishi                                      |       |                         |           |           |                     |         |         |   |        |   |        |             |            | 17          |          |            |            |           |                      |          |        |     |          |          |          |
|              | 90            | 330/132/13.8 | ON/OFB                       | YyoYd1       | 4T2      | mitsubishi                                      | SHELL | 11.4                    | 5.92      | N/A       | 9.918               | 5.1504  | #WERT1  |   |        |   |        |             |            | 17          | 9a       | 5          | 16         | 1         |                      |          | GT     |     |          |          |          |
|              | 150           | 330/132/33   | ONAF/ONAN                    | YNY0d11      | T1       | mitsubishi                                      | SHELL | 11.24                   | 9.38      | 4.45      | 9.7788              | 8.1606  | 3.8715  |   |        |   |        |             |            | 17          | 5        | 5          | 15         | 1.25      |                      |          | DIRECT |     |          |          |          |
|              | 150           | 330/132/11   |                              |              | T1       | EMCO  |       |                         |           |           |                     |         |         |   |        |   |        |             |            |             |          |            |            |           |                      |          |        |     |          |          |          |
| MINNA        | 30            | 132/33       | ONAF(ONAN)                   | YNd1         | T2       | TRAFU-UNION                                     |       | 10.3(7.2)               |           |           | 8.961(6.26)         |         |         | 0.57  | 10.284 | 0.496   | 8.947  |             |            | 17          | 5        | 138.6      | 112.2      | 132       | NO                   |          | GT     |     |          |          |          |
|              | 60            | 132/33       | ONAN/ONAF                    | YNd11        | T7       | TRANF INDIA                                     |       |                         |           |           |                     |         |         |   |        |   |        |             |            | 17          | 5        | 138.6      | 112.2      | 132       | NO                   |          | GT     |     |          |          |          |
| APO T.S      | 40            | 132/33       | ONAN/ONAF                    | YNd11        | T1       | TELK  |       | 9.63                    |           |           | 8.3781              |         |         | 0.485   | 9.618  | 0.422   | 8.367  |             |            | 17          | 5        | 138.6      | 112.2      | 132       | NO                   |          | GT     |     |          |          |          |
|              | 45/30/20      | 132/33/11    | ONAF/ONAN                    | YNd1;yn0     | T1       | TRAFU-UNION                                     |       | 9.74/6.49               | 14.4/9.60 | 8.88/4.59 |                     |         |         |   |        |   |        |             |            | 17          | 5        | 138.6      | 112.2      | 132       | NO                   |          | GT     |     |          |          |          |
|              | 45/30/20      | 132/33/11    | ONAF/ONAN                    | YNd1;yn1     | T2       | TRAFU-UNION                                     |       | 9.74/6.50               | 14.4/9.61 | 8.88/4.60 |                     |         |         |   |        |   |        |             |            | 17          | 5        | 138.6      | 112.2      | 132       | NO                   |          | GT     |     |          |          |          |
|              | 60/45         | 132/33       | BURNT                        |              | T3       | ABB   |       |                         |           |           |                     |         |         |   |        |   |        |             |            |             |          |            |            |           |                      |          |        |     |          |          |          |
| SULEJA       | 100           | 132/33       | ONAN/ONAF                    | YNd11        | T4       | SPECO   |       | 12.91                   |           |           | 11.2317             |         |         | 0.483   | 12.901 | 0.42  | 11.224 |             |            | 17          | 5        | 138.6      | 112.2      | 132       | NO                   |          | GT     |     |          |          |          |
|              | 7.5           | 132/11       | ONAN                         | YNyn0        | T1       | TRAFU-UNION                                     |       | 10.3                    |           |           | 8.961               |         |         | 0.905   | 10.26  | 0.787   | 8.926  |             |            | 17          | 5        | 138.6      | 112.2      | 132       | NO                   |          | GT     |     |          |          |          |
|              | 45/59         | 132/33/11    | ONAN/ONAF                    | YNd11;yn0    | T2       | HYUNDAI   |       | 12.48                   |           |           | 10.8576             |         |         | 0.55  | 12.468 | 0.479   | 10.847 |             |            | 13          | 4        | 138.6      | 112.2      | 132       | NO                   |          | GT     |     |          |          |          |
| KUBWA        | 30            | 132/33       | ONAN/ONAF                    | YNd11        | T3       | ABB POWER TEK                                   |       | 10                      |           |           | 8.7                 |         |         | 0.553   | 9.985  | 0.482   | 8.687  |             |            | 17          | 9        | 145.2      | 118.8      | 132       | NO                   |          | GT     |     |          |          |          |
|              | 60            | 132/33       | ONAN/ONAF                    | YNd11        | TR1      | MBH POWER                                       |       | 10.14                   |           |           | 8.8218              |         |         | 0.447   | 10.13  | 0.387   | 8.813  |             |            | 17          | 9B       | 145.2      | 118.8      | 132       | NO                   |          | GT     |     |          |          |          |
| AKWANGA      | 60            | 132/33       | ONAN/ONAF                    | YNd11        | TR2      | MBH POWER                                       |       | 10.18                   |           |           | 8.8566              |         |         | 0.449   | 10.17  | 0.39  | 8.84   |             |            | 17          | 9B       | 145.2      | 118.8      | 132       | NO                   |          | GT     |     |          |          |          |
|              | 40            | 132/33       | ONAN/ONAF                    | YNd11        | T1       | ABB   |       | 10.6                    |           |           | 9.222               |         |         | 0.534   | 10.587 | 0.464   | 9.21   |             |            | 17          | 5        | 138.6      | 112.2      | 132       | NO                   |          | GT     |     |          |          |          |
| CENTRAL AREA | 40            | 132/33       | ONAN/ONAF                    | YNd11        | T2       | CG ELECTRIC SYSTEMS HUNGARY                     |       | 15.18                   |           |           | 13.2066             |         |         | 0.764   | 15.161 | 0.665   | 13.19  |             |            | 17          | 5        | 138.6      | 112.2      | 132       | NO                   |          | GT     |     |          |          |          |
|              | 60/45         | 132/33       | ONAN/ONAF                    | YNd11        | T1       | ABB   |       | 10.2                    |           |           | 8.874               |         |         | 0.45  | 10.19  | 0.391   | 8.865  |             |            | 17          | 9ABC     | 145.2      | 118.8      | 132       | NO                   |          | GT     |     |          |          |          |
|              | 60/45         | 132/33       | ONAN/ONAF                    | YNd11        | T2       | ABB   |       | 10.2                    |           |           | 8.874               |         |         | 0.45  | 10.19  | 0.391   | 8.865  |             |            | 17          | 9ABC     | 145.2      | 118.8      | 132       | NO                   |          | GT     |     |          |          |          |
| KEFFI        | 60/45         | 132/33       | ONAN/ONAF1/ONAF2             | YNd11        | T3       | CROMPTON GREAVES                                |       | 10.15                   |           |           | 8.8305              |         |         | 0.4477  | 10.14  | 0.389   | 8.822  |             |            | 17          | 9ABC     | 145.2      | 118.8      | 132       | NO                   |          | GT     |     |          |          |          |
|              | 30            | 132/33       | ONAN/ONAF                    | YNd11        | TR1      | ABB   |       | 10.1                    |           |           | 8.787               |         |         | 0.559   | 10.085 | 0.486   | 8.774  |             |            | 17          | 9ABC     | 145.2      | 118.8      | 132       | NO                   |          | GT     |     |          |          |          |
| KARU         | 60            | 132/33       | ONAN/ONAF                    | YNd11        | TR1      | VIJAI INDIA                                     |       | 10.15                   |           |           | 8.8305              |         |         | 0.4477  | 10.14  | 0.391   | 8.865  |             |            | 17          | 9B       | 145.2      | 118.8      | 132       | NO                   |          | GT     |     |          |          |          |
|              | 60            | 132/33       | ONAN/ONAF                    | YNd11        | TR2      | VIJAI INDIA                                     |       | 10.18                   |           |           | 8.8566              |         |         | 0.449   | 10.17  | 0.39  | 8.84   |             |            | 17          | 9B       | 145.2      | 118.8      | 132       | NO                   |          | GT     |     |          |          |          |
| GWAGWALADA   | 150/90        | 330/132/34.5 | ONAN/ONAF                    | YNa0d11      | T1       | SHANDONG DACHI ELECTRIC CO. LTD                 |       | 10.37                   | 35.49     | 47.75     | 9.0219              | 30.8763 | 41.5425 |   |        |   |        |             |            | 17          | 5        | 138.6      | 112.2      | 132       | NO                   |          | GT     |     |          |          |          |
|              | 150           | 330/132/34.5 | ONAN/ONAF                    | YNa0d11      | T2       | SHANDONG DACHI ELECTRIC CO. LTD                 |       | 10.34                   | 35.47     | 47.81     | 8.9958              | 30.8589 | 41.5947 |   |        |   |        |             |            | 17          | 5        | 138.6      | 112.2      | 132       | NO                   |          | GT     |     |          |          |          |
|              | 60            | 132/33       | ONAN/ONAF1/ONAF2(67/83/100%) | YNd11        | T1       | WOLONG ELECTRIC YANTAI DONGYUAN TRANSFORMER LTD |       | 10.31                   |           |           |                     |         |         |   |        |   |        |             |            |             |          |            |            |           |                      |          |        |     |          |          |          |



## Transformer Data

| STATION      | RATINGS(MVA ) | Vrated(kV) | COOLING         | VECTOR GROUP | NOMENCL. | MAKE             | TYPE | POS. SEQ. IMPEDANCE (%) |       |       | ZERO SEQ. IMPEDANCE |         |        | Estimated R & X Value for Positive Sequence Impedance (% on Machine Base) |       | Estimated R & X Value for Zero Sequence Impedance (% on Machine Base) |       | LOSSES (kW) | Imag (pry) | NO. OF TAPS | NOM. TAP | REG. ABOVE | REG. BELOW | REG. STEP (%) | COMPENSATING WINDING | EARTHING |     |     |          |
|--------------|---------------|------------|-----------------|--------------|----------|------------------|------|-------------------------|-------|-------|---------------------|---------|--------|---|-------|---|-------|-------------|------------|-------------|----------|------------|------------|---------------|----------------------|----------|-----|-----|----------|
|              |               |            |                 |              |          |                  |      | Z12                     | Z13   | Z23   | Z1N                 | Z2N     | Z3N    | R   | X     | R   | X     |             |            |             |          |            |            |               |                      |          | Pcu | Pfe | POSITION |
| ITIRE        | 30            | 132/33     |                 |              | T1       | MITSUBISHI       |      |                         |       |       |                     |         |        |   |       |   |       |             |            |             |          |            |            |               |                      |          |     |     |          |
|              | 60            | 132/33     |                 |              | T2       |                  |      |                         |       |       |                     |         |        |   |       |   |       |             |            |             |          |            |            |               |                      |          |     |     |          |
|              | 40            | 132/33     |                 |              | T3       | ABB POWER TECH   |      |                         |       |       |                     |         |        |   |       |   |       |             |            |             |          |            |            |               |                      |          |     |     |          |
| MARYLAND     | 22.5/30       | 132/33     | ONAN/ONAF       | YNd11        | T1       | MITSUBISHI       | CORE |                         |       |       |                     |         |        |   |       |   |       |             |            | 17          | 10       | 5          | -15        | 1.176471      |                      |          |     |     |          |
|              | 60            | 132/33     |                 |              | T2       | CHANGODAR        |      |                         |       |       |                     |         |        |   |       |   |       |             |            |             |          |            |            |               |                      |          |     |     |          |
|              | 30            | 132/33     | ONAN/ONAF       | YNd11        | T3       | MITSUBISHI       | CORE |                         |       |       |                     |         |        |   |       |   |       |             |            |             | 17       | 6          | 10         | -6            | 0.953654             |          |     |     |          |
| IKORODU      | 60            | 132/33     | ONAN/ONAF       | YNd11        | T1       | ABB POWER TECH   | CORE |                         |       |       |                     |         |        |   |       |   |       |             |            |             | 17       | 9          | 10         | 9             | 1.149733             |          |     |     |          |
|              | 60            | 132/33     | ONAN/ONAF       | YNd11        | T2       | ABB POWER TECH   | CORE |                         |       |       |                     |         |        |   |       |   |       |             |            |             | 17       | 9          | 10         | 9             | 1.149733             |          |     |     |          |
|              | 100           | 132/33     | ONAN/ONAF       | YNd11        | T3       | LEEEC            | CORE | 10.17                   |       |       |                     | 8.8479  |        |   | 0.38  | 10.163  | 0.331 | 8.841       |            |             | 17       | 5          | 5          | -15           | 1.176471             |          |     |     |          |
| SHAGAMU      | 15            | 132/33     | ONAN            | Yd11         | T1       | FABRYKA          | CORE |                         |       |       |                     |         |        |   | 0.56  | 10.14   | 0.5   | 9.1         |            |             | 17       |            |            |               |                      |          |     |     |          |
|              | 15            | 132/33     | ONAN            | Yd11         | T2       | FABRYKA          | CORE |                         |       |       |                     |         |        |   | 0.57  | 10.2  | 0.5   | 9.1         |            |             | 17       |            |            |               |                      |          |     |     |          |
| OWORONSHOKI  | 60            | 132/33     | ONAN/ONAF/ONAF2 | YNd11        | T1       | CROMPTON         | CORE | 8.84                    |       |       |                     | 7.6908  |        |   | 0.39  | 8.837   | 0.339 | 7.683       |            |             | 17       | 5          | 5          | -15           | 1.18                 |          |     |     |          |
|              | 60            | 132/33     | ONAN/ONAF/ONAF2 | YNd11        | T2       | CROMPTON         | CORE | 8.84                    |       |       |                     | 7.6908  |        |   | 0.39  | 8.837   | 0.339 | 7.683       |            |             | 17       | 5          | 5          | -15           | 1.18                 |          |     |     |          |
| ALAGBON      | 66            | 132/33     |                 | YNd11        | T1       | ELTA             |      | 12.47                   | 12.15 | 11.21 | 10.8489             | 10.5705 | 9.7527 |   |       |   |       |             |            |             |          |            |            |               |                      |          |     |     |          |
|              | 66            | 132/33     |                 | YNd11        | T2       | ELTA             |      | 10.14                   | 9.98  | 9.61  | 8.8218              | 8.6826  | 8.3607 |   |       |   |       |             |            |             |          |            |            |               |                      |          |     |     |          |
| APAPA-ROAD   | 45/30/15      | 132/33     |                 | YNd11yn0     | T1       | HYUNDAI          |      | 3.01                    | 9.3   | 4.8   | 2.6187              | 8.091   | 4.176  |   |       |   |       |             |            |             |          |            |            |               |                      |          |     |     |          |
|              | 45/30/15      | 132/33     |                 | YNd11        | T2       | ITAL TRAF0       |      | 18.72                   | 12.53 | 5.4   | 16.2864             | 10.9    | 4.698  |   |       |   |       |             |            |             |          |            |            |               |                      |          |     |     |          |
| AKOKA        | 45/30/15      | 132/33     |                 | YNd11yn0     | T1       | TOSHIBA          |      |                         |       |       |                     |         |        |   |       |   |       |             |            |             |          |            |            |               |                      |          |     |     |          |
|              | 40            | 132/33     |                 | YNd11        | T3       | TOSHIBA          |      | 18.38                   |       |       |                     | 15.99   |        |   | 0.925 | 18.357  | 0.805 | 15.97       |            |             |          |            |            |               |                      |          |     |     |          |
| AMUWO-ODOFIN | 60            | 132/33     |                 | YNd11        | T1       | TOSHIBA          |      |                         |       |       |                     |         |        |   |       |   |       |             |            |             |          |            |            |               |                      |          |     |     |          |
|              | 30            | 132/33     |                 | YNd11        | T2       | MITSUBISHI       |      |                         |       |       |                     |         |        |   |       |   |       |             |            |             |          |            |            |               |                      |          |     |     |          |
|              | 40            | 132/33     |                 | YNd11        | T3       | TOSHIBA          |      |                         |       |       |                     |         |        |   |       |   |       |             |            |             |          |            |            |               |                      |          |     |     |          |
|              | 40            | 132/34     |                 | YNd11        | T4       | TOSHIBA          |      |                         |       |       |                     |         |        |   |       |   |       |             |            |             |          |            |            |               |                      |          |     |     |          |
| LEKKI        | 60            | 132/33     |                 | YNd11        | TR1      | AREVA            |      |                         |       |       |                     |         |        |   |       |   |       |             |            |             |          |            |            |               |                      |          |     |     |          |
|              | 60            | 132/34     |                 | YNd11        | TR2      | AREVA            |      |                         |       |       |                     |         |        |   |       |   |       |             |            |             |          |            |            |               |                      |          |     |     |          |
| OGBA         | 60/40/20      | 132/33     |                 |              | T1       | TOSHIBA          |      |                         |       |       |                     |         |        |   |       |   |       |             |            |             | 17       |            |            |               |                      |          |     |     |          |
|              | 60            | 132/33     |                 |              | T2       | PAUWELL          |      |                         |       |       |                     |         |        |   |       |   |       |             |            |             |          | 17         |            |               |                      |          |     |     |          |
|              | 60            | 132/33     |                 |              | T3       | MITSUBISHI       |      |                         |       |       |                     |         |        |   |       |   |       |             |            |             |          | 17         |            |               |                      |          |     |     |          |
|              | 45/30/20      | 132/33     | ONAN/OFAF       | YN.d11.yno   | MOB      | MITSUBISHI       | CORE | 18.74                   | 12.41 | 5.52  | 16.3038             | 10.7967 | 4.8024 |   |       |   |       |             |            |             | 21       | 9          | 10         | -15           | 1.190476             |          |     |     |          |
|              | 20            | 132/11     |                 |              |          | MITSUBISHI       |      |                         |       |       |                     |         |        |   |       |   |       |             |            |             |          | 15         |            |               |                      |          |     |     |          |
| ALIMOSHO     | 30            | 132/33     | ONAN/ONAF       | YNd11        | T1       | MITSUBISHI       |      | 10.7                    |       |       |                     | 9.309   |        |   | 0.592 | 10.684  | 0.515 | 9.295       |            |             | 17       | 4          | 5          | -15           | 1.567599             |          |     |     |          |
|              | 60            | 132/33     | ONAN/ONAF       | YNd11        | T2       | ABB              |      | 10.7                    |       |       |                     | 9.309   |        |   | 4.72  | 10.69   | 0.41  | 9.3         |            |             | 17       | 4          | 5          | -15           | 1.567599             |          |     |     |          |
|              | 30            | 132/33     | ONAN/ONAF       | YNd11        | T3       | MITSUBISHI       |      | 10.7                    |       |       |                     | 9.309   |        |   | 0.592 | 10.684  | 0.515 | 9.295       |            |             | 17       | 5          | 5          | -15           | 1.176471             |          |     |     |          |
| EJIGBO       | 30            | 132/33     | ONAN/ONAF       | YNd11        | T1       | ITAL TRAF0       |      | 10.2                    |       |       |                     | 8.874   |        |   | 0.565 | 10.184  | 0.491 | 8.86        |            |             | 21       | 13         | 10         | -15           | 1.19                 |          |     |     |          |
|              | 30            | 132/33     | ONAN/ONAF       | YNd11        | T2       | ITAL TRAF0       |      | 10.2                    |       |       |                     | 8.874   |        |   | 0.565 | 10.184  | 0.491 | 8.86        |            |             | 21       | 13         | 10         | -15           | 1.19                 |          |     |     |          |
|              | 100           | 132/33     | ONAN/ONAF       | YNd11        | T3       | STECO            |      | 10.7                    |       |       |                     | 9.309   |        |   | 0.4   | 10.693  | 0.348 | 9.3         |            |             | 13       | 4          | 5          | 15            | 1.54                 |          |     |     |          |
| AGBARA       | 45/30/15      | 132/33     |                 |              | T1       | HYUNDAI          |      |                         |       |       |                     |         |        |   |       |   |       |             |            |             | 15       |            |            |               |                      |          |     |     |          |
|              | 45/30/15      | 132/33     |                 |              | T2       | HYUNDAI          |      |                         |       |       |                     |         |        |   |       |   |       |             |            |             | 15       |            |            |               |                      |          |     |     |          |
|              | 60            | 132/33     |                 |              | T3       | CROMPTOM         |      |                         |       |       |                     |         |        |   |       |   |       |             |            |             | 17       |            |            |               |                      |          |     |     |          |
| ALAUZA       | 45/30/15      | 132/33     | ONAN/ONAF       | YNd11, yn0   | T1       | HYUNDAI          | CORE | 13.01                   |       |       |                     | 11.3187 |        |   | 0.63  | 12.995  | 0.548 | 11.304      |            |             | 13       | 3          | 5          | -15           | 1.67                 |          |     |     |          |
|              | 30            | 132/33     | ONAN/ONAF       | YNd11        | T2       | ELTA             | CORE |                         |       |       |                     |         |        |   |       |   |       |             |            |             |          |            |            |               |                      |          |     |     |          |
|              | 60            | 132/33     | ONAN/ONAF       | YNd11        | T3       | PAUWELS          | CORE | 14.54                   |       |       |                     | 12.6498 |        |   | 0.641 | 14.526  | 0.558 | 12.538      |            |             | 17       | 9          | 10         | -5            | 1.67                 |          |     |     |          |
| OTTA         | 40            | 132/33     |                 |              | T1       | MINEL            |      |                         |       |       |                     |         |        |   |       |   |       |             |            |             |          |            |            |               |                      |          |     |     |          |
|              | 60            | 132/33     |                 |              | T2       | PAUWELS          |      |                         |       |       |                     |         |        |   |       |   |       |             |            |             |          |            |            |               |                      |          |     |     |          |
|              | 30            | 132/33     |                 |              | T3       | BBC              |      |                         |       |       |                     |         |        |   |       |   |       |             |            |             |          |            |            |               |                      |          |     |     |          |
|              | 40/30/20      | 132/33     |                 |              | MOB      | CG ELECT.SYSTEM  |      |                         |       |       |                     |         |        |   |       |   |       |             |            |             |          |            |            |               |                      |          |     |     |          |
| PAPALANTO    | 15            | 132/33     |                 |              | T1       | TRAF0-UNION      |      |                         |       |       |                     |         |        |   |       |   |       |             |            |             |          |            |            |               |                      |          |     |     |          |
|              | 15            | 132/33     |                 |              | T2       | TRAF0-UNION      |      |                         |       |       |                     |         |        |   |       |   |       |             |            |             |          |            |            |               |                      |          |     |     |          |
|              | 30            | 132/33     |                 |              | T3       | PAUWELS          |      |                         |       |       |                     |         |        |   |       |   |       |             |            |             |          |            |            |               |                      |          |     |     |          |
| ABEOKUTA     | 30            | 132/33     | ONAN            | YNd11        | T1       | ELTA             |      | 10.16                   |       |       |                     | 8.8392  |        |   | 0.562 | 10.144  | 0.489 | 8.826       |            |             | 17       | 5          | 5          | -15           | 1.67                 |          |     |     |          |
|              | 30            | 132/33     | ONAN            | YNd11        | T2       | ELTA             |      | 10.16                   |       |       |                     | 8.8392  |        |   | 0.562 | 10.144  | 0.489 | 8.826       |            |             | 17       | 5          | 5          | -15           | 1.67                 |          |     |     |          |
|              | 30            | 132/33     | ONAN/ONAF       | YNd11, yn0   | T3       | PAUWEL           |      | 12.2                    |       |       |                     | 10.614  |        |   | 0.675 | 12.181  | 0.587 | 10.598      |            |             | 17       | 9          | 10         | -15           | 1.25                 |          |     |     |          |
| AYOBO        | 60            | 132/33     |                 |              | T1       | PAUWEL           |      |                         |       |       |                     |         |        |   |       |   |       |             |            |             |          |            |            |               |                      |          |     |     |          |
|              | 60            | 132/34     |                 |              | T2       | PAUWEL           |      |                         |       |       |                     |         |        |   |       |   |       |             |            |             |          |            |            |               |                      |          |     |     |          |
| OKE-ARO      | 300           | 330/132/33 |                 |              | T1       | CROMPTOM GREAVES |      |                         |       |       |                     |         |        |   |       |   |       |             |            |             |          |            |            |               |                      |          |     |     |          |
|              | 300           | 330/132/33 |                 |              | T2       | CROMPTOM GREAVES |      |                         |       |       |                     |         |        |   |       |   |       |             |            |             |          |            |            |               |                      |          |     |     |          |
|              | 60            | 132/33     |                 |              | T5       | CROMPTOM GREAVES |      |                         |       |       |                     |         |        |   |       |   |       |             |            |             |          |            |            |               |                      |          |     |     |          |
|              | 60            | 132/33     |                 |              | T6       | CROMPTOM GREAVES |      |                         |       |       |                     |         |        |   |       |   |       |             |            |             |          |            |            |               |                      |          |     |     |          |
| IFE          | 30            | 132/33     | ONAN            | Yd11         | T1       | ELTA             |      |                         |       |       |                     |         |        |   | 0.58  | 10.4  | 0.5   | 9.09        |            |             | 17       | 5          | 4          | -15           | 1.18                 |          |     |     |          |
|              | 30            | 132/33     | ONAN            | Yd11         | T2       | ELTA             |      |                         |       |       |                     |         |        |   | 0.58  | 10.4  | 0.5   | 9.09        |            |             | 17       | 5          | 4          | -15           | 1.18                 |          |     |     |          |
| ILESA        | 40/30         | 132/33     | ONAN/ONAF       | YNd11        | T1       | ABB POWER TECH   |      |                         |       | 10.9  |                     | 9.483   |        |   |       |   |       |             |            |             |          |            |            |               |                      |          |     |     |          |

## Transformer Data

| STATION      | RATINGS(MVA ) | Vrated(kV) | COOLING          | VECTOR GROUP | NOMENCL. | MAKE             | TYPE  | POS. SEQ. IMPEDANCE (%) |       |      | ZERO SEQ. IMPEDANCE |         |        | Estimated R & X Value for Positive Sequence Impedance (% on Machine Base) |       | Estimated R & X Value for Zero Sequence Impedance (% on Machine Base) |       | LOSSES (kW) | Imag (prr) | NO. OF TAPS | NOM. TAP | REG. ABOVE | REG. BELOW | REG. STEP (%) | COMPENSATING WINDING | EARTHING |
|--------------|---------------|------------|------------------|--------------|----------|------------------|-------|-------------------------|-------|------|---------------------|---------|--------|---|-------|---|-------|-------------|------------|-------------|----------|------------|------------|---------------|----------------------|----------|
|              |               |            |                  |              |          |                  |       | Z12                     | Z13   | Z23  | Z1N                 | Z2N     | Z3N    | R   | X     | R   | X     |             |            |             |          |            |            |               |                      |          |
| GANMO        | 150           | 330/132/33 | ONAN/ONAF1/ONAF2 | YNd11yn0     | T2A      | CROMPTON GREAVES | CORE  | 18.6                    | 47    | 33   | 16.182              | 40.89   | 28.71  |   |       |   |       |             |            | 17          | 5        | 5          | -15        | 1.18          |                      |          |
|              | 60            | 132/33     | ONAN/ONAF1       | Yd11         | T1       | SIEMENS          |       |                         |       |      |                     |         |        | 0.74  | 14.75 | 0.65  | 12.8  |             |            | 17          | 5        | 4          | -15        | 1.18          |                      |          |
|              | 60            | 132/33     | ONAN/ONAF1/ONAF2 | Yd11         | T2       | SIEMENS          |       |                         |       |      |                     |         |        | 0.65  | 14.73 | 0.57  | 12.8  |             |            | 17          | 5        | 4          | -15        | 1.18          |                      |          |
| ILORIN       | 60            | 132/33     | ONAN/ONAF        | Yd11         | T1A      | TOSHIBA          | CORE  |                         |       |      |                     |         |        | 0.46  | 10.52 | 0.4   | 9.15  |             |            | 13          | 5        | 4          | -15        | 1.54          |                      |          |
|              | 45/30         | 132/33     | ONAN/ONAN        | Yd11         | T2A      | HYUNDAI          | CORE  |                         |       |      |                     |         |        |   |       |   |       |             |            | 13          | 5        | 4          | -15        | 1.54          |                      |          |
| OMU-ARAN     | 30            | 132/33     |                  |              | T1       | mitsubishi       |       |                         |       |      |                     |         |        | 0.59  | 10.6  | 0.511   | 9.23  |             |            |             |          |            |            |               |                      |          |
|              | 30            | 132/33     |                  |              | T2       | TOSHIBA          |       |                         |       |      |                     |         |        | 0.68  | 12.18 | 0.59  | 10.59 |             |            |             |          |            |            |               |                      |          |
| ONDO         | 30            | 132/33     | ONAN             | Yd11         | T1       | ELTA             | CORE  | 10.42                   |       |      | 9.11                |         |        | 0.58  | 10.4  | 0.5   | 9.09  |             |            | 17          | 5        | 5          | -15        | 1.18          |                      |          |
|              | 30            | 132/33     | ONAN             | Yd11         | T2       | ELTA             | CORE  | 10.42                   |       |      | 9.11                |         |        | 0.58  | 10.4  | 0.5   | 9.09  |             |            | 17          | 5        | 5          | -15        | 1.18          |                      |          |
| ADO EKITI    | 40/30         | 132/33     | ONAN/ONAF        |              | T1       | ABB              | TBA43 |                         |       |      |                     |         |        | 0.56  | 11.09 | 0.49  | 9.65  |             |            | 17          | 5        | 5          | -15        | 1.18          |                      |          |
|              | 40/30         | 132/33     | ONAN/ONAF        |              | T2       | ABB              | TBA43 |                         |       |      |                     |         |        | 0.54  | 10.69 | 0.47  | 9.3   |             |            | 17          | 5        | 5          | -15        | 1.18          |                      |          |
| AKURE        | 30            | 132/33     | ONAN/ONAF        |              | T1A      | ABB              |       |                         |       |      |                     |         |        | 0.57  | 10.18 | 0.49  | 8.86  |             |            | 17          | 10       | 9          | -10        | 1.18          |                      |          |
|              | 30            | 132/33     | ONAN/ONAF        | Yd11         | T2A      | MITSUBISHI       |       |                         |       |      |                     |         |        | 0.55  | 9.84  | 0.47  | 8.56  |             |            | 17          | 5        | 5          | -15        | 1.18          |                      |          |
|              | 60            | 132/33     |                  |              | T3A      | PAUWELLS         |       |                         |       |      |                     |         |        |   |       |   |       |             |            |             |          |            |            |               |                      |          |
| JERICO       | 45/30/15      | 132/33/11  | ONAN/ONAF        | YdY          | T1       | MITSUBISHI       |       | 18.47                   | 12.49 | 5.43 | 16.0689             | 10.8663 | 4.724  |   |       |   |       |             |            | 21          | 9        | 10         | -15        | 1.19          |                      |          |
|              | 40            | 132/33     | ONAN/ONAF        | YNd11        | T2       | PAUWELLS         | CORE  |                         |       |      |                     |         |        | 0.67  | 13.23 | 0.58  | 11.52 |             |            | 17          | 10       | 9          | -10        | 1.18          |                      |          |
| IBADAN NORTH | 60            | 132/33     | ONAN/ONAF        | YNd11        | T1       | LEECC            | CORE  |                         |       |      |                     |         |        | 0.45  | 10.09 | 0.39  | 8.78  |             |            | 17          | 5        | 5          | -15        | 1.18          |                      |          |
|              | 60            | 132/33     | ONAN/ONAF        | YNd11        | T2       | TELK             | CORE  |                         |       |      |                     |         |        | 0.43  | 9.64  | 0.37  | 8.39  |             |            | 17          | 5        | 5          | -15        | 1.18          |                      |          |
| SAGAMU       | 30            | 132/33     | ONAN             | Yd11         | T1       | FABRYKA          | CORE  |                         |       |      |                     |         |        |   |       |   |       |             |            | 17          | 5        | 5          | -15        | 1.18          |                      |          |
|              | 30            | 132/33     | ONAN             | Yd11         | T2       | FABRYKA          | CORE  |                         |       |      |                     |         |        |   |       |   |       |             |            | 17          | 5        | 5          | -15        | 1.18          |                      |          |
| IJBEBU-ODE   | 30            | 132/33     | ONAN             | Yd11         | T1       | ELTA             | CORE  |                         |       |      |                     |         |        |   |       |   |       |             |            |             |          |            |            |               |                      |          |
|              | 30            | 132/33     | ONAN             | Yd11         | T2       | ELTA             | CORE  |                         |       |      |                     |         |        |   |       |   |       |             |            |             |          |            |            |               |                      |          |
| ISEYIN T.S   | 45/30         | 132/33     | ONAN/ONAF        | YNd11yn0     | T1       | HYUNDAI          | CORE  |                         |       |      |                     |         |        |   |       |   |       |             |            | 13          | 5        | -15        | 4          | 1.54          |                      |          |
| IWO T.S      | 30            | 132/33     |                  |              | T1       | LEECC            |       |                         |       |      |                     |         |        |   |       |   |       |             |            |             |          |            |            |               |                      |          |
| OWERRI       | 60            | 132/33/11  |                  |              | TR1      | LEECC            |       |                         |       |      |                     |         |        |   |       |   |       |             |            |             |          |            |            |               |                      |          |
|              | 60            | 132/33     |                  |              | TR2      | LEECC            |       |                         |       |      |                     |         |        |   |       |   |       |             |            |             |          |            |            |               |                      |          |
|              | 40            | 132/33     |                  |              | T1-MOB   | PAUWELLS         |       |                         |       |      |                     |         |        |   |       |   |       |             |            |             |          |            |            |               |                      |          |
|              | 7.5           | 132/6.6    |                  |              | T1A      | PARSON           |       |                         |       |      |                     |         |        |   |       |   |       |             |            |             |          |            |            |               |                      |          |
| ABA          | 60            | 132/33     |                  |              | T1B      | LEECC            |       |                         |       |      |                     |         |        |   |       |   |       |             |            |             |          |            |            |               |                      |          |
|              | 45/30/15      | 132/33/11  | ONAN/ONAF        | YNd11        | T2B      | HYUNDAI          |       | 19.45                   | 13.18 | 4.76 | 16.9215             | 11.4666 | 4.1412 |   |       |   |       |             |            | 13          | 5        | -15        | 4          | 1.538462      |                      |          |
|              | 30            | 132/33     |                  |              | T(MOB)   | MITSUBISHI       |       |                         |       |      |                     |         |        |   |       |   |       |             |            |             |          |            |            |               |                      |          |
|              | 60            | 132/33     |                  |              | T2A      | ABB              |       |                         |       |      |                     |         |        |   |       |   |       |             |            |             |          |            |            |               |                      |          |
|              | 15            | 132/11     |                  |              | T4A(MOB) | MITSUBISHI       |       |                         |       |      |                     |         |        |   |       |   |       |             |            |             |          |            |            |               |                      |          |
| UMUAHIA      | 40            | 132/33     |                  |              | T1       | STEM ITALY       |       |                         |       |      |                     |         |        |   |       |   |       |             |            |             |          |            |            |               |                      |          |
| P.H. MAIN    | 40            | 132/33     |                  |              | T2       | STEM ITALY       |       |                         |       |      |                     |         |        |   |       |   |       |             |            |             |          |            |            |               |                      |          |
|              | 60            | 132/33     |                  |              | T1A      | HYUNDAI          |       |                         |       |      |                     |         |        |   |       |   |       |             |            |             |          |            |            |               |                      |          |
|              | 60            | 132/33     |                  |              | T2A      | LEECC            |       |                         |       |      |                     |         |        |   |       |   |       |             |            |             |          |            |            |               |                      |          |
| P.H. TOWN    | 60            | 132/33     |                  |              | T3A      | ABB              |       |                         |       |      |                     |         |        |   |       |   |       |             |            |             |          |            |            |               |                      |          |
|              | 60            | 132/33     |                  |              | T1A      | FERRANTI         |       |                         |       |      |                     |         |        |   |       |   |       |             |            |             |          |            |            |               |                      |          |
|              | 30            | 132/33     |                  |              | T2A      | PAUWELLS         |       |                         |       |      |                     |         |        |   |       |   |       |             |            |             |          |            |            |               |                      |          |
|              | 30            | 132/33     |                  |              | T1B      | PAUWELLS         |       |                         |       |      |                     |         |        |   |       |   |       |             |            |             |          |            |            |               |                      |          |
|              | 45            | 132/33     |                  |              | T2B      | HYUNDI           |       |                         |       |      |                     |         |        |   |       |   |       |             |            |             |          |            |            |               |                      |          |
|              | 60            | 132/33     |                  |              | T1A      | MITSUBISHI       |       |                         |       |      |                     |         |        |   |       |   |       |             |            |             |          |            |            |               |                      |          |
| AFAM         | 162           | ~330/132   |                  |              | T1A      | MITSUBISHI       |       |                         |       |      |                     |         |        |   |       |   |       |             |            |             |          |            |            |               |                      |          |
|              | 45            | 132/33     |                  |              | T1       | HYUNDI           |       |                         |       |      |                     |         |        |   |       |   |       |             |            |             |          |            |            |               |                      |          |
|              | 64            | 132/11     |                  |              | T5       | SECHERON         |       |                         |       |      |                     |         |        |   |       |   |       |             |            |             |          |            |            |               |                      |          |
| AFAM IPP     | 198           | ~330/132   |                  |              | TRIO     | GENTRA           |       |                         |       |      |                     |         |        |   |       |   |       |             |            |             |          |            |            |               |                      |          |
| YENAGOA      | 30/40         | 132/33     |                  |              | T1       | STEM             |       |                         |       |      |                     |         |        |   |       |   |       |             |            |             |          |            |            |               |                      |          |
|              | 30/40         | 132/33     |                  |              | T2       | STEM             |       |                         |       |      |                     |         |        |   |       |   |       |             |            |             |          |            |            |               |                      |          |
| AHAODA       | 30/40         | 132/33     |                  |              | TR1      | STEM             |       |                         |       |      |                     |         |        |   |       |   |       |             |            |             |          |            |            |               |                      |          |
|              | 30/40         | 132/33     |                  |              | TR2      | HYUNDAI          |       |                         |       |      |                     |         |        |   |       |   |       |             |            |             |          |            |            |               |                      |          |
| ELELENWO     | 60            | 132/33     |                  |              | TR1      | SIEMEN           |       |                         |       |      |                     |         |        |   |       |   |       |             |            |             |          |            |            |               |                      |          |
|              | 60            | 132/33     |                  |              | TR2      | SIEMEN           |       |                         |       |      |                     |         |        |   |       |   |       |             |            |             |          |            |            |               |                      |          |
| RUMUSOI      | 60            | 132/33     |                  |              | T1       | BERNZ            |       |                         |       |      |                     |         |        |   |       |   |       |             |            |             |          |            |            |               |                      |          |
|              | 60            | 132/33     |                  |              | T2       | BERNZ            |       |                         |       |      |                     |         |        |   |       |   |       |             |            |             |          |            |            |               |                      |          |
| EKET         | 45            | 132/33     |                  |              | T1B      | ASEA             |       |                         |       |      |                     |         |        |   |       |   |       |             |            |             |          |            |            |               |                      |          |
|              | 60            | 132/33     |                  |              | T2B      | ABB              |       |                         |       |      |                     |         |        |   |       |   |       |             |            |             |          |            |            |               |                      |          |
| CALABAR      | 60            | 132/33     |                  |              | T1       | ASEA             |       |                         |       |      |                     |         |        |   |       |   |       |             |            |             |          |            |            |               |                      |          |
|              | 60            | 132/33     |                  |              | T3       | ABB              |       |                         |       |      |                     |         |        |   |       |   |       |             |            |             |          |            |            |               |                      |          |
| UYO          | 40            | 132/33     |                  |              | T1A      | A.B.B.           |       |                         |       |      |                     |         |        |   |       |   |       |             |            |             |          |            |            |               |                      |          |
|              | 40            | 132/33     |                  |              | T2B      | A.B.B.           |       |                         |       |      |                     |         |        |   |       |   |       |             |            |             |          |            |            |               |                      |          |
| ITU          | 60            | 132/33     |                  |              | T1A      | LEECC            |       |                         |       |      |                     |         |        |   |       |   |       |             |            |             |          |            |            |               |                      |          |
| IRRUA        | 60            | 132/33     | ONAN/ONAF        | YNd11        | T1       | ABB TECH.        |       | 10.1                    |       |      | 8.787               |         |        | 0.445   | 10.09 | 0.387   | 8.778 |             |            |             |          |            |            |               |                      |          |
|              | 30            | 132/33     | ONAN/ONAF        | YNd11        | T2       | ABB TECH.        |       | 9.93                    |       |      | 8.6391              |         |        | 0.55  | 9.915 | 0.478   | 8.626 |             |            |             |          |            |            |               |                      |          |
| EFFURUN      | 60            | 132/33     | ONAN/ONAF        | YNd11        | T21      | FERRANTI         |       | 10.41                   |       |      | 9.0567              |         |        | 0.459   | 10.4  | 0.399   | 9.048 |             |            |             |          |            |            |               |                      |          |
|              | 60            | 132/33     | ONAN/ONAF        | YNd11        | T22      | ELTA             |       |                         |       |      |                     |         |        |   |       |   |       |             |            |             |          |            |            |               |                      |          |
|              | 60            | 132/33     | ONAN/ONAF        | YNd11        | T23      | PAUWELLS         |       | 10.41                   |       |      | 9.0567              |         |        | 0.459   | 10.4  | 0.399   | 9.048 |             |            |             |          |            |            |               |                      |          |
|              |               |            |                  |              |          |                  |       |                         |       |      |                     |         |        |   |       |   |       |             |            |             |          |            |            |               |                      |          |

### Transformer Data

| STATION  | RATINGS(MVA) | Vrated(kV) | COOLING   | VECTOR GROUP | NOMENCL. | MAKE         | TYPE | POS. SEQ. IMPEDANCE (%) |     |     | ZERO SEQ. IMPEDANCE |     |     | Estimated R & X Value for Positive Sequence Impedance (% on Machine Base) |   | Estimated R & X Value for Zero Sequence Impedance (% on Machine Base) |   | LOSSES (kW) | Imag (prr) | NO. OF TAPS | NOM. TAP | REG. ABOVE | REG. BELOW | REG. STEP | COMPENSATING WINDING | EARTHING |
|----------|--------------|------------|-----------|--------------|----------|--------------|------|-------------------------|-----|-----|---------------------|-----|-----|---|---|---|---|-------------|------------|-------------|----------|------------|------------|-----------|----------------------|----------|
|          |              |            |           |              |          |              |      | Z12                     | Z13 | Z23 | Z1N                 | Z2N | Z3N | R   | X | R   | X |             |            |             |          |            |            |           |                      |          |
| OTURKPO  | 7.5          | 132/33     | ONAN/ONAF | YNd11        | T1       | PAUWELS      |      |                         |     |     |                     |     |     |   |   |   |   |             |            |             |          |            |            |           |                      |          |
|          | 30           | 132/33     | ONAN/ONAF | YNd11        | T2       | ABB          |      |                         |     |     |                     |     |     |   |   |   |   |             |            |             |          |            |            |           |                      |          |
| NKALAGU  | 30           | 132/33     | ONAN/ONAF | YNd11        | T1A      | GEN. ELECT.  |      |                         |     |     |                     |     |     |   |   |   |   |             |            |             |          |            |            |           |                      |          |
|          | 30           | 132/33     | ONAN/ONAF | YNd11        | T2A      | ESPANOLA     |      |                         |     |     |                     |     |     |   |   |   |   |             |            |             |          |            |            |           |                      |          |
| YANDEV   | 15           | 132/33     | ONAN/ONAF | YNd11        | T1       | FERRENTI     |      |                         |     |     |                     |     |     |   |   |   |   |             |            |             |          |            |            |           |                      |          |
|          | 60           | 132/33     | ONAN/ONAF | YNd11        | T2       | LEEEC        |      |                         |     |     |                     |     |     |   |   |   |   |             |            |             |          |            |            |           |                      |          |
|          | 45           | 132/33     | ONAN/ONAF | YNd11        | MOB      | mitsubishi   |      |                         |     |     |                     |     |     |   |   |   |   |             |            |             |          |            |            |           |                      |          |
| APIR     | 40           | 132/33     | ONAN/ONAF | YNd11        | MOB      | ABB          |      |                         |     |     |                     |     |     |   |   |   |   |             |            |             |          |            |            |           |                      |          |
| ASABA    | 150          | 330/132/33 | ONAN/ONAF | YNd11        | T1       |              |      |                         |     |     |                     |     |     |   |   |   |   |             |            |             |          |            |            |           |                      |          |
|          | 150          | 330/132/33 | ONAN/ONAF | YNd11        | T2       |              |      |                         |     |     |                     |     |     |   |   |   |   |             |            |             |          |            |            |           |                      |          |
|          | 60           | 132/33     | ONAN/ONAF | YNd11        | TR1      |              |      |                         |     |     |                     |     |     |   |   |   |   |             |            |             |          |            |            |           |                      |          |
|          | 60           | 132/33     | ONAN/ONAF | YNd11        | TR2      |              |      |                         |     |     |                     |     |     |   |   |   |   |             |            |             |          |            |            |           |                      |          |
| AWKA     | 30           | 132/33     | ONAN/ONAF | YNd11        | TR1      | ABB          |      |                         |     |     |                     |     |     |   |   |   |   |             |            |             |          |            |            |           |                      |          |
|          | 30           | 132/33     | ONAN/ONAF | YNd11        | TR3      | PAUWEL TRAFO |      |                         |     |     |                     |     |     |   |   |   |   |             |            |             |          |            |            |           |                      |          |
| AGU-AWKA | 40           | 132/33     | ONAN/ONAF | YNd11        | MOB      | LEEEC        |      |                         |     |     |                     |     |     |   |   |   |   |             |            |             |          |            |            |           |                      |          |
| NSUKKA   | 7.5          | 66/33      | ONAN/ONAF | YNd11        | T1A      | TRAFO-UNION  |      |                         |     |     |                     |     |     |   |   |   |   |             |            |             |          |            |            |           |                      |          |
|          | 7.5          | 66/33      | ONAN/ONAF | YNd11        | T1B      | FOSTER       |      |                         |     |     |                     |     |     |   |   |   |   |             |            |             |          |            |            |           |                      |          |
| OJITS    | 30           | 132/33     | ONAN/ONAF | YNd11        | T1A      | PAUWELL      |      |                         |     |     |                     |     |     |   |   |   |   |             |            |             |          |            |            |           |                      |          |
|          | 15           | 132/66     | ONAN/ONAF | YNd11        | T1B      | SAVIGLIANO   |      |                         |     |     |                     |     |     |   |   |   |   |             |            |             |          |            |            |           |                      |          |

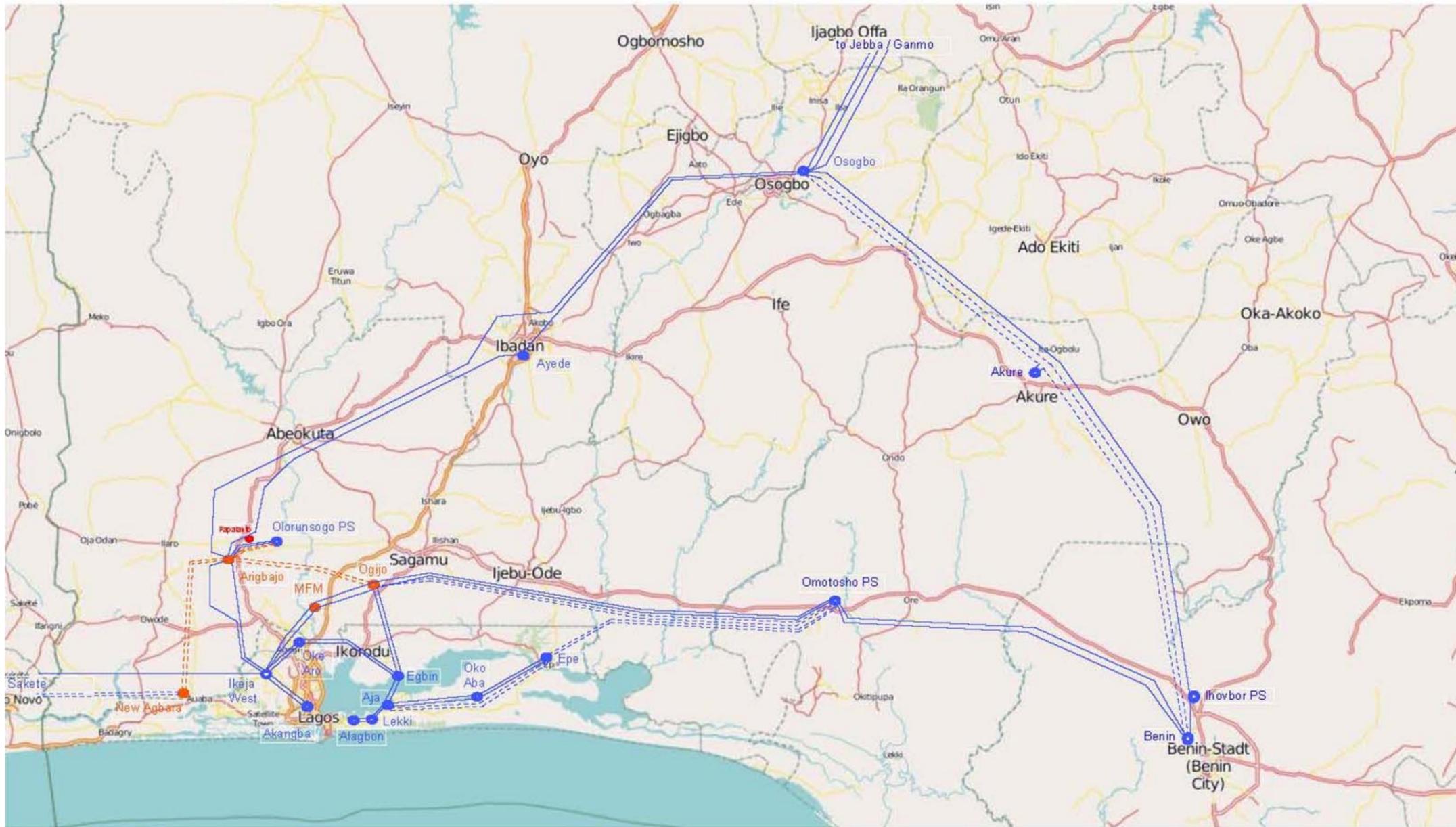


# Generator Data

| STATION                | NOMEN-CLATURE | TYPE | MAKE         | RATING (MVA) | TERMINAL VOLTAGE (kV) | RATED P.F. (pu) | X'' <sub>d sat.</sub> (pu) | X'' <sub>d unsat.</sub> (pu) | X'' <sub>q sat.</sub> (pu) | X'' <sub>q unsat.</sub> (pu) | X' <sub>d sat.</sub> (pu) | X' <sub>d unsat.</sub> (pu) | X' <sub>q sat.</sub> (pu) | X' <sub>q unsat.</sub> (pu) | X <sub>d sat.</sub> (pu) | X <sub>d unsat.</sub> (pu) | X <sub>q sat.</sub> (pu) | X <sub>q unsat.</sub> (pu) | X <sub>2 sat.</sub> (pu) | X <sub>2 unsat.</sub> (pu) | X <sub>0 sat.</sub> (pu) | X <sub>0 unsat.</sub> (pu) | X <sub>L sat.</sub> (pu) | X <sub>L unsat.</sub> (pu) | X <sub>p</sub> (pu) | X <sub>c</sub> (pu) | R <sub>1</sub> (pu) | R <sub>2</sub> (pu) | R <sub>0</sub> (pu) | R <sub>a</sub> (mΩ) | R <sub>i</sub> (mΩ) |  |
|------------------------|---------------|------|--------------|--------------|-----------------------|-----------------|----------------------------|------------------------------|----------------------------|------------------------------|---------------------------|-----------------------------|---------------------------|-----------------------------|--------------------------|----------------------------|--------------------------|----------------------------|--------------------------|----------------------------|--------------------------|----------------------------|--------------------------|----------------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|--|
|                        |               |      |              |              |                       |                 |                            |                              |                            |                              |                           |                             |                           |                             |                          |                            | Page 2a                  |                            |                          |                            |                          |                            |                          |                            |                     |                     |                     |                     |                     |                     |                     |  |
| AFAM IV                | GT16          | GAS  | BBC          | 110          | 11.5± 5               | 0.8             |                            | 0.137                        |                            |                              | 0.211                     |                             |                           |                             | 2.37                     |                            |                          |                            |                          |                            |                          | 0.152                      |                          | 0.081                      |                     |                     |                     |                     |                     |                     |                     |  |
|                        | GT17          | GAS  | BBC          | 110          | 11.5± 5               | 0.8             | 0.133                      | 0.137                        |                            |                              | 0.21                      | 0.211                       |                           |                             | 2.17                     | 2.37                       | 1.95                     |                            |                          |                            |                          | 0.152                      | 0.13                     | 0.081                      |                     |                     |                     |                     |                     |                     |                     |  |
|                        | GT18          | GAS  | BBC          | 110          | 11.5± 5               | 0.8             | 0.133                      | 0.137                        |                            |                              | 0.21                      | 0.211                       |                           |                             | 2.17                     | 2.37                       | 1.95                     |                            |                          |                            |                          | 0.152                      | 0.13                     | 0.081                      |                     |                     |                     |                     |                     |                     |                     |  |
| AFAM V                 | GT19          | GAS  | SIEMENS      | 162.69       | 15.75± 5              | 0.85            | 0.2                        |                              |                            |                              | 0.275                     |                             |                           |                             | 2.3                      |                            | 2.2                      |                            |                          |                            |                          |                            | 0.175                    |                            |                     |                     |                     |                     |                     |                     |                     |  |
|                        | GT20          | GAS  | SIEMENS      | 162.69       | 15.75± 5              | 0.85            | 0.2                        |                              |                            |                              | 0.275                     |                             |                           |                             | 2.3                      |                            | 2.2                      |                            |                          |                            |                          |                            | 0.175                    |                            |                     |                     |                     |                     |                     |                     |                     |  |
| PAPALANTO (OLORUNSOGO) | GT1           | GAS  | GE (FRAME 6) | 48           | 10.5                  | 0.8             | 0.148                      |                              |                            |                              | 0.22                      |                             |                           |                             | 2.47                     | 2                          | 2                        |                            | 0.19                     |                            |                          | 0.095                      |                          |                            | 0.137               | 0.0036 at 20 °C     | 0.132 at 20°C       |                     |                     |                     |                     |  |
|                        | GT2           | GAS  | GE (FRAME 6) | 48           | 10.5                  | 0.8             | 0.148                      |                              |                            |                              | 0.22                      |                             |                           |                             | 2.47                     | 2                          | 2                        |                            | 0.19                     |                            |                          | 0.095                      |                          |                            | 0.137               | 0.0036 at 20 °C     | 0.132 at 20°C       |                     |                     |                     |                     |  |
|                        | GT3           | GAS  | GE (FRAME 6) | 48           | 10.5                  | 0.8             | 0.148                      |                              |                            |                              | 0.22                      |                             |                           |                             | 2.47                     | 2                          | 2                        |                            | 0.19                     |                            |                          | 0.095                      |                          |                            | 0.137               | 0.0036 at 20 °C     | 0.132 at 20°C       |                     |                     |                     |                     |  |
|                        | GT4           | GAS  | GE (FRAME 6) | 48           | 10.5                  | 0.8             | 0.148                      |                              |                            |                              | 0.22                      |                             |                           |                             | 2.47                     | 2                          | 2                        |                            | 0.19                     |                            |                          | 0.095                      |                          |                            | 0.137               | 0.0036 at 20 °C     | 0.132 at 20°C       |                     |                     |                     |                     |  |
|                        | GT5           | GAS  | GE (FRAME 6) | 48           | 10.5                  | 0.8             | 0.148                      |                              |                            |                              | 0.22                      |                             |                           |                             | 2.47                     | 2                          | 2                        |                            | 0.19                     |                            |                          | 0.095                      |                          |                            | 0.137               | 0.0036 at 20 °C     | 0.132 at 20°C       |                     |                     |                     |                     |  |
|                        | GT6           | GAS  | GE (FRAME 6) | 48           | 10.5                  | 0.8             | 0.148                      |                              |                            |                              | 0.22                      |                             |                           |                             | 2.47                     | 2                          | 2                        |                            | 0.19                     |                            |                          | 0.095                      |                          |                            | 0.137               | 0.0036 at 20 °C     | 0.132 at 20°C       |                     |                     |                     |                     |  |
|                        | GT7           | GAS  | GE (FRAME 6) | 48           | 10.5                  | 0.8             | 0.148                      |                              |                            |                              | 0.22                      |                             |                           |                             | 2.47                     | 2                          | 2                        |                            | 0.19                     |                            |                          | 0.095                      |                          |                            | 0.137               | 0.0036 at 20 °C     | 0.132 at 20°C       |                     |                     |                     |                     |  |
|                        | GT8           | GAS  | GE (FRAME 6) | 48           | 10.5                  | 0.8             | 0.148                      |                              |                            |                              | 0.22                      |                             |                           |                             | 2.47                     | 2                          | 2                        |                            | 0.19                     |                            |                          | 0.095                      |                          |                            | 0.137               | 0.0036 at 20 °C     | 0.132 at 20°C       |                     |                     |                     |                     |  |
| OMOTOSO_PHASE I        | GT1           | GAS  | NANJING      | 47.5         | 10.5+/-5%             | 0.8             |                            | 0.17                         |                            | 0.17                         |                           | 0.231                       | 0.231                     |                             |                          | 2.38                       | 2.38                     |                            | 0.1941                   |                            |                          | 0.103                      |                          | 0.137                      |                     |                     |                     |                     |                     | 3.84                | 138.8               |  |
|                        | GT2           | GAS  | NANJING      | 47.5         | 10.5+/-5%             | 0.8             |                            | 0.17                         |                            | 0.17                         |                           | 0.231                       | 0.231                     |                             |                          | 2.38                       | 2.38                     |                            | 0.1941                   |                            |                          | 0.103                      |                          | 0.137                      |                     |                     |                     |                     |                     | 3.84                | 138.8               |  |
|                        | GT3           | GAS  | NANJING      | 47.5         | 10.5+/-5%             | 0.8             |                            | 0.17                         |                            | 0.17                         |                           | 0.231                       | 0.231                     |                             |                          | 2.38                       | 2.38                     |                            | 0.1941                   |                            |                          | 0.103                      |                          | 0.137                      |                     |                     |                     |                     |                     | 3.84                | 138.8               |  |
|                        | GT4           | GAS  | NANJING      | 47.5         | 10.5+/-5%             | 0.8             |                            | 0.17                         |                            | 0.17                         |                           | 0.231                       | 0.231                     |                             |                          | 2.38                       | 2.38                     |                            | 0.1941                   |                            |                          | 0.103                      |                          | 0.137                      |                     |                     |                     |                     |                     | 3.84                | 138.8               |  |
|                        | GT5           | GAS  | NANJING      | 47.5         | 10.5+/-5%             | 0.8             |                            | 0.17                         |                            | 0.17                         |                           | 0.231                       | 0.231                     |                             |                          | 2.38                       | 2.38                     |                            | 0.1941                   |                            |                          | 0.103                      |                          | 0.137                      |                     |                     |                     |                     |                     | 3.84                | 138.8               |  |
|                        | GT6           | GAS  | NANJING      | 47.5         | 10.5+/-5%             | 0.8             |                            | 0.17                         |                            | 0.17                         |                           | 0.231                       | 0.231                     |                             |                          | 2.38                       | 2.38                     |                            | 0.1941                   |                            |                          | 0.103                      |                          | 0.137                      |                     |                     |                     |                     |                     | 3.84                | 138.8               |  |
|                        | GT7           | GAS  | NANJING      | 47.5         | 10.5+/-5%             | 0.8             |                            | 0.17                         |                            | 0.17                         |                           | 0.231                       | 0.231                     |                             |                          | 2.38                       | 2.38                     |                            | 0.1941                   |                            |                          | 0.103                      |                          | 0.137                      |                     |                     |                     |                     |                     | 3.84                | 138.8               |  |
|                        | GT8           | GAS  | NANJING      | 47.5         | 10.5+/-5%             | 0.8             |                            | 0.17                         |                            | 0.17                         |                           | 0.231                       | 0.231                     |                             |                          | 2.38                       | 2.38                     |                            | 0.1941                   |                            |                          | 0.103                      |                          | 0.137                      |                     |                     |                     |                     |                     | 3.84                | 138.8               |  |
| GEREGU                 | GT11          | GAS  | SIEMENS      | 174          | 15.75+/-5%            | 0.85            | 0.121+/-15%                |                              |                            |                              | 0.184+/-15%               |                             |                           |                             | 1.918+/-15%              |                            |                          |                            |                          |                            |                          |                            |                          |                            |                     |                     | 0.0039              |                     | 0.0062              | 5                   |                     |  |
|                        | GT12          | GAS  | SIEMENS      | 174          | 15.75+/-5%            | 0.85            | 0.121+/-15%                |                              |                            |                              | 0.184+/-15%               |                             |                           |                             | 1.918+/-15%              |                            |                          |                            |                          |                            |                          |                            |                          |                            |                     |                     |                     | 0.0039              |                     | 0.0062              | 5                   |  |
|                        | GT13          | GAS  | SIEMENS      | 174          | 15.75+/-5%            | 0.85            | 0.121+/-15%                |                              |                            |                              | 0.184+/-15%               |                             |                           |                             | 1.918+/-15%              |                            |                          |                            |                          |                            |                          |                            |                          |                            |                     |                     |                     | 0.0039              |                     | 0.0062              | 5                   |  |
| ALAOJI (NIPP)          | GT1           | GAS  | GE           | 141.25       | 15                    | 0.85            | 0.132                      | 0.164                        | 0.16                       | 0.195                        | 0.19                      | 0.231                       | 0.23                      | 0.33                        |                          | 1.82                       | 1.35                     | 1.66                       | 0.129                    | 0.16                       |                          | 0.08                       | 0.078                    | 0.119                      | 0.196               | 0.0027 at 75 °C     | 0.0188at 75°C       | 0.0041at 75°C       | 1.2                 | 93                  |                     |  |
|                        | GT2           | GAS  | GE           | 141.25       | 15                    | 0.85            | 0.132                      | 0.164                        | 0.16                       | 0.195                        | 0.19                      | 0.231                       | 0.23                      | 0.33                        |                          | 1.82                       | 1.35                     | 1.66                       | 0.129                    | 0.16                       |                          | 0.08                       | 0.078                    | 0.119                      | 0.196               | 0.0027at 75°C       | 0.0188at 75°C       | 0.0041at 75°C       | 1.2                 | 93                  |                     |  |
|                        | GT3           | GAS  | GE           | 141.25       | 15                    | 0.8             | 0.132                      | 0.164                        | 0.16                       | 0.195                        | 0.19                      | 0.231                       | 0.23                      | 0.33                        |                          | 1.82                       | 1.35                     | 1.66                       | 0.129                    | 0.16                       |                          | 0.08                       | 0.078                    | 0.119                      | 0.196               | 0.0027at 75°C       | 0.0188at 75°C       | 0.0041at 75°C       | 1.2                 | 93                  |                     |  |
| CALABAR (ODUKPANI)     | UNIT1         | GAS  | GE           | 141.25       | 15                    | 0.8             | 0.13                       | 0.164                        | 0.16                       | 0.195                        | 0.19                      | 0.231                       | 0.23                      | 0.33                        |                          | 1.82                       | 1.35                     | 1.66                       | 0.129                    | 0.16                       |                          | 0.08                       | 0.078                    | 0.119                      | 0.196               | 0.0027at 75°C       | 0.0188at 75°C       | 0.0041at 75°C       | 1.2                 | 93                  |                     |  |
|                        | UNIT2         | GAS  | GE           | 141.25       | 15                    | 0.8             | 0.13                       | 0.164                        | 0.16                       | 0.195                        | 0.19                      | 0.231                       | 0.23                      | 0.33                        |                          | 1.82                       | 1.35                     | 1.66                       | 0.129                    | 0.16                       |                          | 0.08                       | 0.078                    | 0.119                      | 0.196               | 0.0027at 75°C       | 0.0188at 75°C       | 0.0041at 75°C       | 1.2                 | 93                  |                     |  |
|                        | UNIT3         | GAS  | GE           | 141.25       | 15                    | 0.8             | 0.13                       | 0.164                        | 0.16                       | 0.195                        | 0.19                      | 0.231                       | 0.23                      | 0.33                        |                          | 1.82                       | 1.35                     | 1.66                       | 0.129                    | 0.16                       |                          | 0.08                       | 0.078                    | 0.119                      | 0.196               | 0.0027at 75°C       | 0.0188at 75°C       | 0.0041at 75°C       | 1.2                 | 93                  |                     |  |
|                        | UNIT4         | GAS  | GE           | 141.25       | 15                    | 0.8             | 0.13                       | 0.164                        | 0.16                       | 0.195                        | 0.19                      | 0.231                       | 0.23                      | 0.33                        |                          | 1.82                       | 1.35                     | 1.66                       | 0.129                    | 0.16                       |                          | 0.08                       | 0.078                    | 0.119                      | 0.196               | 0.0027at 75°C       | 0.0188at 75°C       | 0.0041at 75°C       | 1.2                 | 93                  |                     |  |
|                        | UNIT5         | GAS  | GE           | 141.25       | 15                    | 0.8             | 0.13                       | 0.164                        | 0.16                       | 0.195                        | 0.19                      | 0.231                       | 0.23                      | 0.33                        |                          | 1.82                       | 1.35                     | 1.66                       | 0.129                    | 0.16                       |                          | 0.08                       | 0.078                    | 0.119                      | 0.196               | 0.0027at 75°C       | 0.0188at 75°C       | 0.0041at 75°C       | 1.2                 | 93                  |                     |  |
| EGBEMA                 | UNIT1         | GAS  | GE           | 141.25       | 15                    | 0.8             | 0.13                       | 0.164                        | 0.16                       | 0.195                        | 0.19                      | 0.231                       | 0.23                      | 0.33                        |                          | 1.82                       | 1.35                     | 1.66                       | 0.129                    | 0.16                       |                          | 0.08                       | 0.078                    | 0.119                      | 0.196               | 0.0027at 75°C       | 0.0188at 75°C       | 0.0041at 75°C       | 1.2                 | 93                  |                     |  |
|                        | UNIT2         | GAS  | GE           | 141.25       | 15                    | 0.8             | 0.13                       | 0.164                        | 0.16                       | 0.195                        | 0.19                      | 0.231                       | 0.23                      | 0.33                        |                          | 1.82                       | 1.35                     | 1.66                       | 0.129                    | 0.16                       |                          | 0.08                       | 0.078                    | 0.119                      | 0.196               | 0.0027at 75°C       | 0.0188at 75°C       | 0.0041at 75°C       | 1.2                 | 93                  |                     |  |
|                        | UNIT3         | GAS  | GE           | 141.25       | 15                    | 0.8             | 0.13                       | 0.164                        | 0.16                       | 0.195                        | 0.19                      | 0.231                       | 0.23                      | 0.33                        |                          | 1.82                       | 1.35                     | 1.66                       | 0.129                    | 0.16                       |                          | 0.08                       | 0.078                    | 0.119                      | 0.196               | 0.0027at 75°C       | 0.0188at 75°C       | 0.0041at 75°C       | 1.2                 | 93                  |                     |  |
| EYAN (IHOVBOR)         | UNIT1         | GAS  | GE           | 141.25       | 15                    | 0.8             | 0.13                       | 0.164                        | 0.16                       | 0.195                        | 0.19                      | 0.231                       | 0.23                      | 0.33                        |                          | 1.82                       | 1.35                     | 1.66                       | 0.129                    | 0.16                       |                          | 0.08                       | 0.078                    | 0.119                      | 0.196               | 0.0027at 75°C       | 0.0188at 75°C       | 0.0041at 75°C       | 1.2                 | 93                  |                     |  |
|                        | UNIT2         | GAS  | GE           | 141.25       | 15                    | 0.8             | 0.13                       | 0.164                        | 0.16                       | 0.195                        | 0.19                      | 0.231                       | 0.23                      | 0.33                        |                          | 1.82                       | 1.35                     | 1.66                       | 0.129                    | 0.16                       |                          | 0.08                       | 0.078                    | 0.119                      | 0.196               | 0.0027at 75°C       | 0.0188at 75°C       | 0.0041at 75°C       | 1.2                 | 93                  |                     |  |
|                        | UNIT3         | GAS  | GE           | 141.25       | 15                    | 0.8             | 0.13                       | 0.164                        | 0.16                       | 0.195                        | 0.19                      | 0.231                       | 0.23                      | 0.33                        |                          | 1.82                       | 1.35                     | 1.66                       | 0.129                    | 0.16                       |                          | 0.08                       | 0.078                    | 0.119                      | 0.196               | 0.0027at 75°C       | 0.0188at 75°C       | 0.0041at 75°C       | 1.2                 | 93                  |                     |  |
|                        | UNIT4         | GAS  | GE           | 141.25       | 15                    | 0.8             | 0.13                       | 0.164                        | 0.16                       | 0.195                        | 0.19                      | 0.231                       | 0.23                      | 0.33                        |                          | 1.82                       | 1.35                     | 1.66                       | 0.129                    | 0.16                       |                          | 0.08                       | 0.078                    | 0.119                      | 0.196               | 0.0027at 75°C       | 0.0188at 75°C       | 0.0041at 75°C       | 1.2                 | 93                  |                     |  |
| GBARAN                 | UNIT1         | GAS  | GE           | 141.25       | 15                    | 0.8             | 0.13                       | 0.164                        | 0.16                       | 0.195                        | 0.19                      | 0.231                       | 0.23                      | 0.33                        |                          | 1.82                       | 1.35                     | 1.66                       | 0.129                    | 0.16                       |                          | 0.08                       | 0.078                    | 0.119                      | 0.196               | 0.0027at 75°C       | 0.0188at 75°C       | 0.0041at 75°C       | 1.2                 | 93                  |                     |  |
|                        | UNIT2         | GAS  | GE           | 141.25       | 15                    | 0.8             | 0.13                       | 0.164                        | 0.16                       | 0.195                        | 0.19                      | 0.231                       | 0.23                      | 0.33                        |                          | 1.82                       | 1.35                     | 1.66                       | 0.129                    | 0.16                       |                          | 0.08                       | 0.078                    | 0.119                      | 0.196               | 0.0027at 75°C       | 0.0188at 75°C       | 0.0041at 75°C       | 1.2                 | 93                  |                     |  |
| IKOT ABASI             | UNIT1         | GAS  | GE           | 141.25       | 15                    | 0.8             | 0.13                       | 0.164                        | 0.16                       | 0.195                        | 0.19                      | 0.231                       | 0.23                      | 0.33                        |                          | 1.82                       | 1.35                     | 1.66                       | 0.129                    | 0.16                       |                          | 0.08                       | 0.078                    | 0.119                      | 0.196               | 0.0027at 75°C       | 0.0188at 75°C       | 0.0041at 75°C       | 1.2                 | 93                  |                     |  |
|                        | UNIT2         | GAS  | GE           | 141.25       |                       |                 |                            |                              |                            |                              |                           |                             |                           |                             |                          |                            |                          |                            |                          |                            |                          |                            |                          |                            |                     |                     |                     |                     |                     |                     |                     |  |







**Legend**

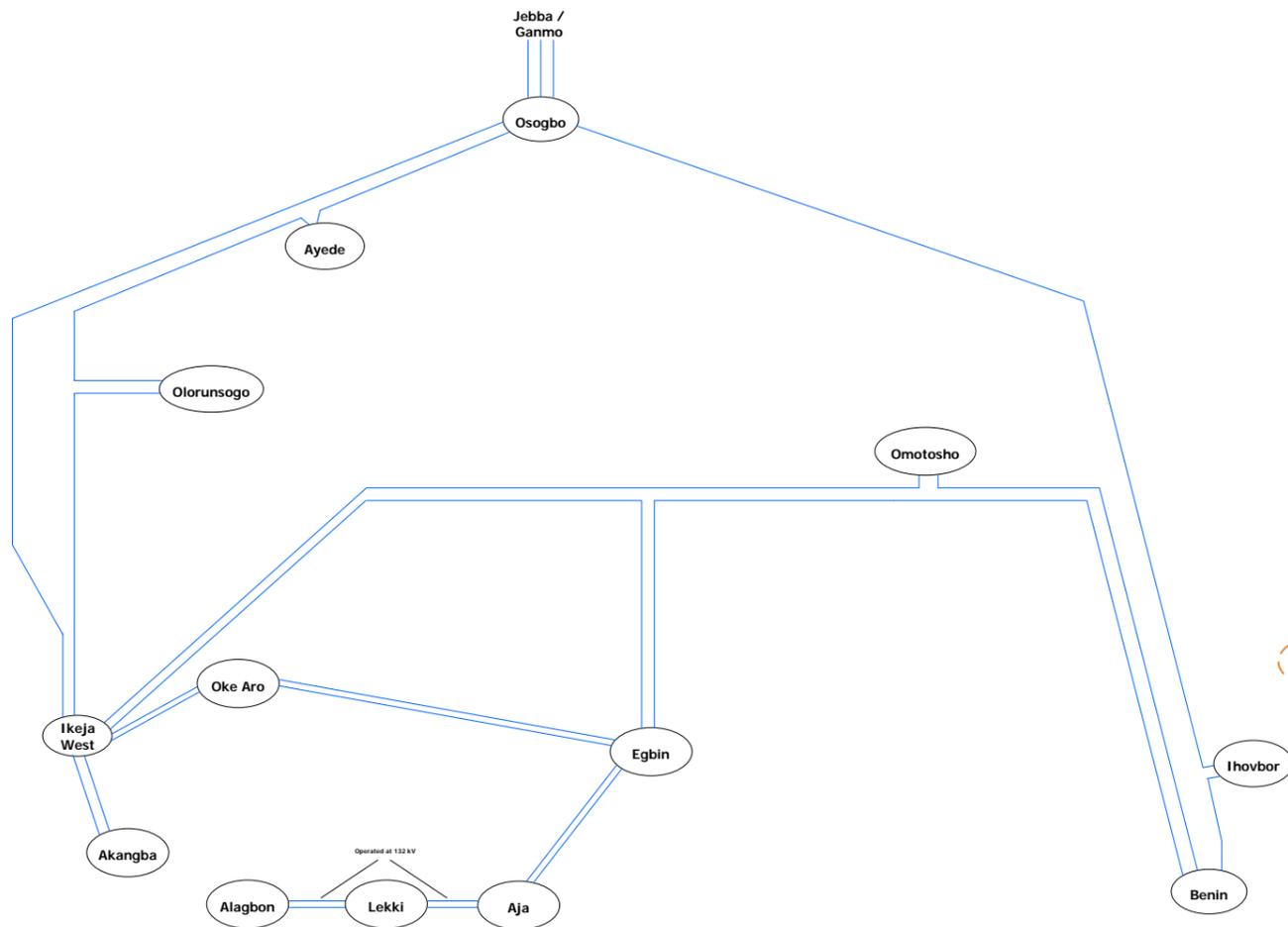
- 330 kV Lines - Existing
- - - - 330 kV Lines – Ongoing TCN / NIPP Projects
- - - - 330 kV Lines – Planned JICA Projects

FICHTNER

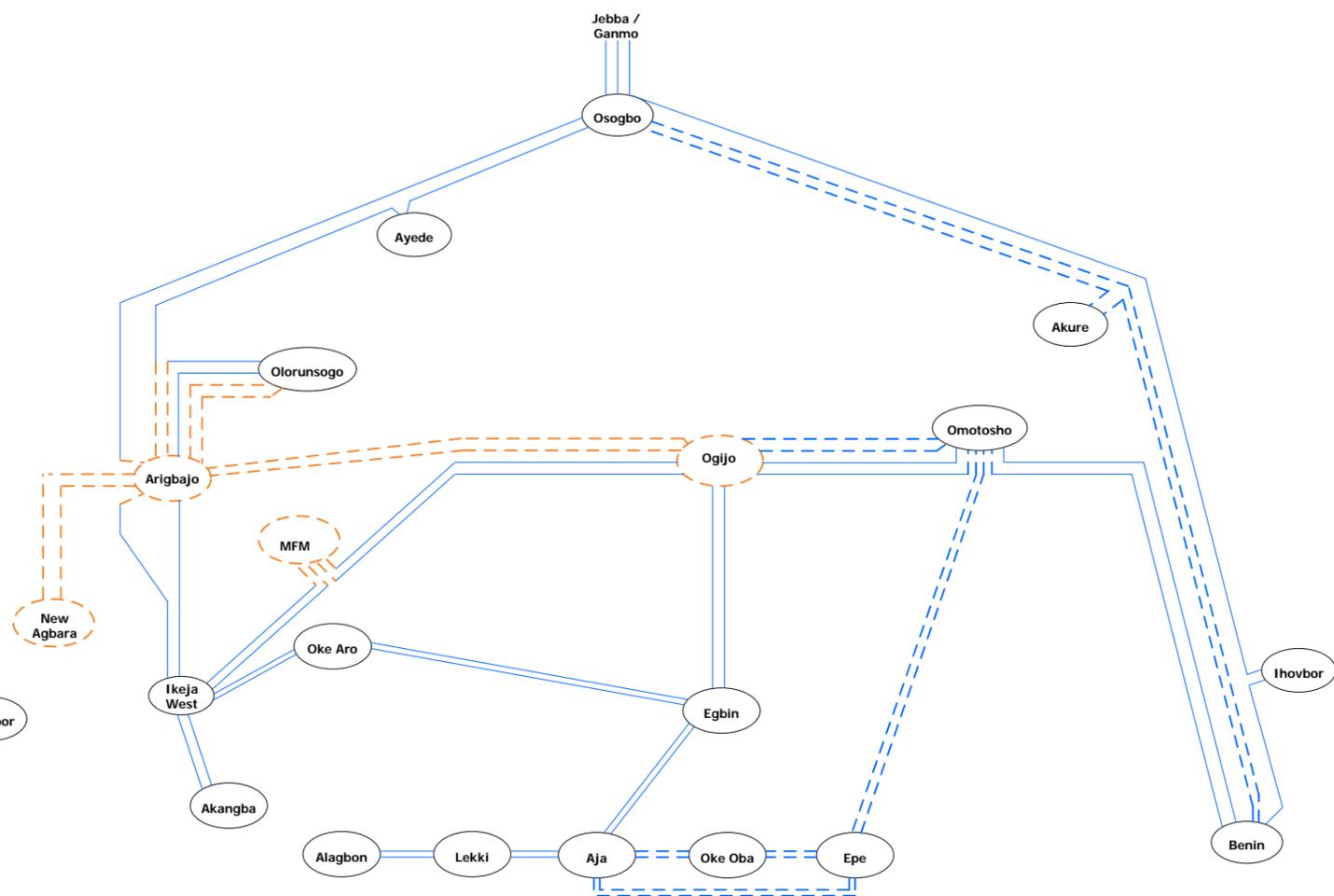
**Annex 4.6a**

|                 |      |                                       |  |              |
|-----------------|------|---------------------------------------|--|--------------|
| D               |      |                                       |  |              |
| C               |      |                                       |  |              |
| B               |      |                                       |  |              |
| A               |      |                                       |  |              |
|                 | Date | Name                                  | Note   |              |
| <b>FICHTNER</b> |      | <b>330 kV Network in Lagos Region</b> |  |              |
| Drawn:          | Date | Name                                  | <b>Network Extensions<br/>under JICA Project</b> | Scale:       |
| Checked:        |      |                                       |  | Sheet:<br>of |
| Supersedes:     |      |                                       |  |              |
| Superseded by:  |      | Size:                                 | Project No. : 8328P01                            | File:        |
| System:         |      | Annex:                                | Drawing No.:                                     |              |

**Existing 330 kV Network Configuration**



**Future 330 kV Network Configuration**



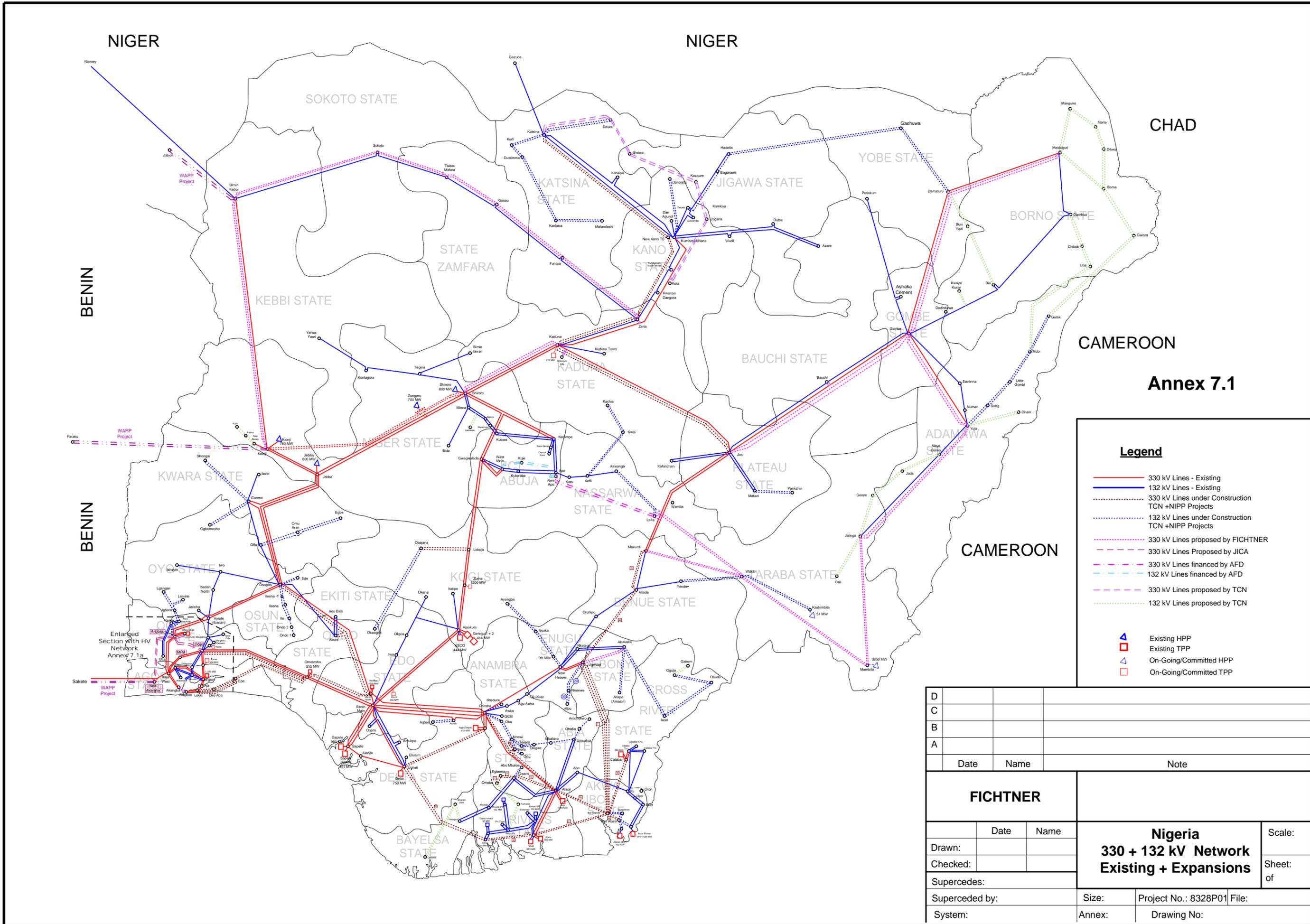
**Legend**

- - - JICA Projects
- - - TCN / NIPP Projects

**Annex 4.6b**

|                 |      |  |                      |
|-----------------|------|--|----------------------|
| D               |      |  |                      |
| C               |      |  |                      |
| B               |      |  |                      |
| A               |      |  |                      |
|                 | Date | Name   | Note                 |
| <b>FICHTNER</b> |      | <b>330 kV Network in Lagos Region</b>            |                      |
| Drawn:          |      | <b>Network Extensions<br/>under JICA Project</b> | Scale:               |
| Checked:        |      |  | Sheet:<br>of         |
| Supersedes:     |      | Size:  | Project No.: 8328P01 |
| Superseded by:  |      | File:  |                      |
| System:         |      | Annex:   | Drawing No:          |





CHAD

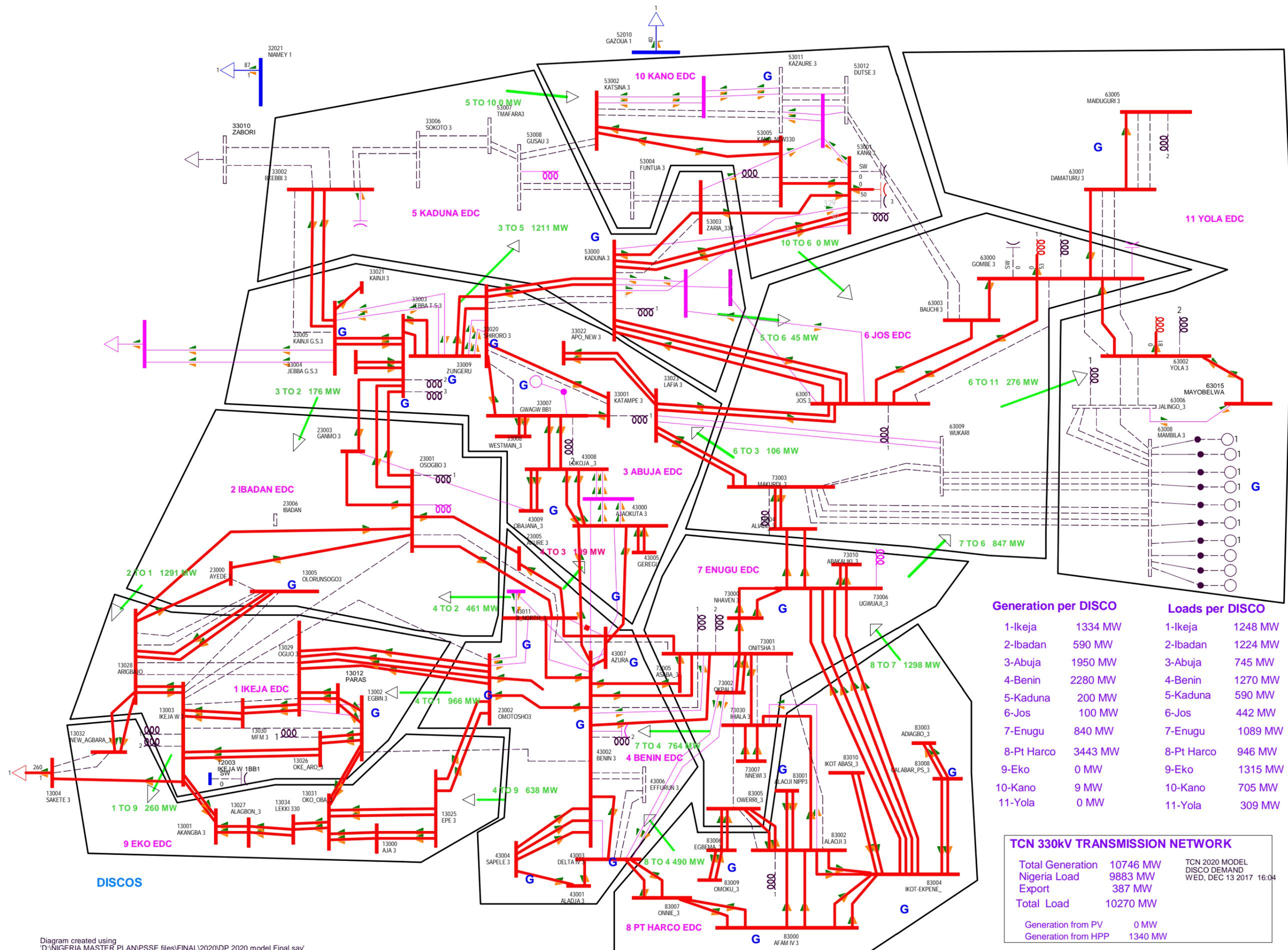
CAMEROON

**Annex 7.1**

**Legend**

- 330 kV Lines - Existing
  - 132 kV Lines - Existing
  - - - 330 kV Lines under Construction TCN +NIPP Projects
  - - - 132 kV Lines under Construction TCN +NIPP Projects
  - · · 330 kV Lines proposed by FICHTNER
  - - - 330 kV Lines Proposed by JICA
  - - - 330 kV Lines financed by AFD
  - - - 132 kV Lines financed by AFD
  - - - 330 kV Lines proposed by TCN
  - - - 132 kV Lines proposed by TCN
- ▲ Existing HPP
  - Existing TPP
  - ▲ On-Going/Committed HPP
  - On-Going/Committed TPP

|                 |        |                      |   |
|-----------------|--------|----------------------|---|
| D               |        |                      |   |
| C               |        |                      |   |
| B               |        |                      |   |
| A               |        |                      |   |
|                 | Date   | Name                 | Note  |
| <b>FICHTNER</b> |        |                      |   |
|                 | Date   | Name                 |   |
| Drawn:          |        |                      | <b>Nigeria<br/>330 + 132 kV Network<br/>Existing + Expansions</b> |
| Checked:        |        |                      |   |
| Supersedes:     |        |                      | Scale:  |
| Superceded by:  |        |                      | Sheet:<br>of  |
| System:         | Annex: | Project No.: 8328P01 | File:   |
|                 |        | Drawing No:          |   |



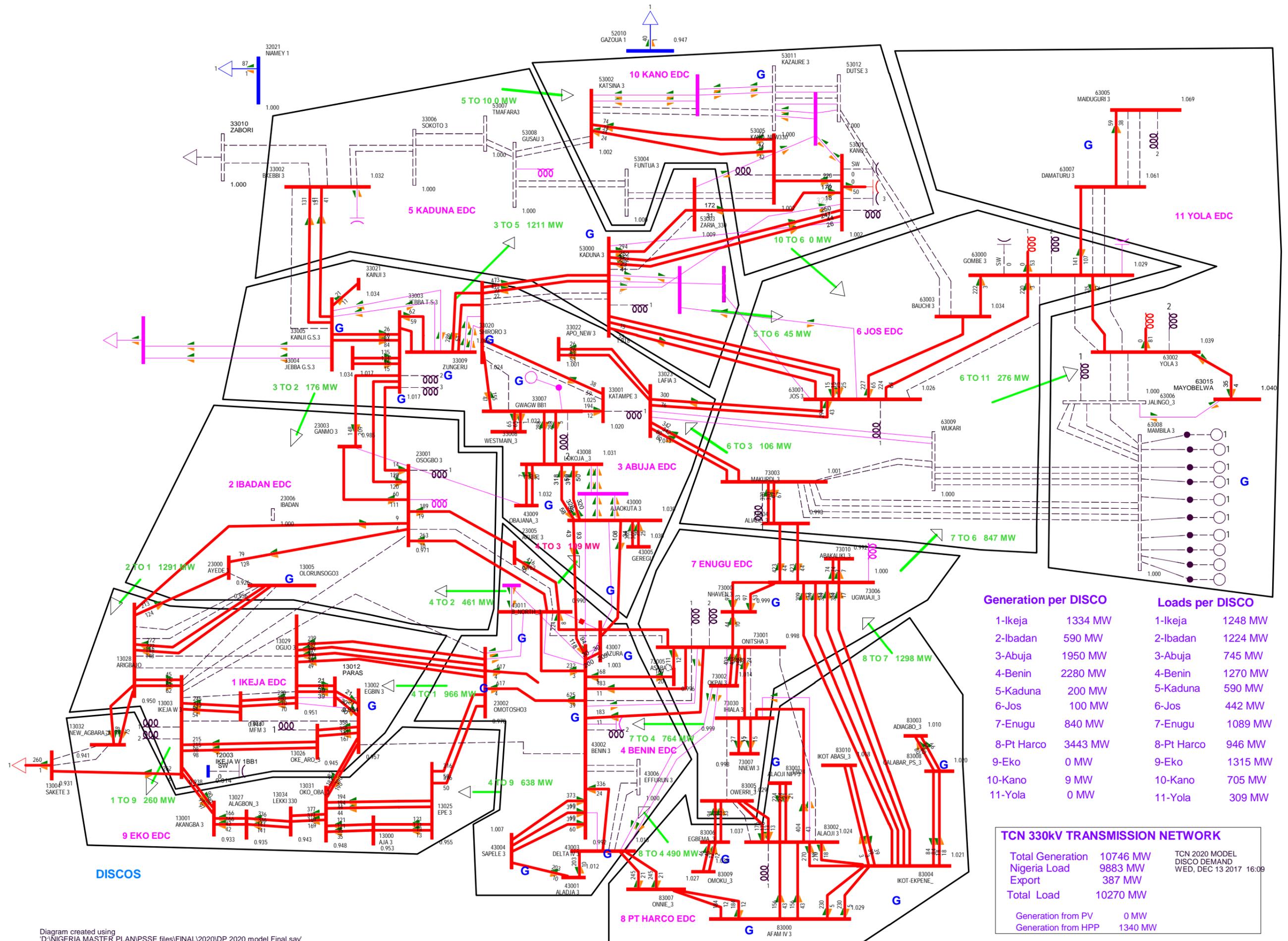
| Generation per DISCO |         | Loads per DISCO |         |
|----------------------|---------|-----------------|---------|
| 1-Ikeja              | 1334 MW | 1-Ikeja         | 1248 MW |
| 2-Ibadan             | 590 MW  | 2-Ibadan        | 1224 MW |
| 3-Abuja              | 1950 MW | 3-Abuja         | 745 MW  |
| 4-Benin              | 2280 MW | 4-Benin         | 1270 MW |
| 5-Kaduna             | 200 MW  | 5-Kaduna        | 590 MW  |
| 6-Jos                | 100 MW  | 6-Jos           | 442 MW  |
| 7-Enugu              | 840 MW  | 7-Enugu         | 1089 MW |
| 8-Pt Harco           | 3443 MW | 8-Pt Harco      | 946 MW  |
| 9-Eko                | 0 MW    | 9-Eko           | 1315 MW |
| 10-Kano              | 9 MW    | 10-Kano         | 705 MW  |
| 11-Yola              | 0 MW    | 11-Yola         | 309 MW  |

| TCN 330kV TRANSMISSION NETWORK |          |  |
|--------------------------------|----------|--|
| Total Generation               | 10746 MW | TCN 2020 MODEL<br>DISCO DEMAND<br>WED, DEC 13 2017 16:04 |
| Nigeria Load                   | 9883 MW  |  |
| Export                         | 387 MW   |  |
| Total Load                     | 10270 MW |  |
| Generation from PV             | 0 MW     |  |
| Generation from HPP            | 1340 MW  |  |

Diagram created using  
 'D:\NIGERIA MASTER PLAN\PSSE files\FINAL\2020\DP 2020 model Final.sav'  
 'D:\NIGERIA MASTER PLAN\PSSE files\FINAL\Diagrams-SLDs-Use Power Exch only\Power Exchanges 330kV model Discos Final with SUPERGRID.sld'

**Annex 7.2**  
**330kV transmission 2020**



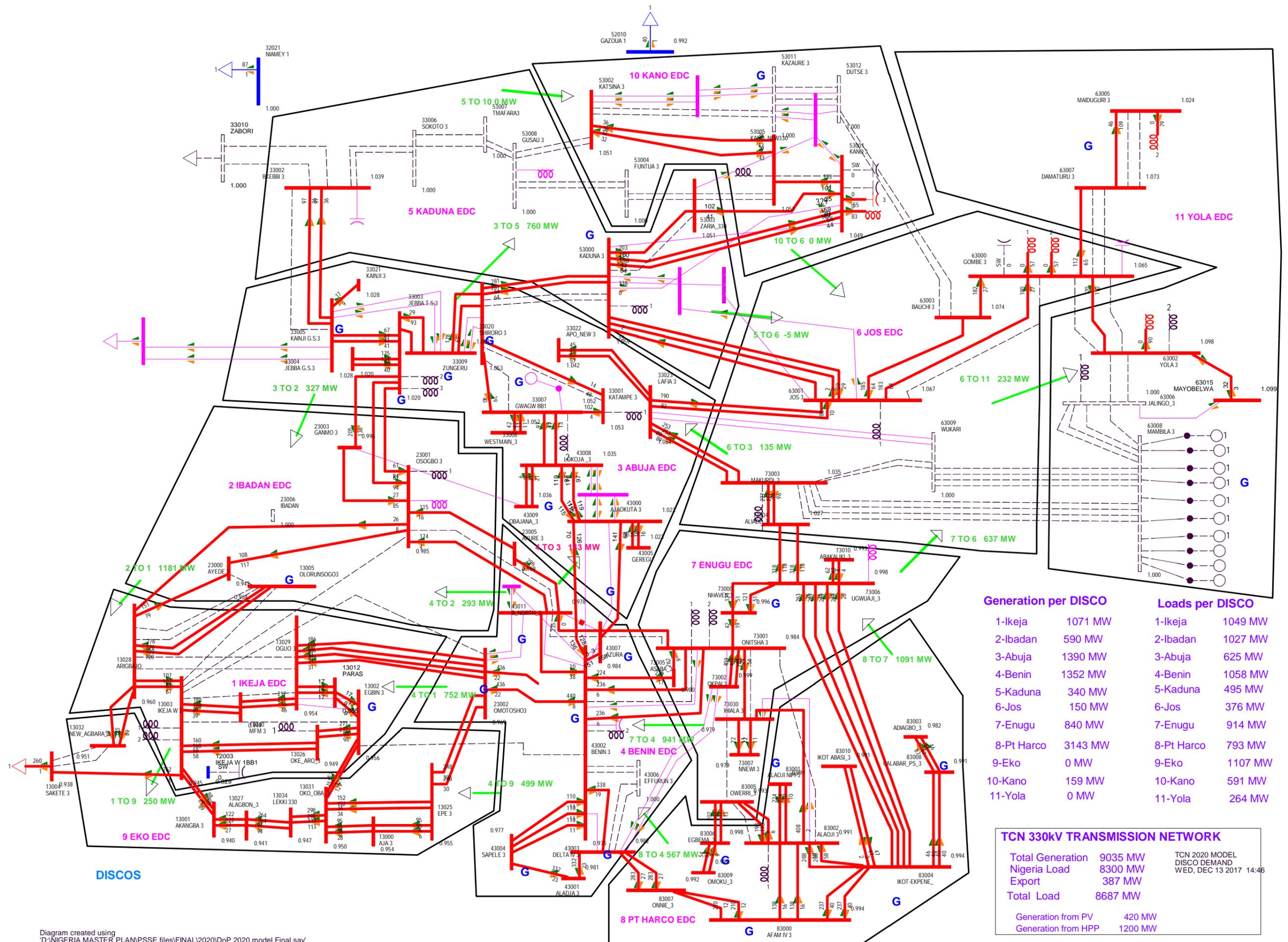


| Generation per DISCO |         | Loads per DISCO |         |
|----------------------|---------|-----------------|---------|
| 1-Ikeja              | 1334 MW | 1-Ikeja         | 1248 MW |
| 2-Ibadan             | 590 MW  | 2-Ibadan        | 1224 MW |
| 3-Abuja              | 1950 MW | 3-Abuja         | 745 MW  |
| 4-Benin              | 2280 MW | 4-Benin         | 1270 MW |
| 5-Kaduna             | 200 MW  | 5-Kaduna        | 590 MW  |
| 6-Jos                | 100 MW  | 6-Jos           | 442 MW  |
| 7-Enugu              | 840 MW  | 7-Enugu         | 1089 MW |
| 8-Pt Harco           | 3443 MW | 8-Pt Harco      | 946 MW  |
| 9-Eko                | 0 MW    | 9-Eko           | 1315 MW |
| 10-Kano              | 9 MW    | 10-Kano         | 705 MW  |
| 11-Yola              | 0 MW    | 11-Yola         | 309 MW  |

| TCN 330kV TRANSMISSION NETWORK |          |  |
|--------------------------------|----------|--|
| Total Generation               | 10746 MW | TCN 2020 MODEL<br>DISCO DEMAND<br>WED, DEC 13 2017 16:09 |
| Nigeria Load                   | 9883 MW  |  |
| Export                         | 387 MW   |  |
| Total Load                     | 10270 MW |  |
| Generation from PV             | 0 MW     |  |
| Generation from HPP            | 1340 MW  |  |

Diagram created using  
 'D:\NIGERIA MASTER PLAN\PSSE files\FINAL\2020\DP 2020 model Final.sav'  
 'D:\NIGERIA MASTER PLAN\PSSE files\FINAL\Diagrams-SLDs-Use Power Exch only\Power Exchanges 330kV model Discos Final with SUPERGRID.sld'

**Annex 7.4a**  
**Dry season Peak 2020**

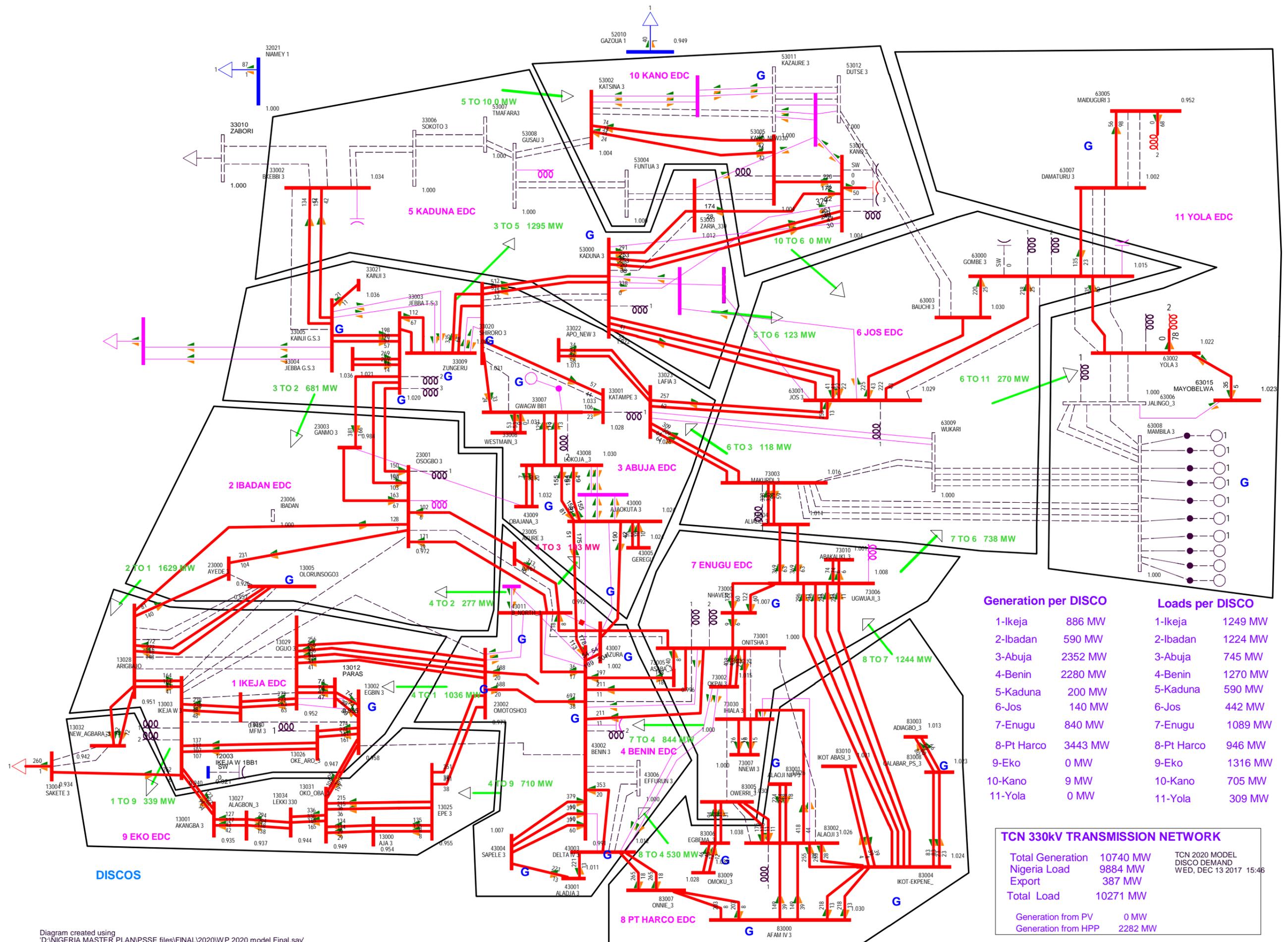


| Generation per DISCO |         | Loads per DISCO |         |
|----------------------|---------|-----------------|---------|
| 1-Ikeja              | 1071 MW | 1-Ikeja         | 1049 MW |
| 2-Ibadan             | 590 MW  | 2-Ibadan        | 1027 MW |
| 3-Abuja              | 1390 MW | 3-Abuja         | 625 MW  |
| 4-Benin              | 1352 MW | 4-Benin         | 1058 MW |
| 5-Kaduna             | 340 MW  | 5-Kaduna        | 495 MW  |
| 6-Jos                | 150 MW  | 6-Jos           | 376 MW  |
| 7-Enugu              | 840 MW  | 7-Enugu         | 914 MW  |
| 8-Pt Harco           | 3143 MW | 8-Pt Harco      | 793 MW  |
| 9-Eko                | 0 MW    | 9-Eko           | 1107 MW |
| 10-Kano              | 159 MW  | 10-Kano         | 591 MW  |
| 11-Yola              | 0 MW    | 11-Yola         | 264 MW  |

| TCN 330kV TRANSMISSION NETWORK |         |  |
|--------------------------------|---------|--|
| Total Generation               | 9035 MW | TCN 2020 MODEL<br>DISCO DEMAND<br>WED, DEC 13 2017 14:46 |
| Nigeria Load                   | 8300 MW |  |
| Export                         | 387 MW  |  |
| Total Load                     | 8687 MW |  |
| Generation from PV             | 420 MW  |  |
| Generation from HPP            | 1200 MW |  |

Diagram created using  
 'D:\NIGERIA MASTER PLAN\PSSE files\FINAL\2020\DoP 2020 model Final.sav'  
 'D:\NIGERIA MASTER PLAN\PSSE files\FINAL\Diagrams-SLDs-Use Power Exch only\Power Exchanges 330kV model Discos Final with SUPERGRID.sld'

**Annex 7.4b**  
**Dry season Off-Peak 2020**



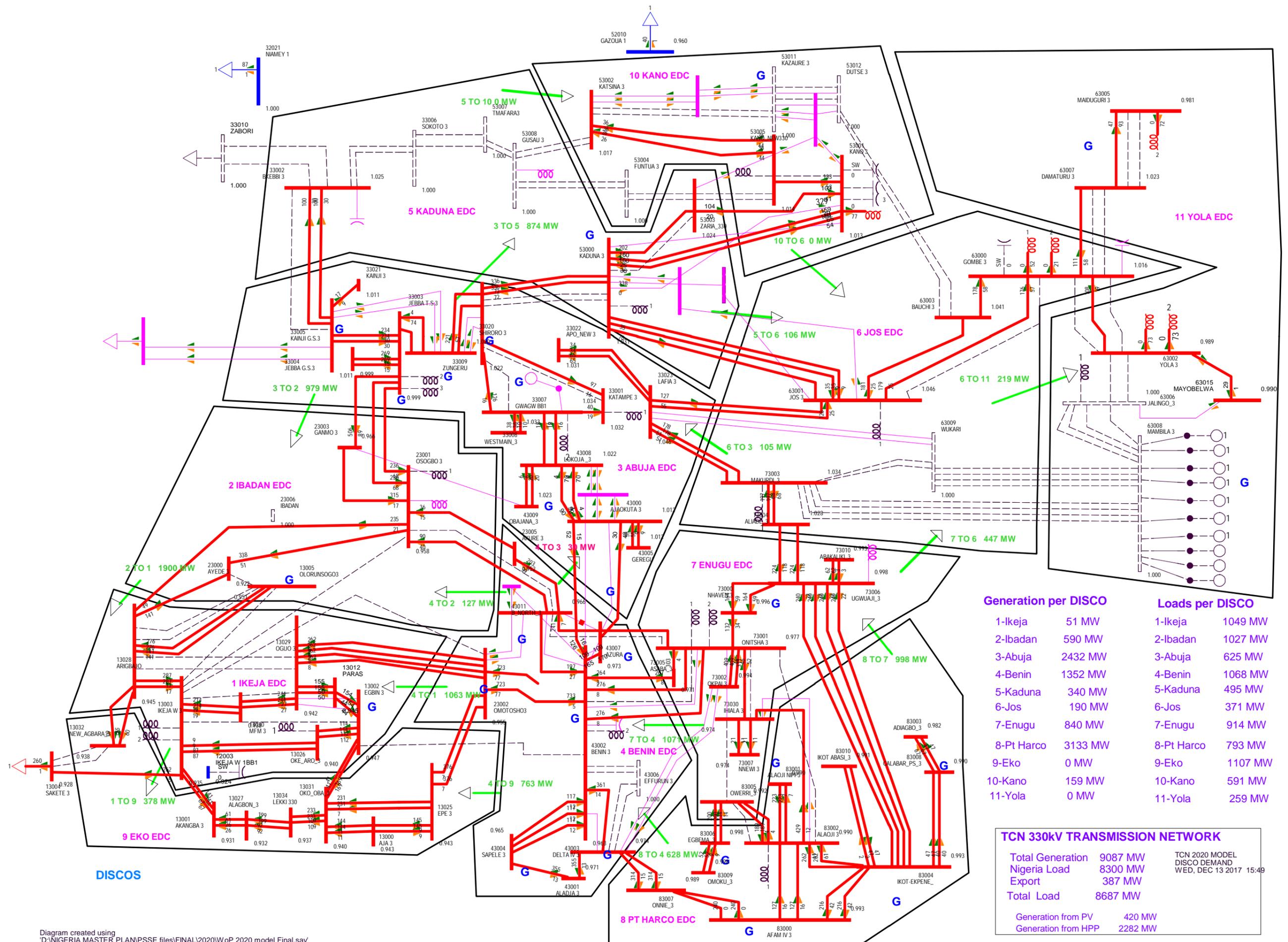
| Generation per DISCO |         | Loads per DISCO |         |
|----------------------|---------|-----------------|---------|
| 1-Ikeja              | 886 MW  | 1-Ikeja         | 1249 MW |
| 2-Ibadan             | 590 MW  | 2-Ibadan        | 1224 MW |
| 3-Abuja              | 2352 MW | 3-Abuja         | 745 MW  |
| 4-Benin              | 2280 MW | 4-Benin         | 1270 MW |
| 5-Kaduna             | 200 MW  | 5-Kaduna        | 590 MW  |
| 6-Jos                | 140 MW  | 6-Jos           | 442 MW  |
| 7-Enugu              | 840 MW  | 7-Enugu         | 1089 MW |
| 8-Pt Harco           | 3443 MW | 8-Pt Harco      | 946 MW  |
| 9-Eko                | 0 MW    | 9-Eko           | 1316 MW |
| 10-Kano              | 9 MW    | 10-Kano         | 705 MW  |
| 11-Yola              | 0 MW    | 11-Yola         | 309 MW  |

| TCN 330kV TRANSMISSION NETWORK |          |
|--------------------------------|----------|
| Total Generation               | 10740 MW |
| Nigeria Load                   | 9884 MW  |
| Export                         | 387 MW   |
| Total Load                     | 10271 MW |
| Generation from PV             | 0 MW     |
| Generation from HPP            | 2282 MW  |

TCN 2020 MODEL DISCO DEMAND WED, DEC 13 2017 15:46

Diagram created using  
 'D:\NIGERIA MASTER PLAN\PSSE files\FINAL\2020\WP 2020 model Final.sav'  
 'D:\NIGERIA MASTER PLAN\PSSE files\FINAL\Diagrams-SLDs-Use Power Exch only\Power Exchanges 330kV model Discos Final with SUPERGRID.sld'

**Annex 7.4c**  
**Wet season Peak 2020**

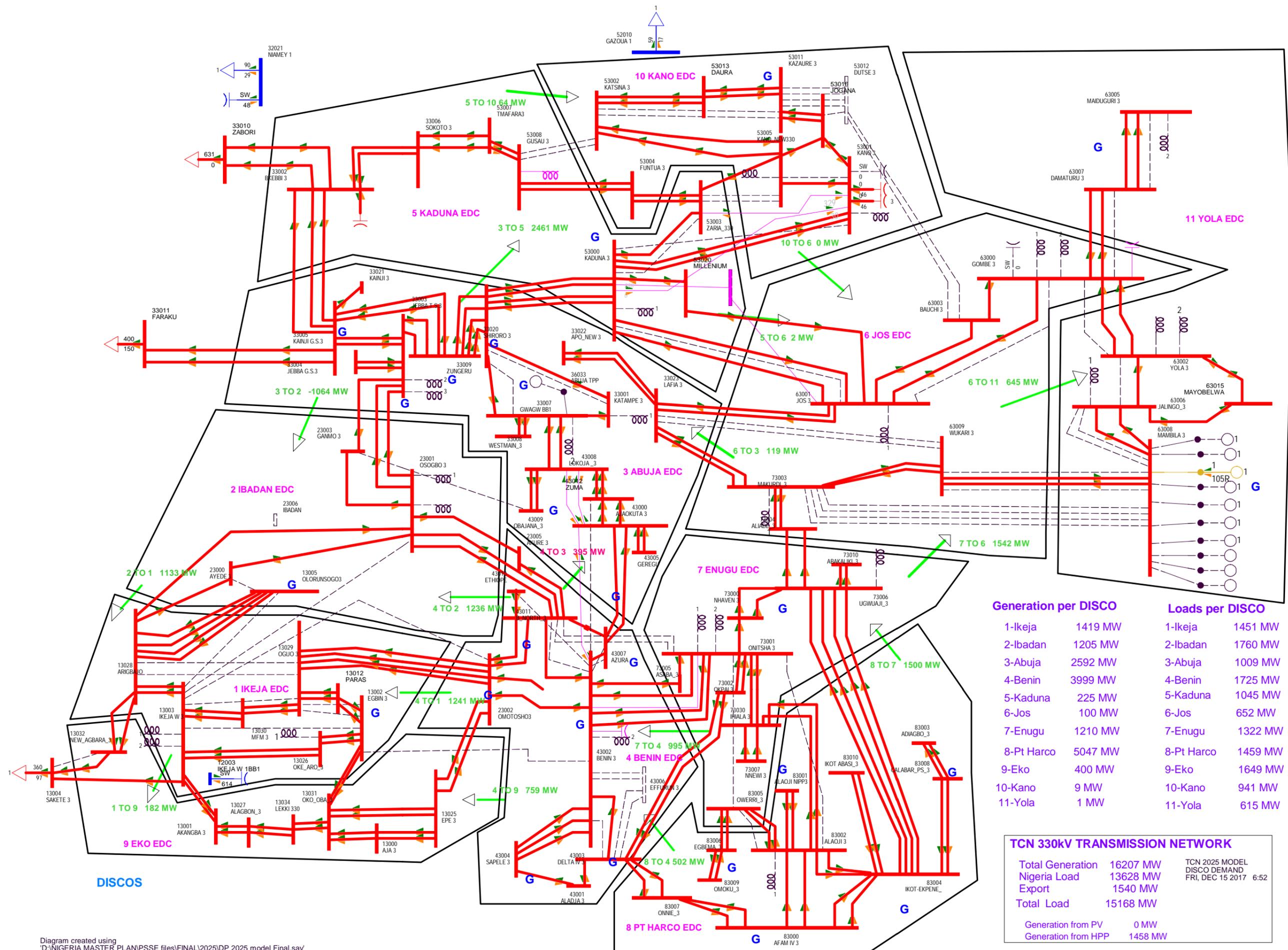


| Generation per DISCO |         | Loads per DISCO |         |
|----------------------|---------|-----------------|---------|
| 1-Ikeja              | 51 MW   | 1-Ikeja         | 1049 MW |
| 2-Ibadan             | 590 MW  | 2-Ibadan        | 1027 MW |
| 3-Abuja              | 2432 MW | 3-Abuja         | 625 MW  |
| 4-Benin              | 1352 MW | 4-Benin         | 1068 MW |
| 5-Kaduna             | 340 MW  | 5-Kaduna        | 495 MW  |
| 6-Jos                | 190 MW  | 6-Jos           | 371 MW  |
| 7-Enugu              | 840 MW  | 7-Enugu         | 914 MW  |
| 8-Pt Harco           | 3133 MW | 8-Pt Harco      | 793 MW  |
| 9-Eko                | 0 MW    | 9-Eko           | 1107 MW |
| 10-Kano              | 159 MW  | 10-Kano         | 591 MW  |
| 11-Yola              | 0 MW    | 11-Yola         | 259 MW  |

| TCN 330kV TRANSMISSION NETWORK |         |  |
|--------------------------------|---------|--|
| Total Generation               | 9087 MW | TCN 2020 MODEL<br>DISCO DEMAND<br>WED, DEC 13 2017 15:49 |
| Nigeria Load                   | 8300 MW |  |
| Export                         | 387 MW  |  |
| Total Load                     | 8687 MW |  |
| Generation from PV             | 420 MW  |  |
| Generation from HPP            | 2282 MW |  |

Diagram created using  
 'D:\NIGERIA MASTER PLAN\PSSE files\FINAL\2020\WOP 2020 model Final.sav'  
 'D:\NIGERIA MASTER PLAN\PSSE files\FINAL\Diagrams-SLDs-Use Power Exch only\Power Exchanges 330kV model Discos Final with SUPERGRID.sld'

**Annex 7.4d**  
**Wet season Off-Peak 2020**

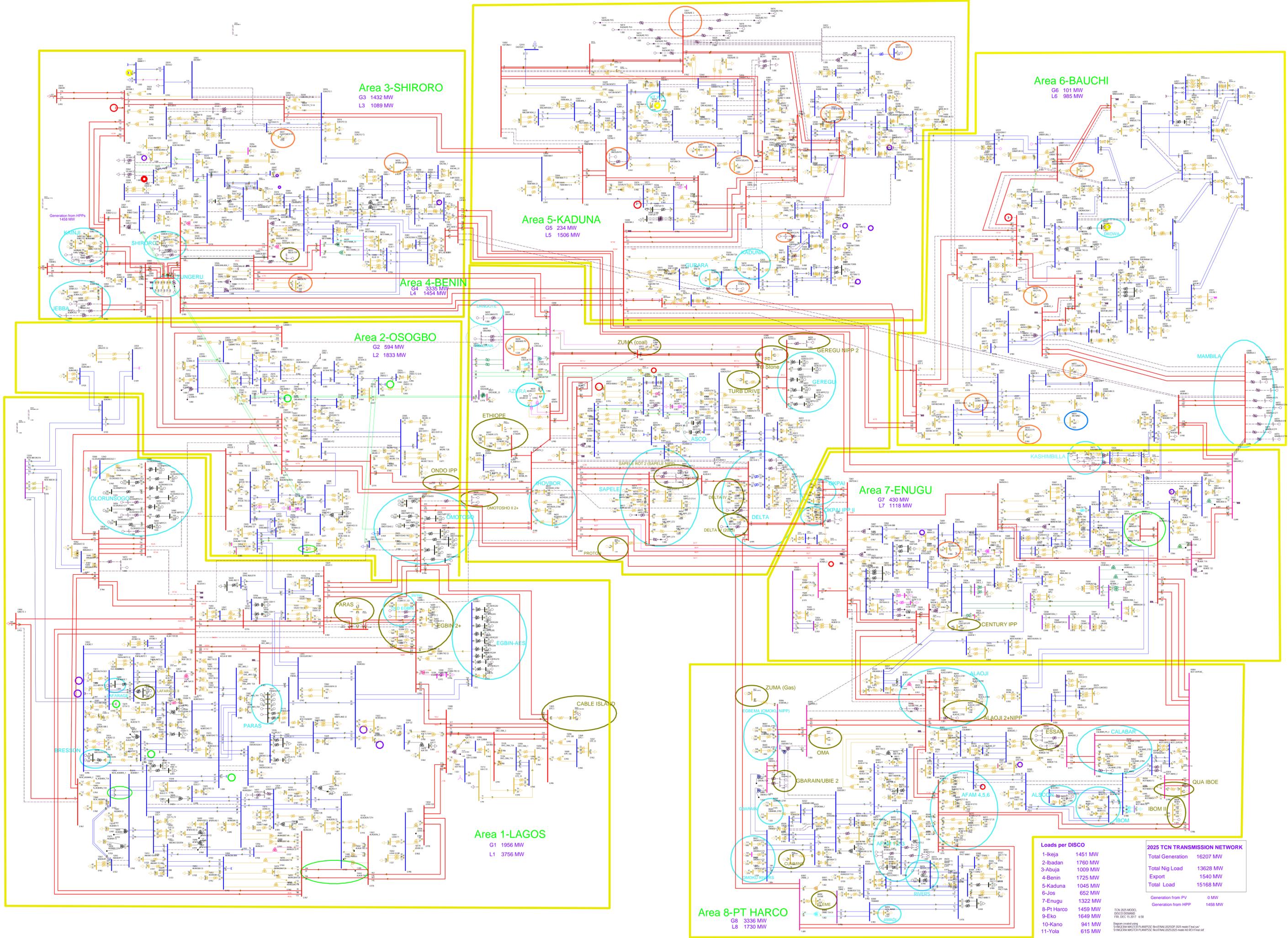


| Generation per DISCO |         | Loads per DISCO |         |
|----------------------|---------|-----------------|---------|
| 1-Ikeja              | 1419 MW | 1-Ikeja         | 1451 MW |
| 2-Ibadan             | 1205 MW | 2-Ibadan        | 1760 MW |
| 3-Abuja              | 2592 MW | 3-Abuja         | 1009 MW |
| 4-Benin              | 3999 MW | 4-Benin         | 1725 MW |
| 5-Kaduna             | 225 MW  | 5-Kaduna        | 1045 MW |
| 6-Jos                | 100 MW  | 6-Jos           | 652 MW  |
| 7-Enugu              | 1210 MW | 7-Enugu         | 1322 MW |
| 8-Pt Harco           | 5047 MW | 8-Pt Harco      | 1459 MW |
| 9-Eko                | 400 MW  | 9-Eko           | 1649 MW |
| 10-Kano              | 9 MW    | 10-Kano         | 941 MW  |
| 11-Yola              | 1 MW    | 11-Yola         | 615 MW  |

| TCN 330kV TRANSMISSION NETWORK |                 |   |
|--------------------------------|-----------------|---|
| Total Generation               | 16207 MW        | TCN 2025 MODEL DISCO DEMAND FRI, DEC 15 2017 6:52 |
| Nigeria Load                   | 13628 MW        |   |
| Export                         | 1540 MW         |   |
| <b>Total Load</b>              | <b>15168 MW</b> |   |
| Generation from PV             | 0 MW            |   |
| Generation from HPP            | 1458 MW         |   |

Diagram created using  
 'D:\NIGERIA MASTER PLAN\PSSSE files\FINAL\2025\DP 2025 model Final.sav'  
 'D:\NIGERIA MASTER PLAN\PSSSE files\FINAL\Diagrams-SLDs-Use Power Exch only\Power Exchanges 330kV model Discos Final with SUPERGRID.sld'

**Annex 7.5**  
**330kV transmission 2025**



**Area 3-SHIRORO**  
 G3 1432 MW  
 L3 1089 MW

**Area 6-BAUCHI**  
 G6 101 MW  
 L6 985 MW

**Area 5-KADUNA**  
 G5 234 MW  
 L5 1506 MW

**Area 4-BENIN**  
 G4 3335 MW  
 L4 1454 MW

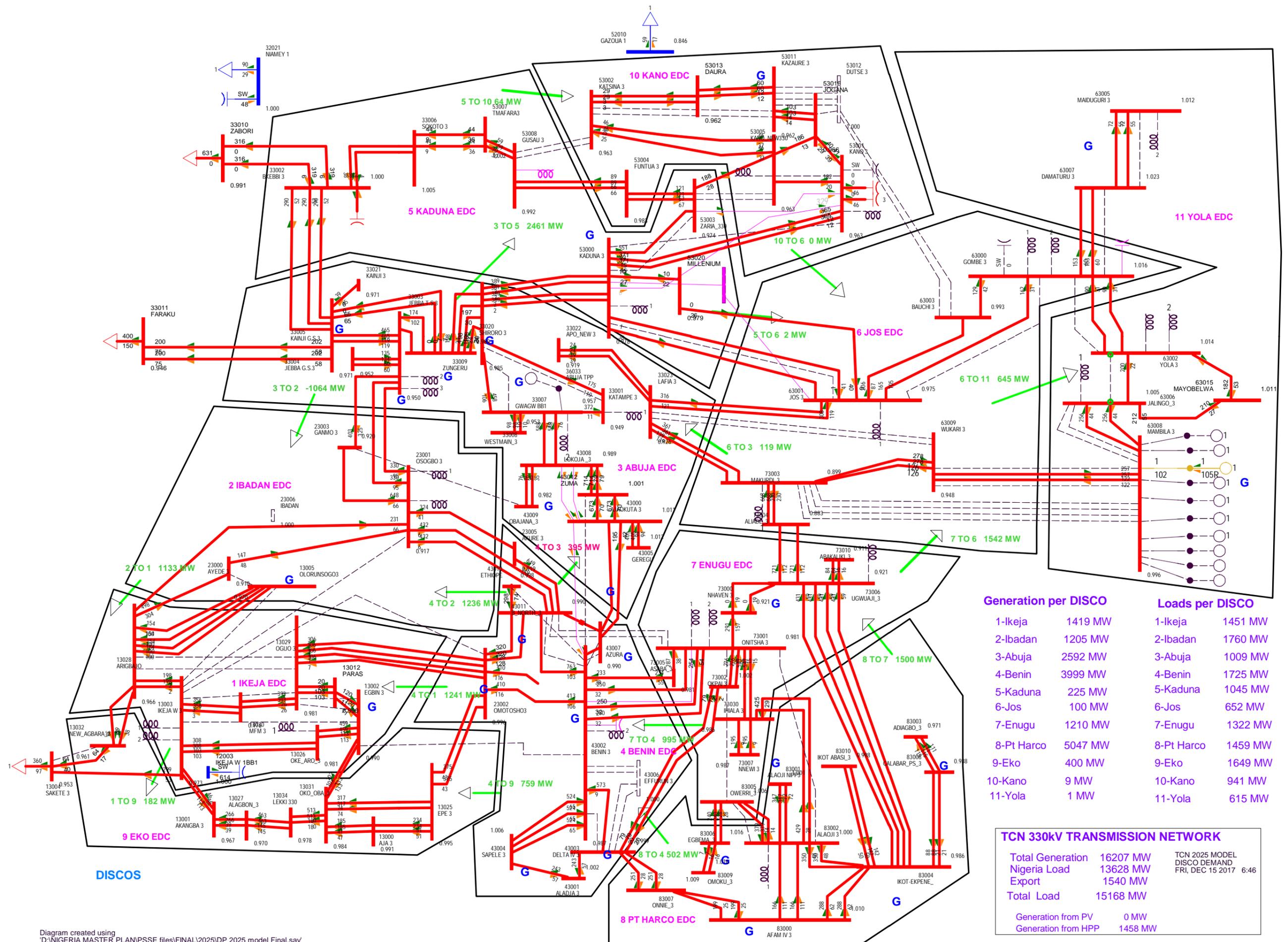
**Area 2-OSOGBO**  
 G2 594 MW  
 L2 1833 MW

**Area 7-ENUGU**  
 G7 430 MW  
 L7 1118 MW

**Area 1-LAGOS**  
 G1 1956 MW  
 L1 3756 MW

**Area 8-PT HARCO**  
 G8 3336 MW  
 L8 1730 MW

| Loads per DISCO |         | 2025 TCN TRANSMISSION NETWORK |          |
|-----------------|---------|-------------------------------|----------|
| 1-Ikeja         | 1451 MW | Total Generation              | 16207 MW |
| 2-Ibadan        | 1760 MW | Total Nig Load                | 13628 MW |
| 3-Abuja         | 1009 MW | Export                        | 1540 MW  |
| 4-Benin         | 1725 MW | Total Load                    | 15168 MW |
| 5-Kaduna        | 1045 MW |                               |          |
| 6-Jos           | 652 MW  | Generation from PV            | 0 MW     |
| 7-Enugu         | 1322 MW | Generation from HPP           | 1458 MW  |
| 8-Pt Harco      | 1459 MW |                               |          |
| 9-Eko           | 1649 MW |                               |          |
| 10-Kano         | 941 MW  |                               |          |
| 11-Yola         | 615 MW  |                               |          |

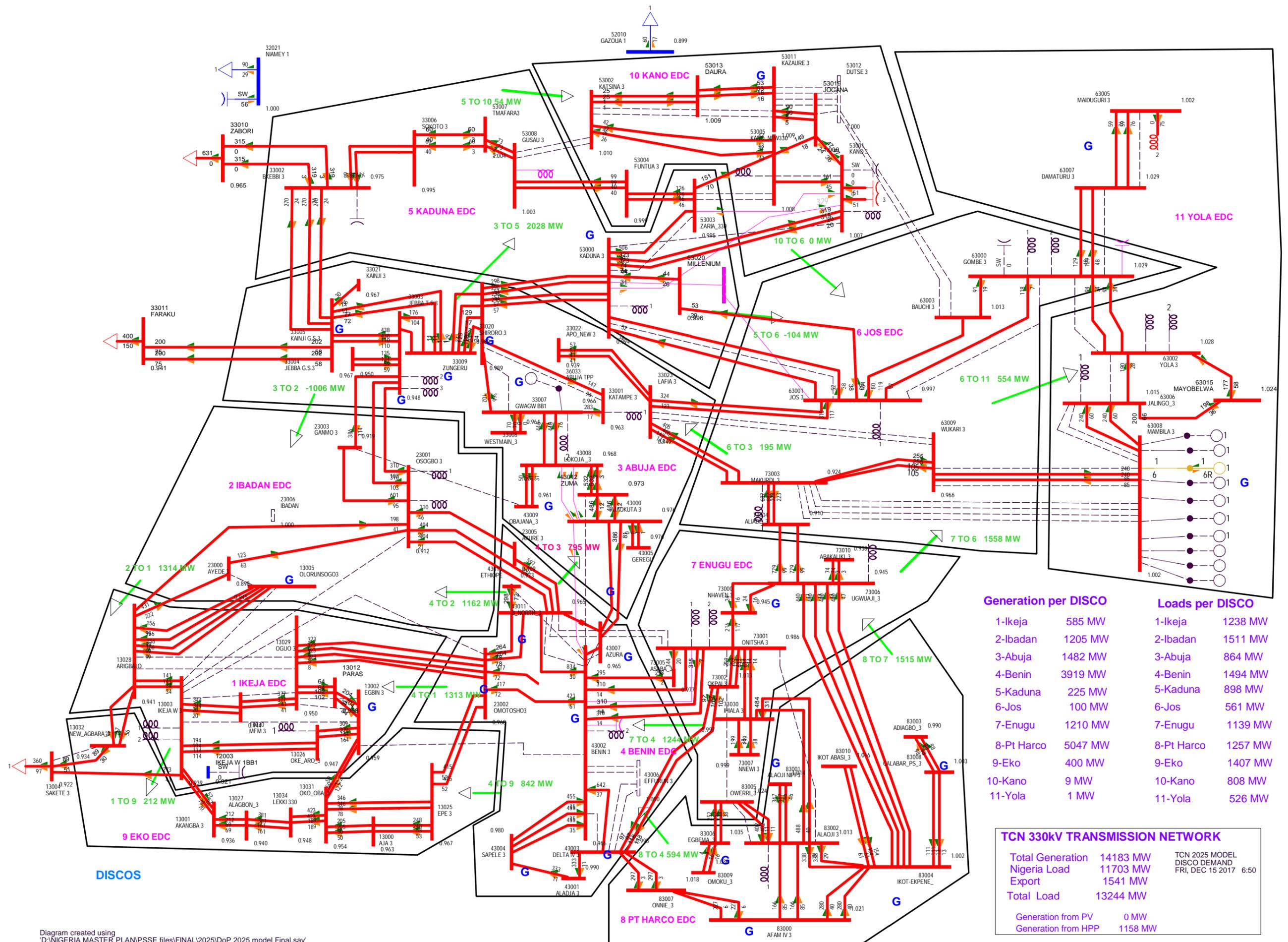


| Generation per DISCO |         | Loads per DISCO |         |
|----------------------|---------|-----------------|---------|
| 1-Ikeja              | 1419 MW | 1-Ikeja         | 1451 MW |
| 2-Ibadan             | 1205 MW | 2-Ibadan        | 1760 MW |
| 3-Abuja              | 2592 MW | 3-Abuja         | 1009 MW |
| 4-Benin              | 3999 MW | 4-Benin         | 1725 MW |
| 5-Kaduna             | 225 MW  | 5-Kaduna        | 1045 MW |
| 6-Jos                | 100 MW  | 6-Jos           | 652 MW  |
| 7-Enugu              | 1210 MW | 7-Enugu         | 1322 MW |
| 8-Pt Harco           | 5047 MW | 8-Pt Harco      | 1459 MW |
| 9-Eko                | 400 MW  | 9-Eko           | 1649 MW |
| 10-Kano              | 9 MW    | 10-Kano         | 941 MW  |
| 11-Yola              | 1 MW    | 11-Yola         | 615 MW  |

| TCN 330kV TRANSMISSION NETWORK |          |   |
|--------------------------------|----------|---|
| Total Generation               | 16207 MW | TCN 2025 MODEL<br>DISCO DEMAND<br>FRI, DEC 15 2017 6:46 |
| Nigeria Load                   | 13628 MW |   |
| Export                         | 1540 MW  |   |
| Total Load                     | 15168 MW |   |
| Generation from PV             | 0 MW     |   |
| Generation from HPP            | 1458 MW  |   |

Diagram created using  
 'D:\NIGERIA MASTER PLAN\PSSE files\FINAL\2025\DP 2025 model Final.sav'  
 'D:\NIGERIA MASTER PLAN\PSSE files\FINAL\Diagrams-SLDs-Use Power Exch only\Power Exchanges 330kV model Discos Final with SUPERGRID.sld'

**Annex 7.7a**  
**Dry season Peak 2025**



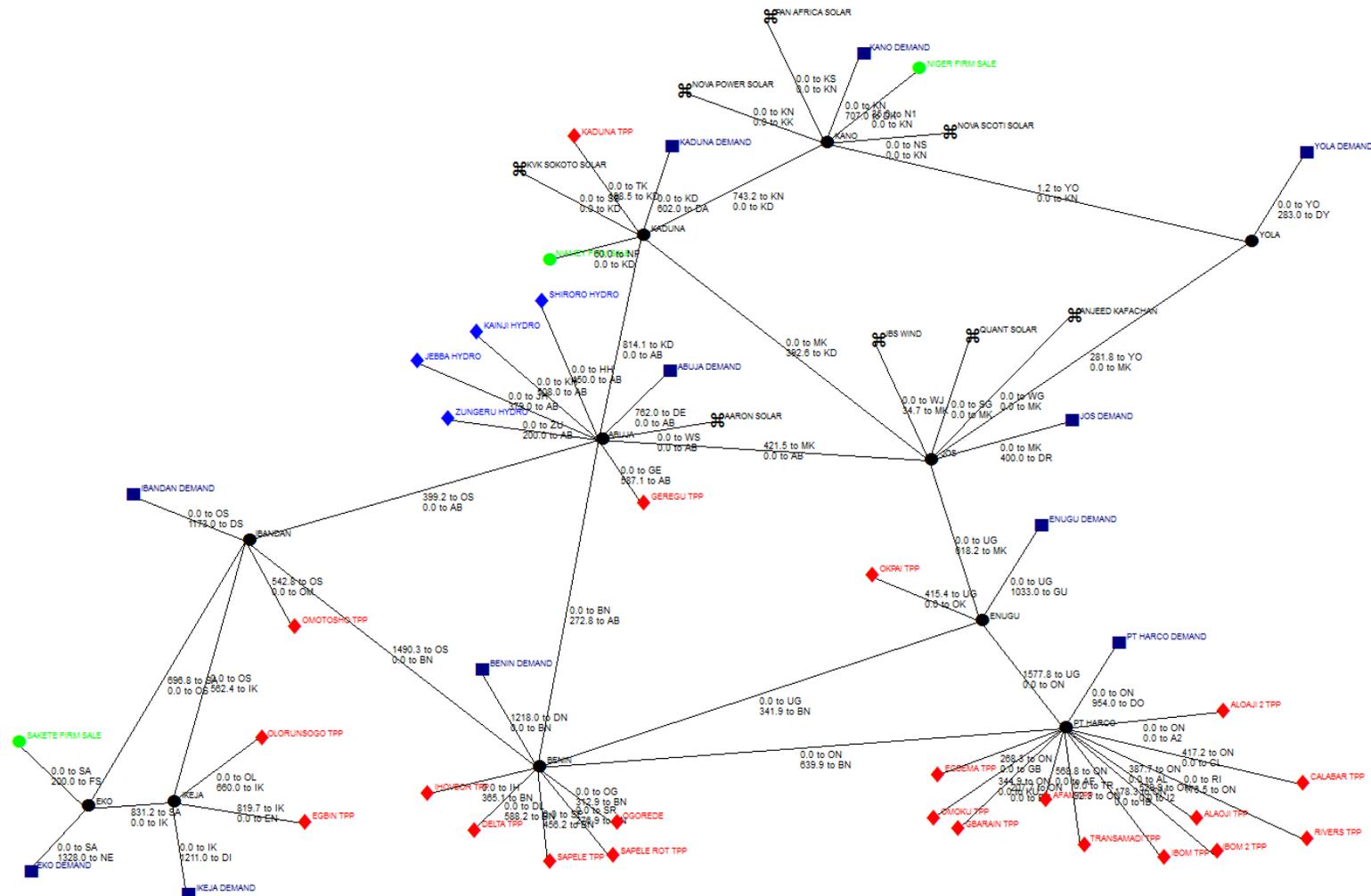
| Generation per DISCO |         | Loads per DISCO |         |
|----------------------|---------|-----------------|---------|
| 1-Ikeja              | 585 MW  | 1-Ikeja         | 1238 MW |
| 2-Ibadan             | 1205 MW | 2-Ibadan        | 1511 MW |
| 3-Abuja              | 1482 MW | 3-Abuja         | 864 MW  |
| 4-Benin              | 3919 MW | 4-Benin         | 1494 MW |
| 5-Kaduna             | 225 MW  | 5-Kaduna        | 898 MW  |
| 6-Jos                | 100 MW  | 6-Jos           | 561 MW  |
| 7-Enugu              | 1210 MW | 7-Enugu         | 1139 MW |
| 8-Pt Harco           | 5047 MW | 8-Pt Harco      | 1257 MW |
| 9-Eko                | 400 MW  | 9-Eko           | 1407 MW |
| 10-Kano              | 9 MW    | 10-Kano         | 808 MW  |
| 11-Yola              | 1 MW    | 11-Yola         | 526 MW  |

| TCN 330kV TRANSMISSION NETWORK |                 |   |
|--------------------------------|-----------------|---|
| Total Generation               | 14183 MW        | TCN 2025 MODEL DISCO DEMAND FRI, DEC 15 2017 6:50 |
| Nigeria Load                   | 11703 MW        |   |
| Export                         | 1541 MW         |   |
| <b>Total Load</b>              | <b>13244 MW</b> |   |
| Generation from PV             | 0 MW            |   |
| Generation from HPP            | 1158 MW         |   |

Diagram created using  
 'D:\NIGERIA MASTER PLAN\PSSSE files\FINAL\2025\DoP 2025 model Final.sav'  
 'D:\NIGERIA MASTER PLAN\PSSSE files\FINAL\Diagrams-SLDs-Use Power Exch only\Power Exchanges 330kV model Discos Final with SUPERGRID.sld'

**Annex 7.7b**  
**Dry season Off-Peak 2025**

| Node | Water Links | Transmission Link | Heat Pipeline | Fuel Transport | Year | Week        | Day  | Hour |
|------|-------------|-------------------|---------------|----------------|------|-------------|------|------|
| ame  | None        | Energy Flow       | None          | None           | 2000 | 1: 1 Jan W1 | Sun. | 21   |

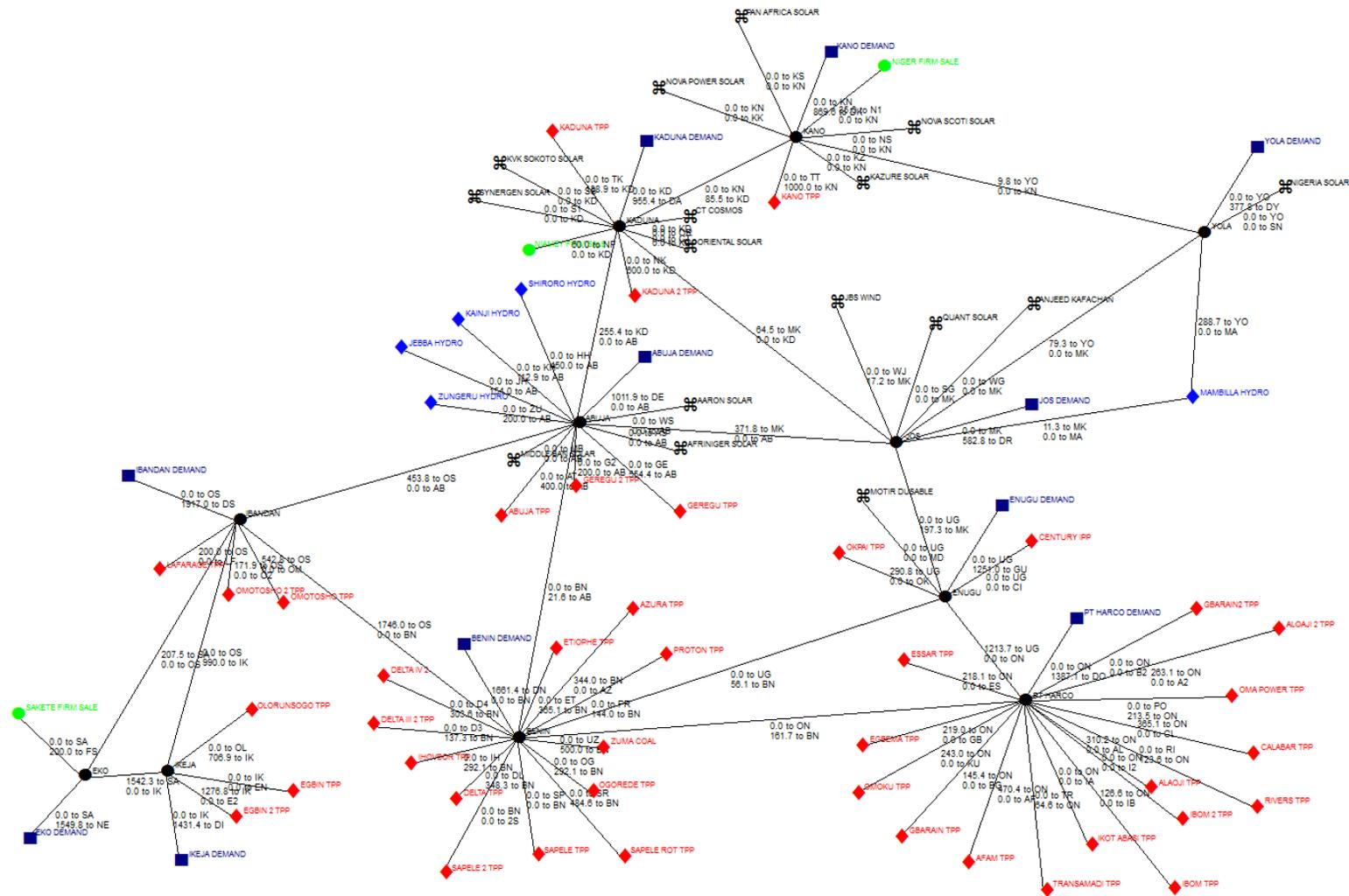


**Annex 8.3.1**  
**GTMax Topology 2020**

**Legend:**

The values next to the demand node present the demand at the given hour in MW  
 The values next to the thermal generation node present the generation at the given hour in MW  
 The values next to the hydro generation node present the generation at the given hour in MW  
 The values next to the renewable generation node present the generation at the given hour in MW  
 The values next to the sale node present the sale at the given hour in MW  
 Each substation presents a DISCO  
 The values under each equivalent transmission link present the power flows in the one and in the opposite direction in MW

|    |         |    |          |
|----|---------|----|----------|
| KN | KANO    | KD | KADUNA   |
| AB | ABUJA   | MK | OS       |
| BN | BENIN   | ON | PT HARCO |
| OS | IBANDAN | IK | IKEJA    |
| SA | EKO     | YO | YOLA     |
| UG | ENUGU   |    |          |



## Annex 8.3.2

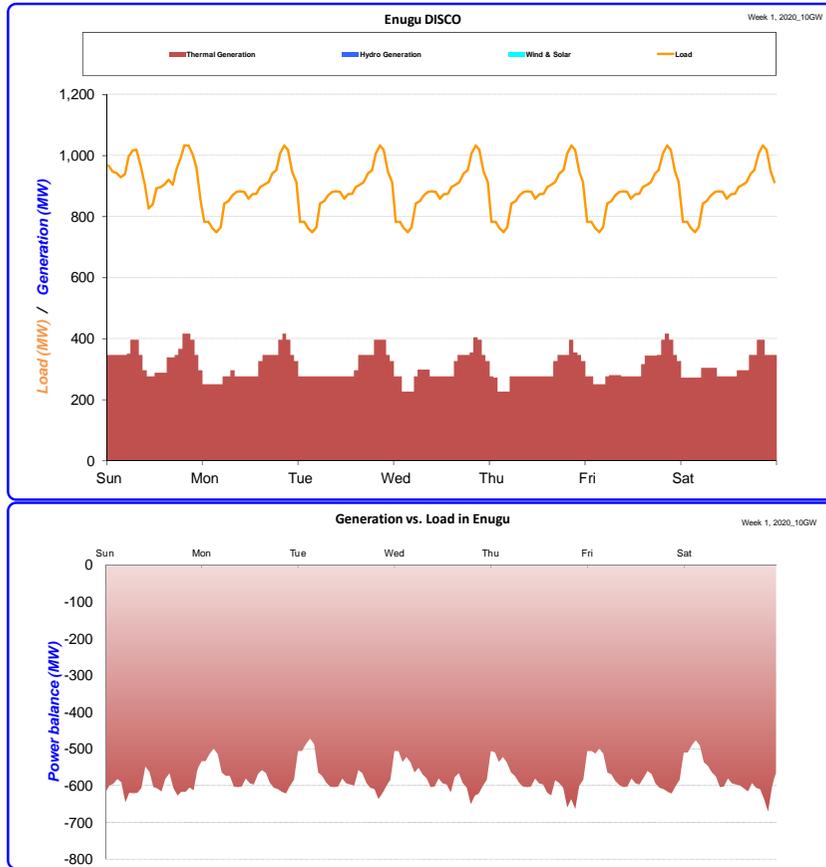
### GTMax Topology 2025

#### Legend:

The values next to the demand node present the demand at the given hour in MW  
 The values next to the thermal generation node present the generation at the given hour in MW  
 The values next to the hydro generation node present the generation at the given hour in MW  
 The values next to the renewable generation node present the generation at the given hour in MW  
 The values next to the sale node present the sale at the given hour in MW  
 Each substation presents a DISCO  
 The values under each equivalent transmission link present the power flows in the one and in the opposite direction in MW

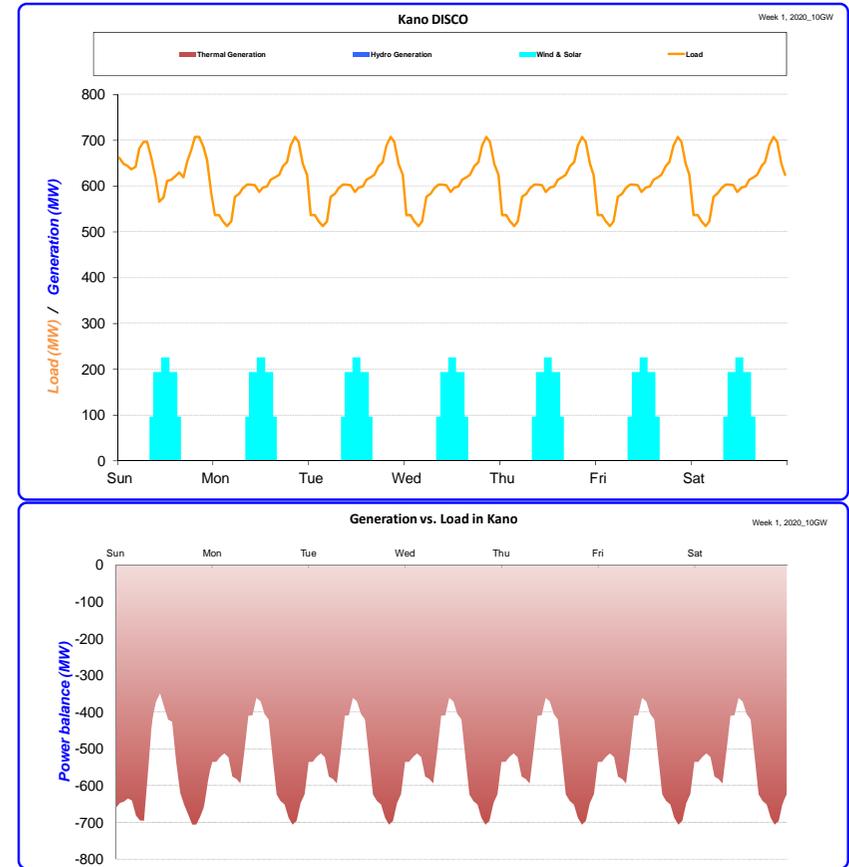
|    |         |    |          |
|----|---------|----|----------|
| KN | KANO    | KD | KADUNA   |
| AB | ABUJA   | MK | OS       |
| BN | BENIN   | ON | PT HARCO |
| OS | IBANDAN | IK | IKEJA    |
| SA | EKO     | YO | YOLA     |
| UG | ENUGU   |    |          |

### Annex 8.4.1 - Winter 2020 - 10GW



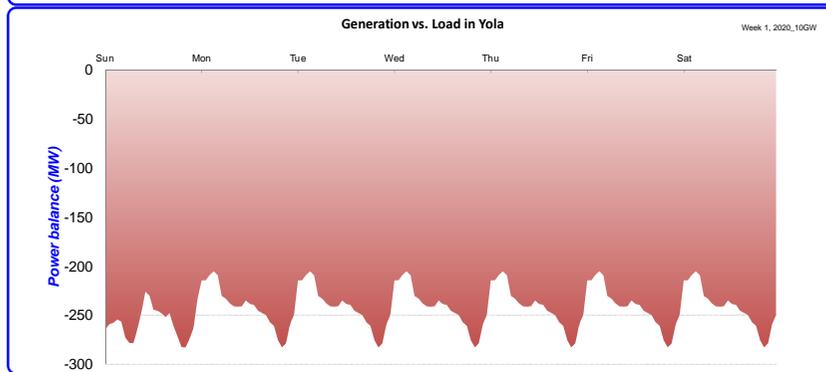
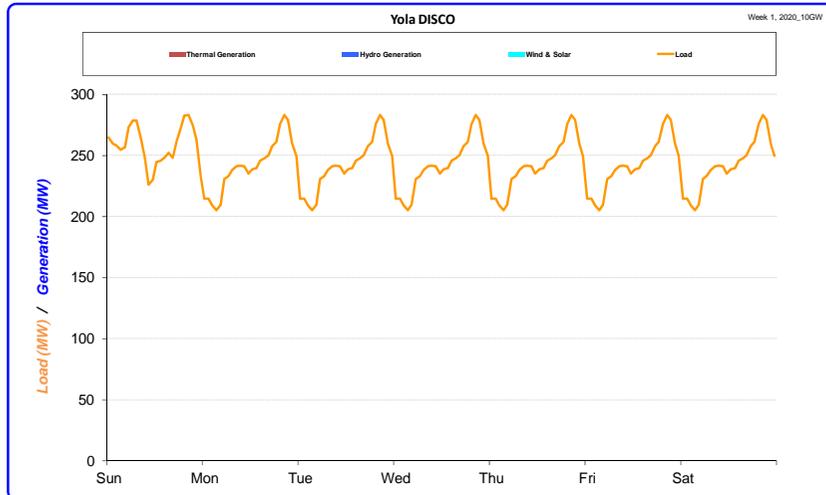
The generation profile of Enugu DISCO is based on thermal power. The demand of the DISCO is higher than the available generation in 2020. The generation vs. Load Balance shows that the DISCO is a net importer of power. The imported power is from the Pt Harco and Benin DISCO. The peak of imported power reaches 600 MW which can be transferred via the available transmission infrastructure between the three DISCOs.

### Annex 8.4.1 - Winter 2020 - 10GW



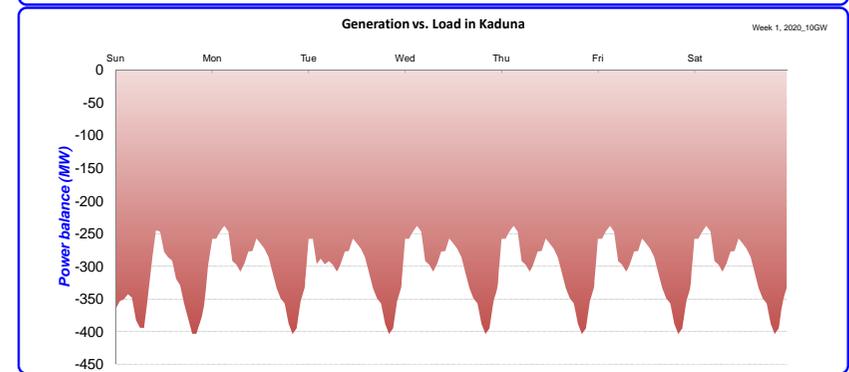
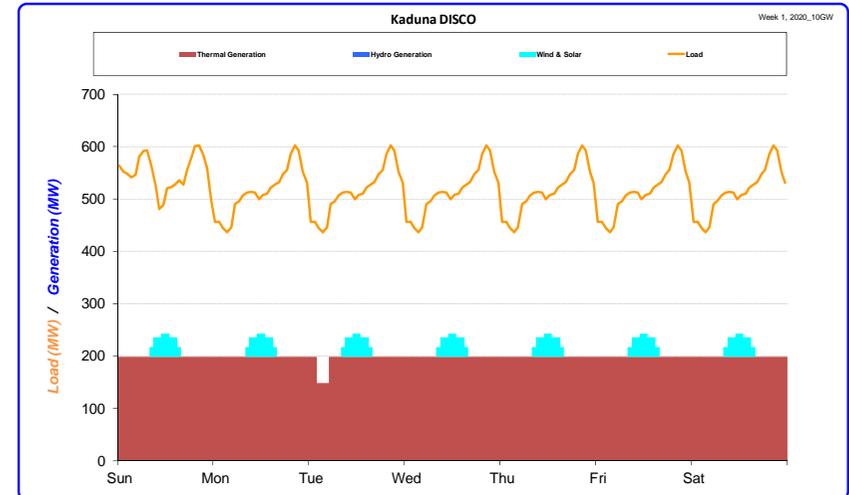
In 2020 Kano DISCO remains a net importer of power. The installed solar power can supply only a local part of the load and has no contribution on the lowering the peak demand. The imported power peaks to 700 MW and is obtained mainly via transfer from Kaduna/Abuja DISCO.

### Annex 8.4.1 - Winter 2020 - 10GW



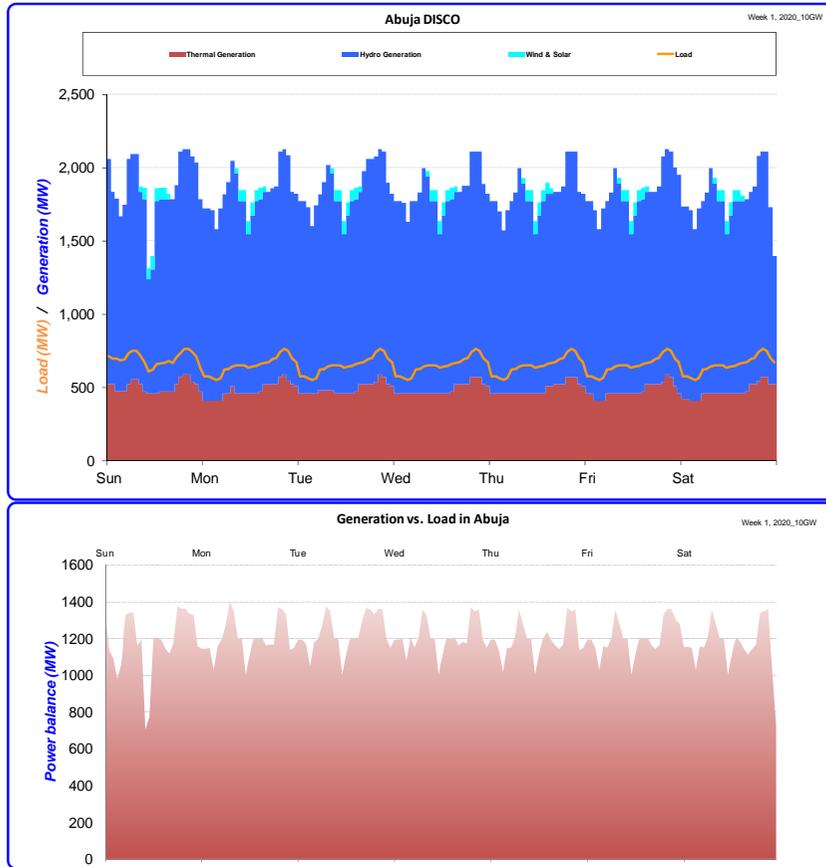
In 2020 Yola DISCO remains a net importer of power. There is no generation installed. The imported power peaks to 270 MW and is obtained mainly via transfer from Pt Harco DISCO.

### Annex 8.4.1 - Winter 2020 - 10GW



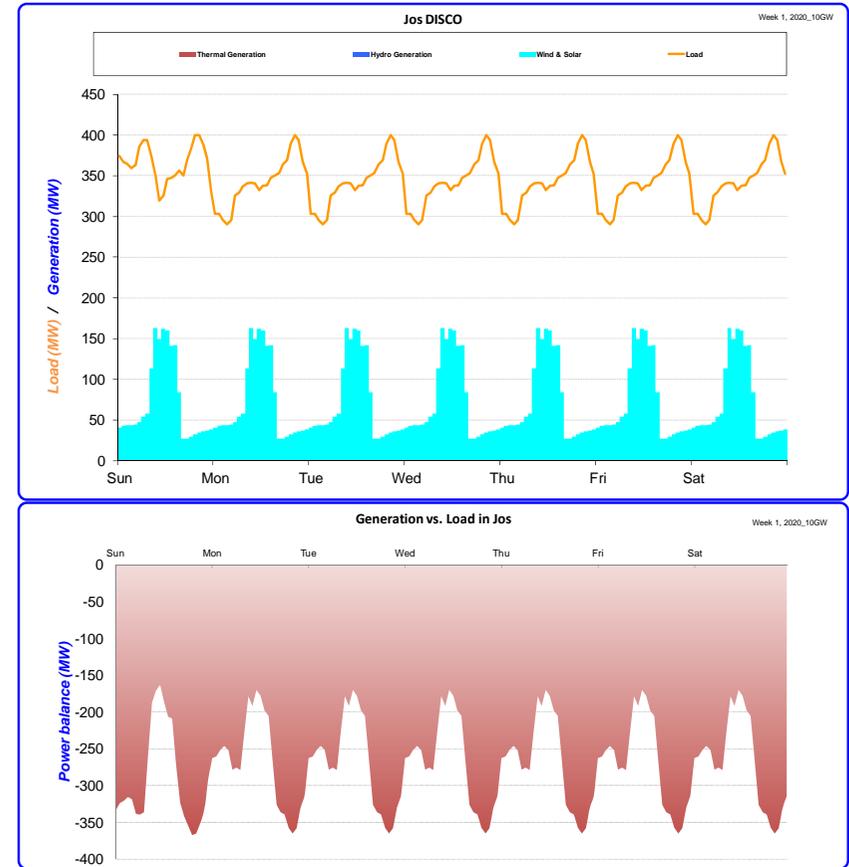
In 2020 Kaduna DISCO remains a net importer of power. The installed thermal and solar power can supply only a third of the load and the solar power has no contribution on the lowering the peak demand. The imported power peaks to 400 MW and is obtained mainly via transfer from Abuja/Benin DISCO.

### Annex 8.4.1 - Winter 2020 - 10GW



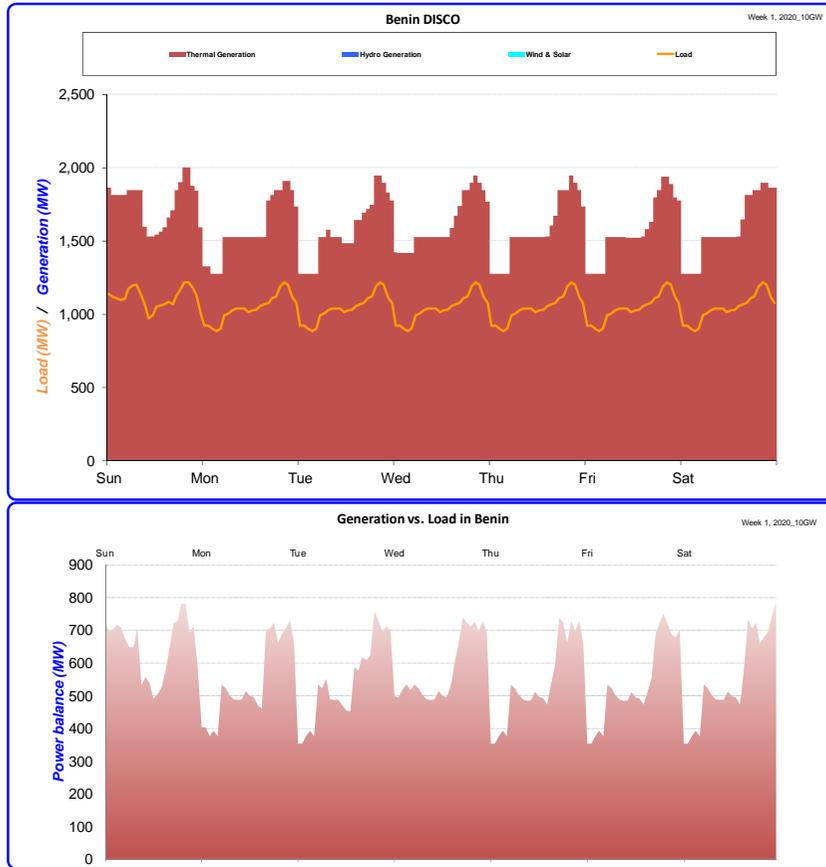
The Abuja DISCO in 2020 is a net exporter of power. The exported power reaches 1300 MW in the peak load hours. The base load supply is from thermal and hydro power in the DISCO and the peaking is done by the available hydro generation. The solar power is also present in the generation/load balance with marginal significance. The exported power goes to the neighboring DISCOs: Kaduna, Kano, Ibandan and Jos. Abuja DISCO also transfers power from Benin DISCO to the north of Nigeria.

### Annex 8.4.1 - Winter 2020 - 10GW



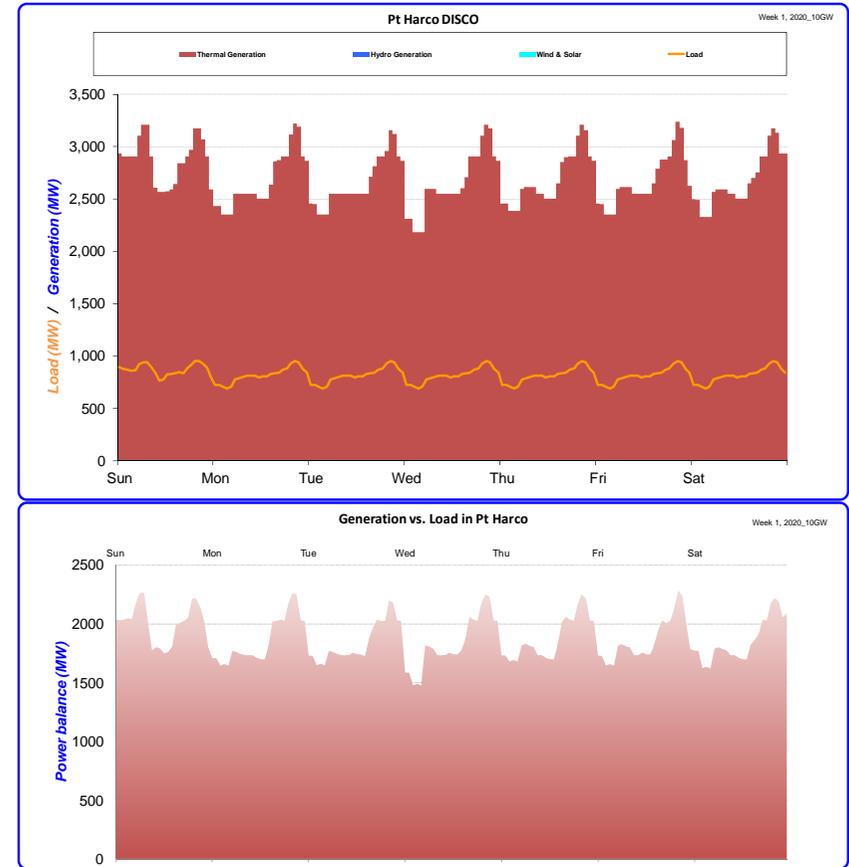
In 2020 Jos DISCO remains a net importer of power. The installed wind solar power can supply only a local part of the load and has no contribution on the lowering the peak demand. The imported power peaks to 360 MW and is obtained mainly via transfer from Pt Harco /Abuja DISCO.

### Annex 8.4.1 - Winter 2020 - 10GW



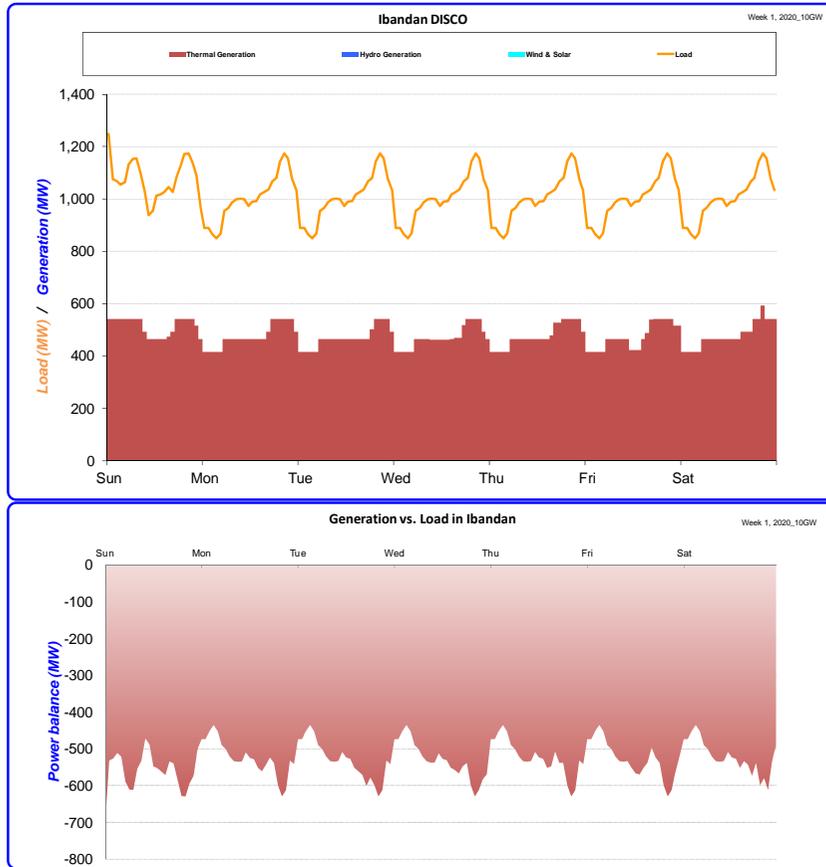
The Benin DISCO in 2020 is a net exporter of power. The exported power reaches 780 MW in the peak load hours. The base and peak load supply is from thermal generation. The exported power goes to the neighboring DISCOs: Abuja (Kaduna, Kano) and Ibandan. Benin DISCO also transfers power from Pt Harco DISCO to the north and west of Nigeria. The existing transmission infrastructure is sufficient for obtaining the power export to the neighboring DISCOs.

### Annex 8.4.1 - Winter 2020 - 10GW



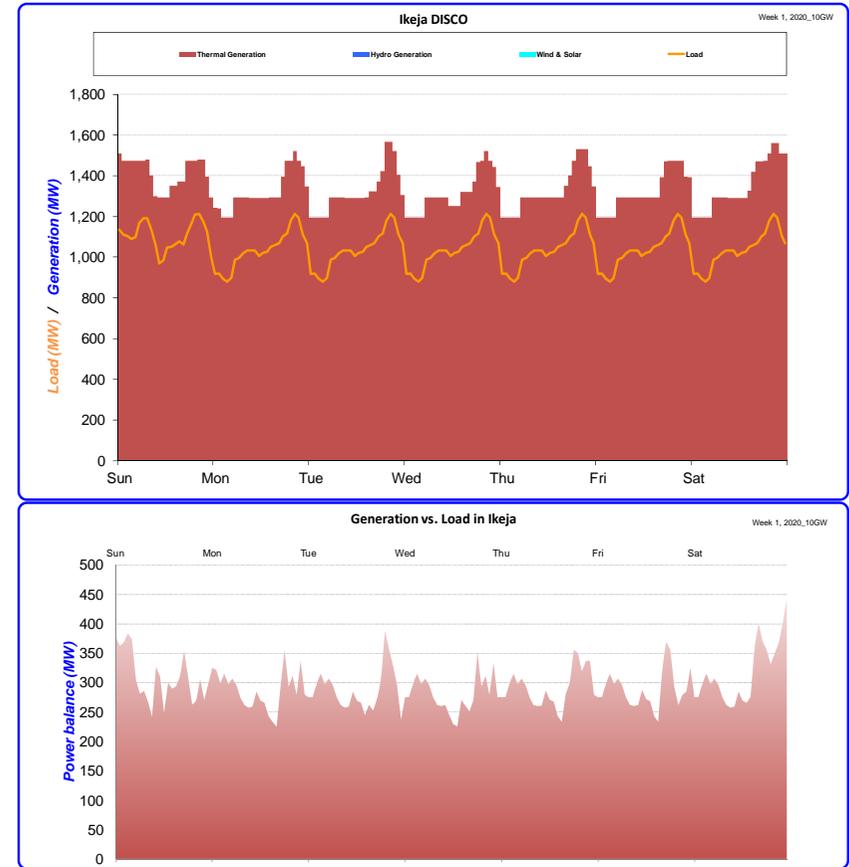
The Pt Harco DISCO in 2020 is a net exporter of power. The exported power reaches 2200MW in the peak load hours. The base and peak load supply is from thermal generation. The exported power goes to the neighboring DISCOs: Benin and further to Abuja (Kaduna, Kano) and Enugu (Jos, Yola). The existing transmission infrastructure is sufficient for obtaining the power export to the neighboring DISCOs.

### Annex 8.4.1 - Winter 2020 - 10GW



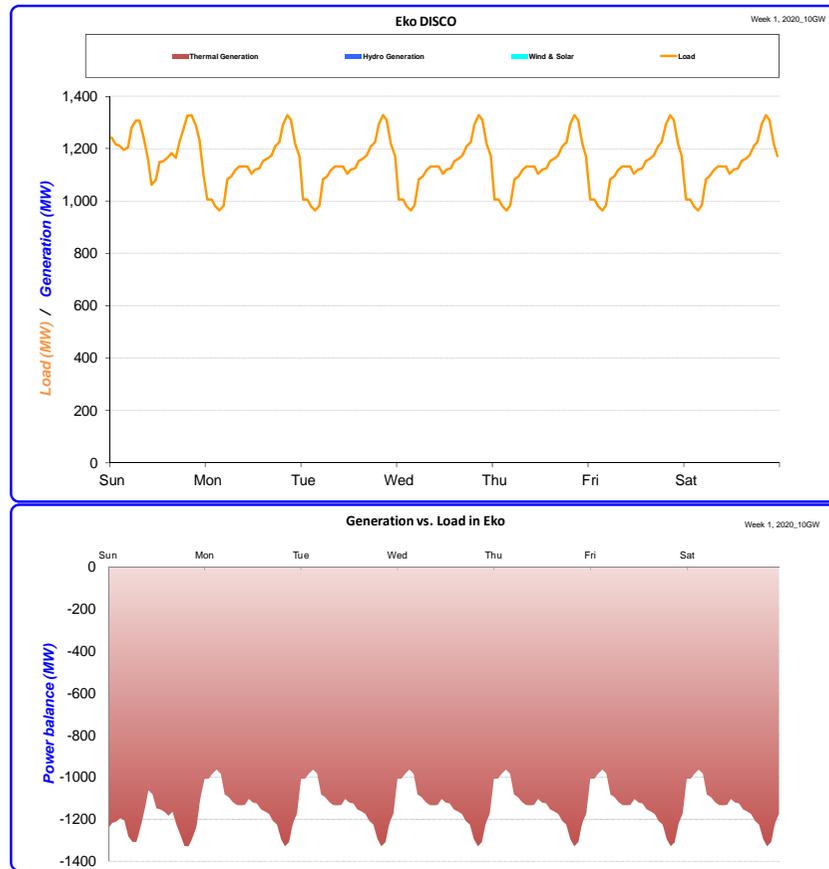
In 2020 Ibandan DISCO remains a net importer of power. The installed thermal power can supply only a third of the load. The imported power peaks to 600 MW and is obtained mainly via transfer from Abuja/Benin DISCO.

### Annex 8.4.1 - Winter 2020 - 10GW



The Ikeja DISCO in 2020 is a net exporter of power. The exported power reaches 380 MW in the peak load hours. The base and peak load supply is from thermal generation. The exported power goes to the neighboring Eko DISCO. The existing transmission infrastructure is sufficient for obtaining the power export to Eko DISCO.

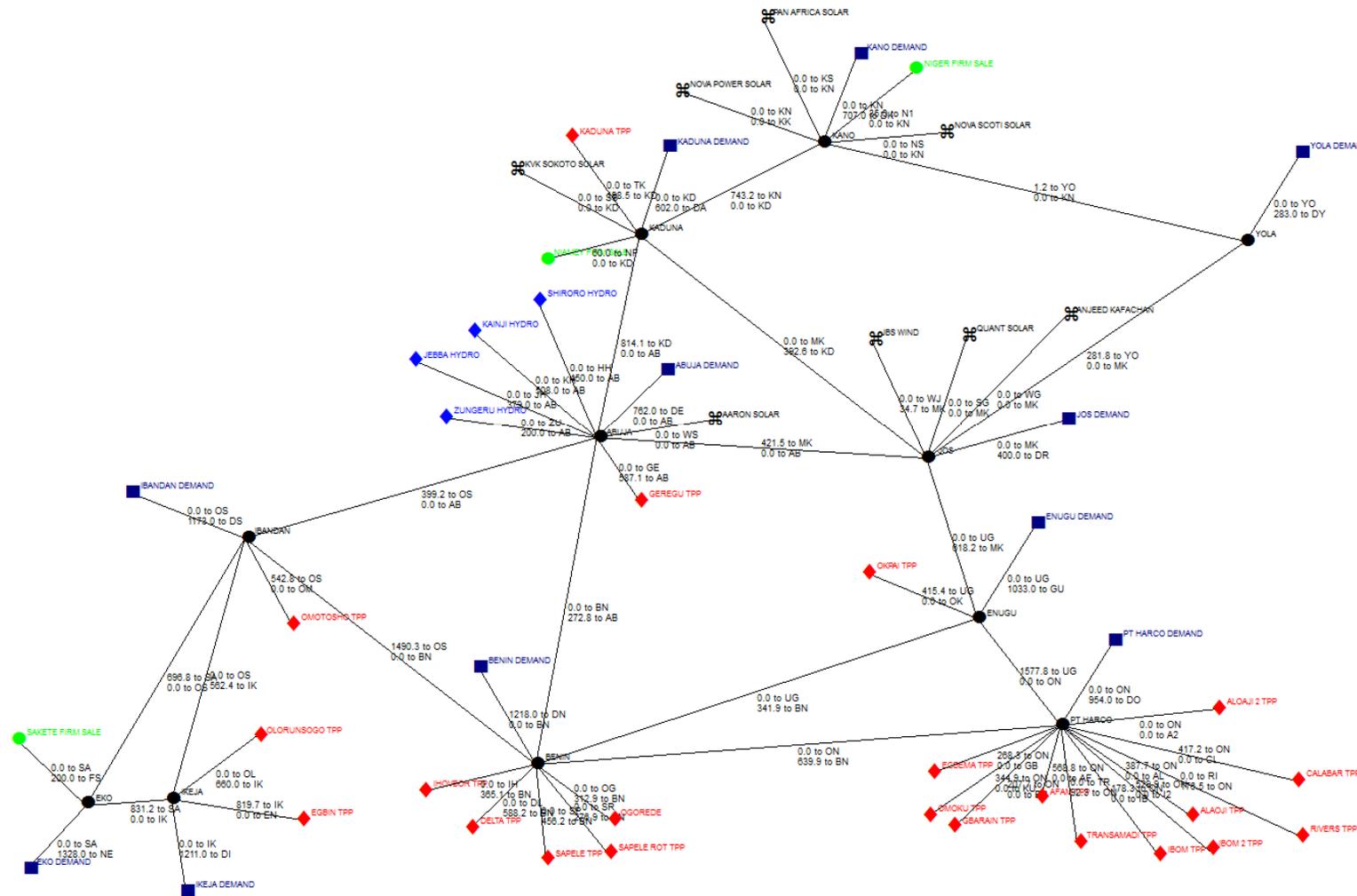
## Annex 8.4.1 - Winter 2020 - 10GW



In 2020 Eko DISCO remains a net importer of power. There is no generation installed. The imported power peaks to 1300 MW and is obtained mainly via transfer from Ikeja/Benin and Ibandan DISCO. The existing transmission infrastructure is sufficient for obtaining the power import from Ikeja and Ibandan DISCO.

# Annex 8.4.1 - Winter 2020 - 10GW

| Node | Water Links | Transmission Link | Heat Pipeline | Fuel Transport | Year | Week        | Day  | Hour |
|------|-------------|-------------------|---------------|----------------|------|-------------|------|------|
| ame  | None        | Energy Flow       | None          | None           | 2000 | 1: 1 Jan W1 | Sun. | 21   |

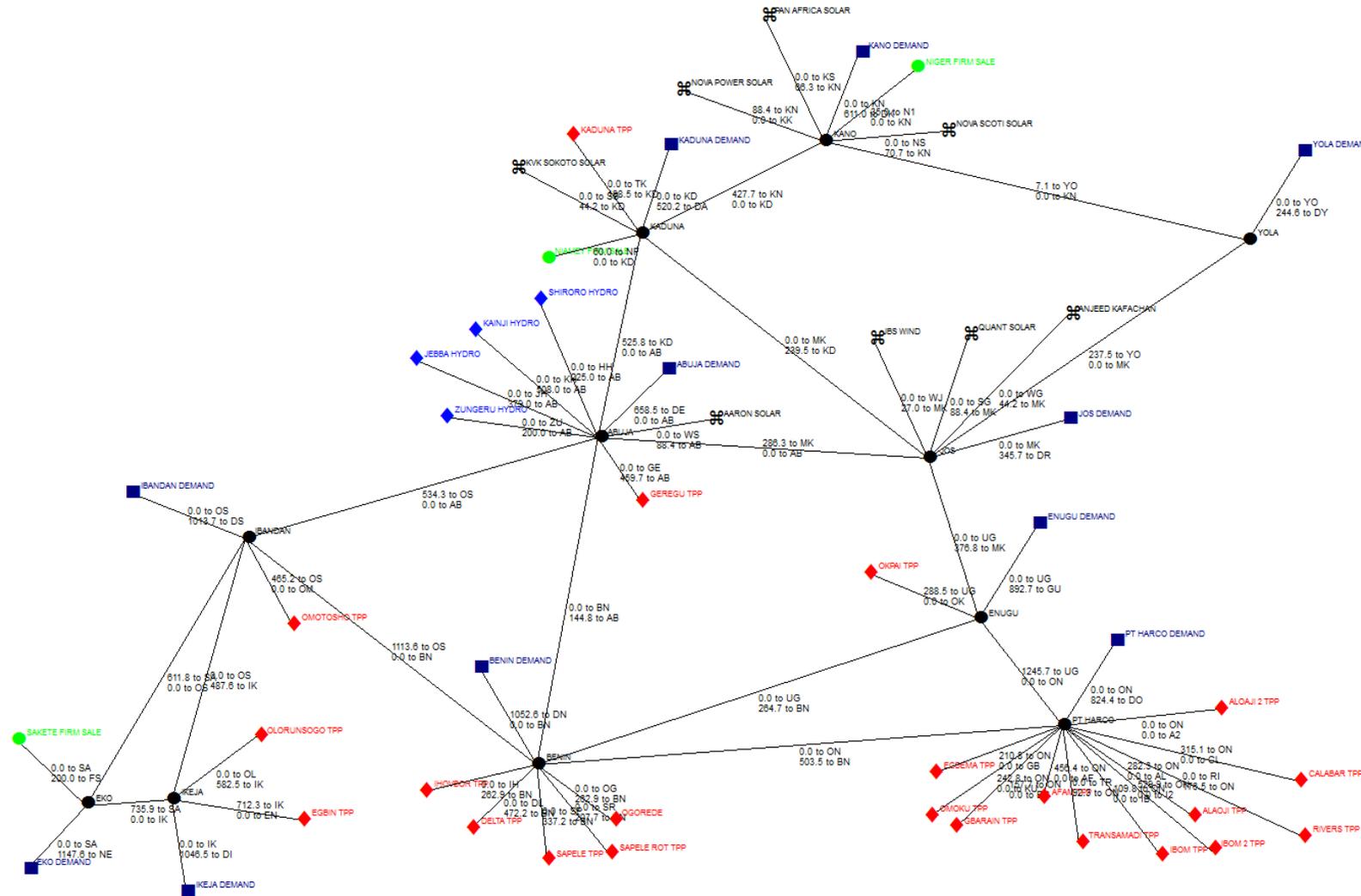


**Annex 8.4.1  
Winter 2020 - 10GW**

**Power flow during peak hours:** The power flows between the DISCOs in Nigeria for the peaking hours in winter in 2020 are from the south to the north, from the east to the west. Main power exporters are remaining Benin, Pt Harco and Ikeja. During peaking hours the solar power is not available, so the peaking is further on done by thermal power from the south and mid of the country.

# Annex 8.4.1 - Winter 2020 - 10GW

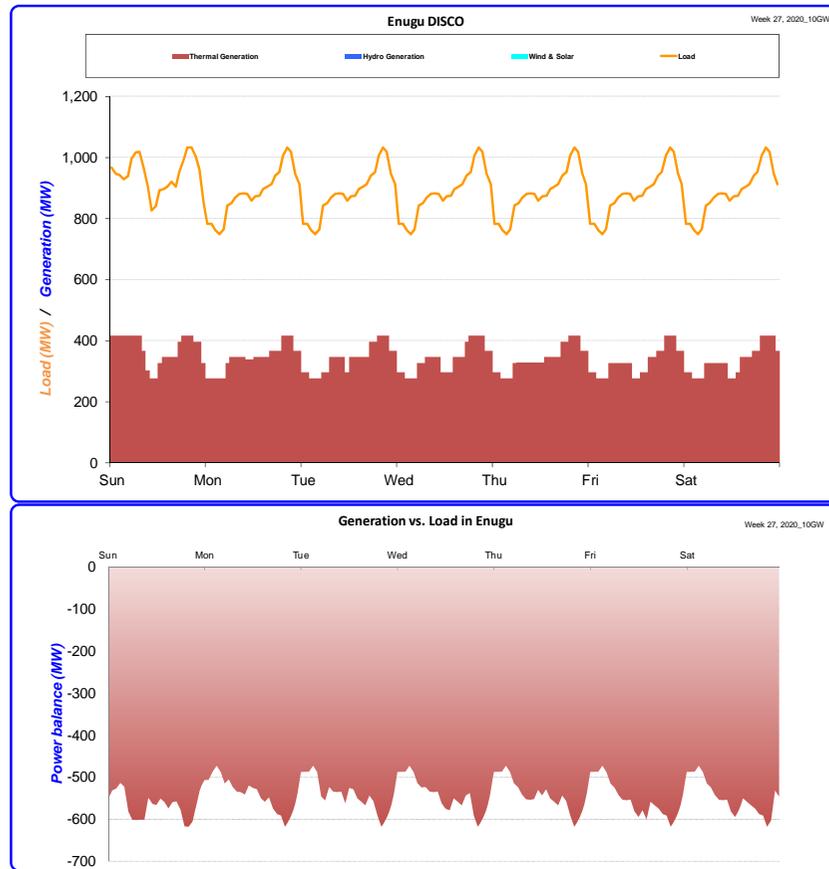
| Node | Water Links | Transmission Link | Heat Pipeline | Fuel Transport | Year | Week        | Day  | Hour |
|------|-------------|-------------------|---------------|----------------|------|-------------|------|------|
| ame  | None        | Energy Flow       | None          | None           | 2000 | 1: 1 Jan W1 | Sun. | 13   |



**Annex 8.4.1  
Winter 2020 - 10GW**

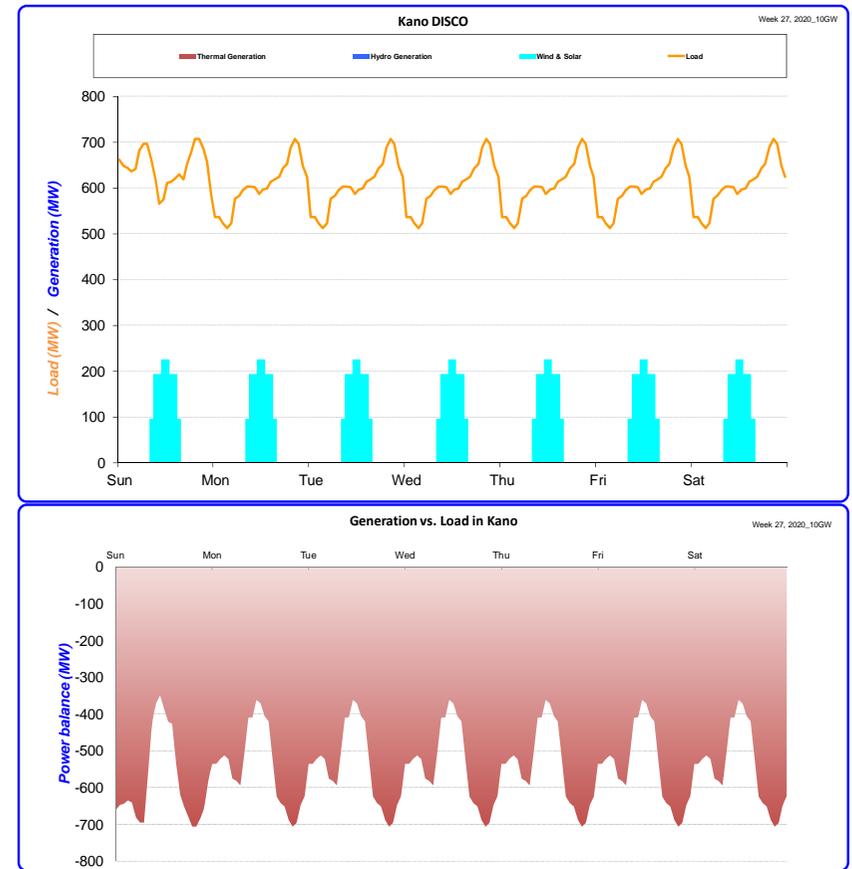
**Power flow during Off-peak hours:** During off - peaking hours the solar power is available, so the power flows from the south/mid of the country to the north are reduced, e.g. from Abuja to Kaduna 526 MW in off peak and 814 MW in peak hours.

### Annex 8.4.2 - Summer 2020 - 10GW



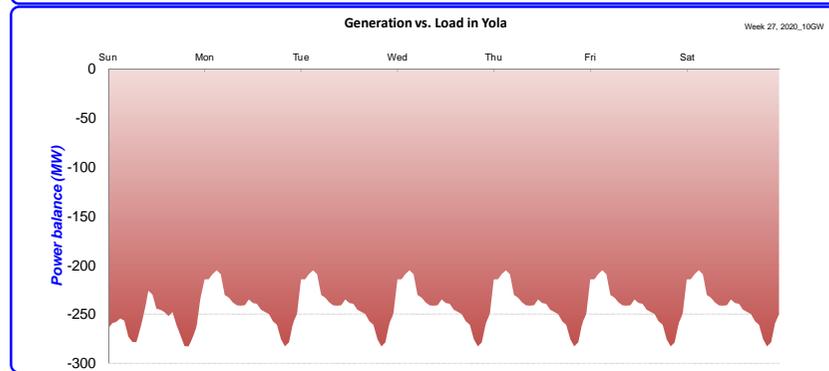
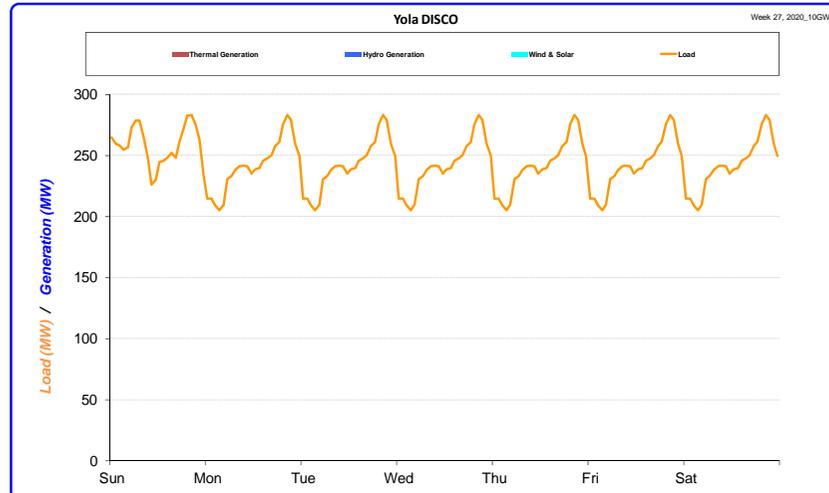
The generation profile of Enugu DISCO is based on thermal power. The demand of the DISCO is higher than the available generation in 2020. The generation vs. Load Balance shows that the DISCO is a net importer of power. The imported power is from the Pt Harco DISCO. The peak of imported power reaches 600 MW which can be transferred via the available transmission infrastructure between the two DISCOs. The generation/load balance in the summer season is quite similar to the one of winter season.

### Annex 8.4.2 - Summer 2020 - 10GW



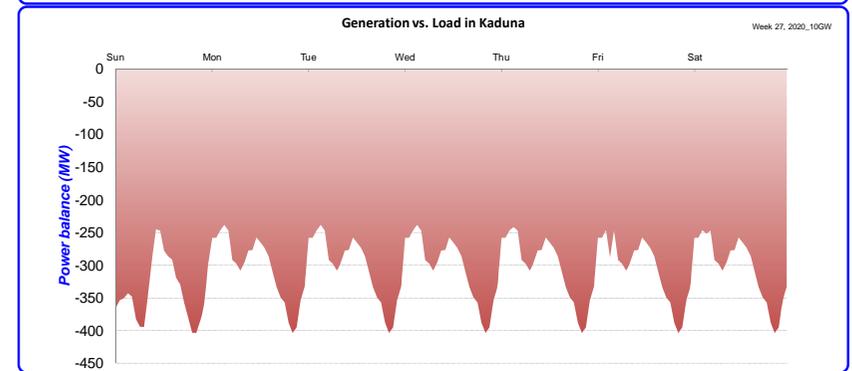
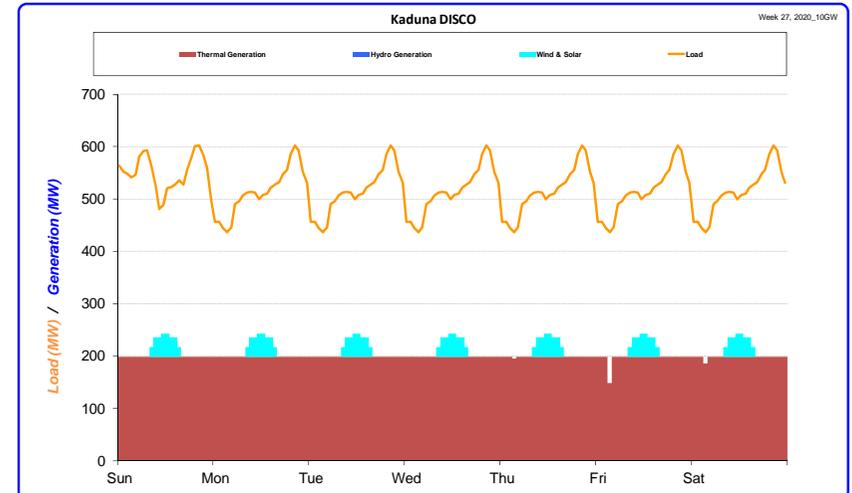
In 2020 Kano DISCO remains a net importer of power. The installed solar power can supply only a local part of the load and has no contribution on the lowering the peak demand. The imported power peaks to 700 MW and is obtained mainly via transfer from Kaduna/Abuja DISCO. The generation/load balance in the summer season is quite similar to the one of winter season.

### Annex 8.4.2 - Summer 2020 - 10GW



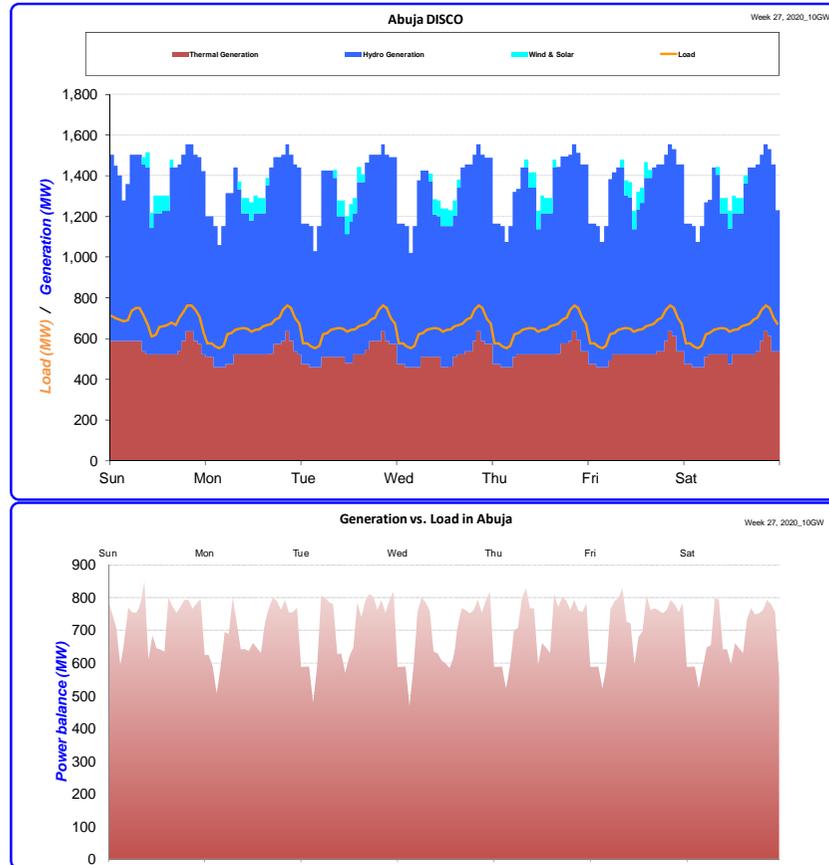
In 2020 Yola DISCO remains a net importer of power. There is no generation installed. The imported power peaks to 270 MW and is obtained mainly via transfer from Pt Harco DISCO. The generation/load balance in the summer season is quite similar to the one of winter season.

### Annex 8.4.2 - Summer 2020 - 10GW



In 2020 Kaduna DISCO remains a net importer of power. The installed thermal and solar power can supply only a third of the load and the solar power has no contribution on the lowering the peak demand. The imported power peaks to 400 MW and is obtained mainly via transfer from Abuja/Benin DISCO. The generation/load balance in the summer season is quite similar to the one of winter season.

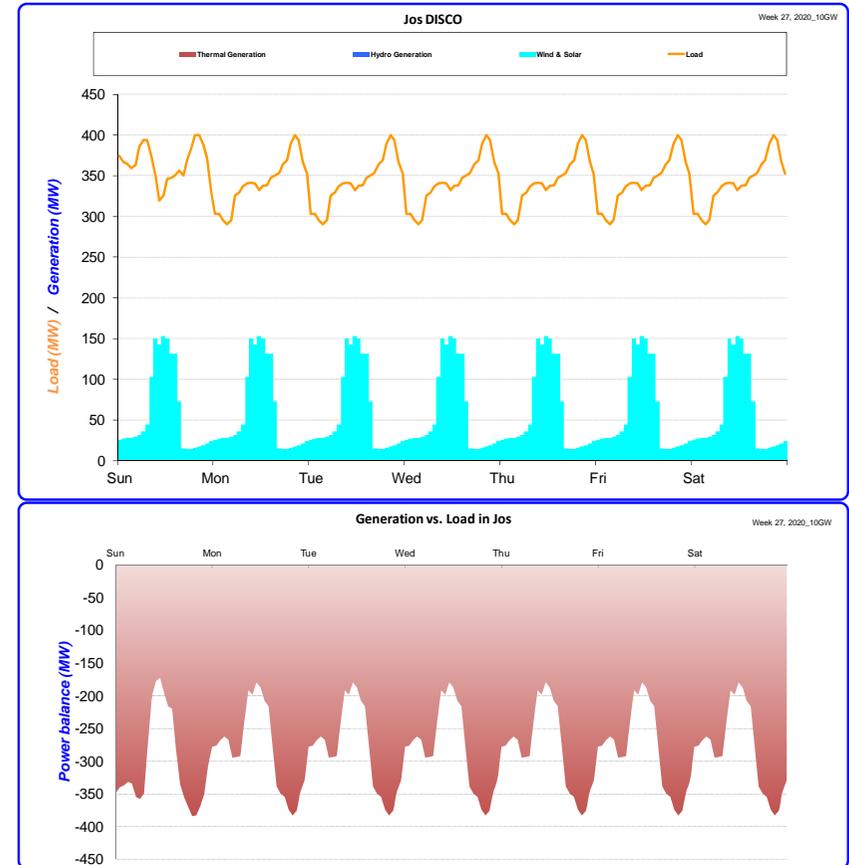
### Annex 8.4.2 - Summer 2020 - 10GW



The Abuja DISCO in 2020 is a net exporter of power. The exported power reaches 800 MW in the peak load hours. The base load supply is from thermal and hydro power in the DISCO and the peaking is done by the available hydro generation. The solar power is also present in the generation/load balance with marginal significance. The exported power goes to the neighboring DISCOs: Kaduna, Kano, Ibandan and Jos. Abuja DISCO also transfers power from Benin DISCO to the north of Nigeria.

The summer season is characterized with reduced hydro generation, due to seasonal conditions. Therefore, about 500 MW peaking power less than in the winter season can be exported to the north.

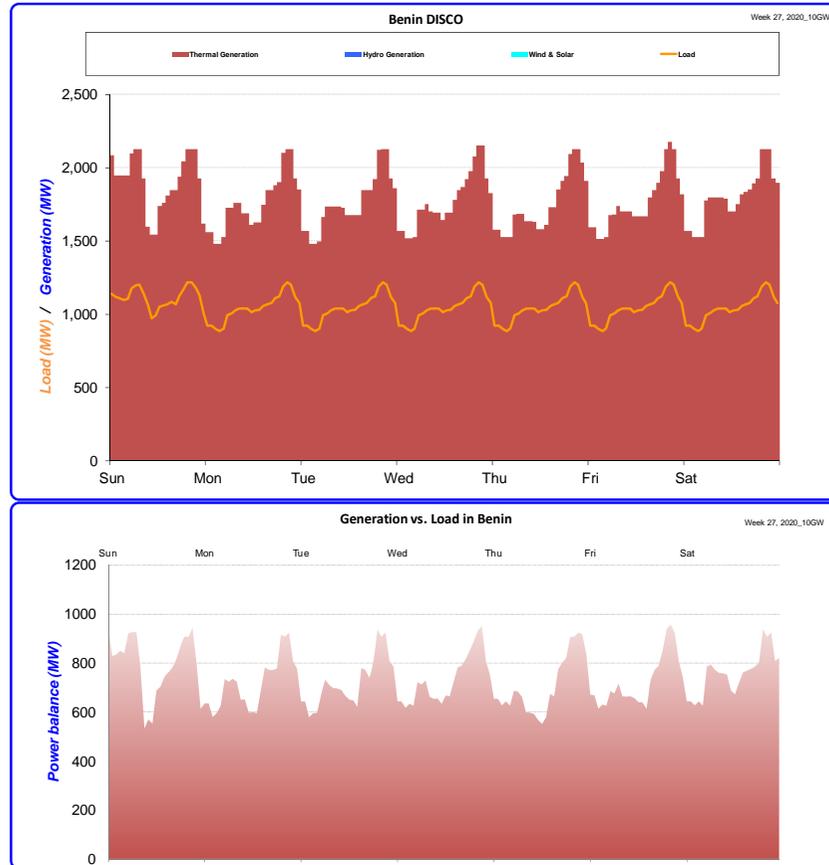
### Annex 8.4.2 - Summer 2020 - 10GW



In 2020 Jos DISCO remains a net importer of power. The installed wind solar power can supply only a local part of the load and has no contribution on the lowering the peak demand. The imported power peaks to 360 MW and is obtained mainly via transfer from Pt Harco /Abuja DISCO.

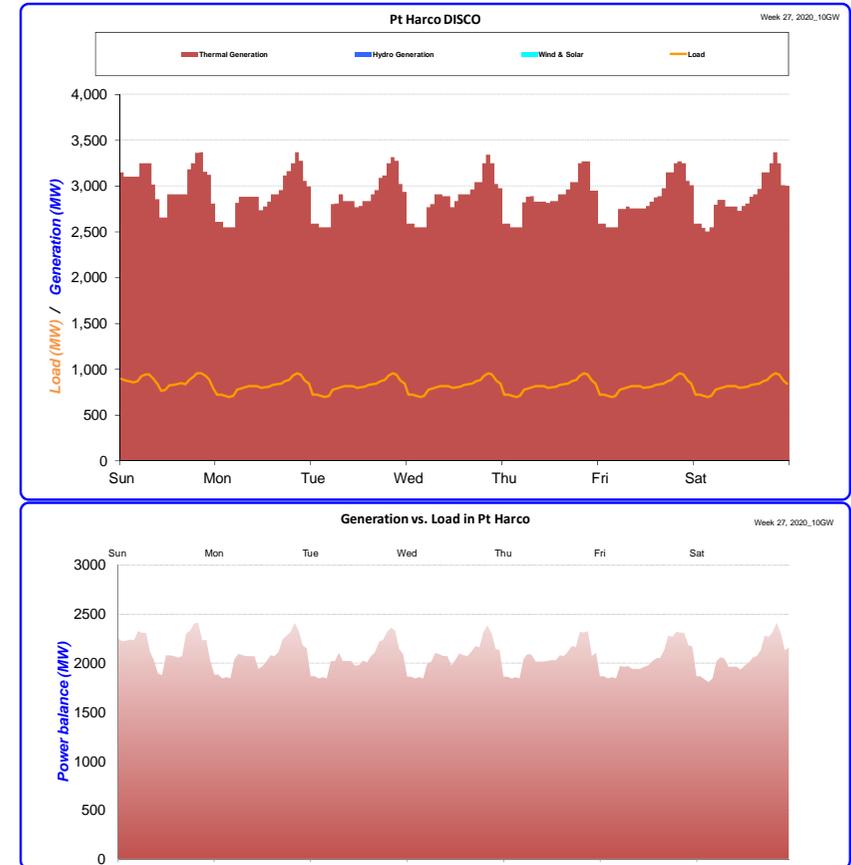
The generation/load balance in the summer season is quite similar to the one of winter season.

### Annex 8.4.2 - Summer 2020 - 10GW



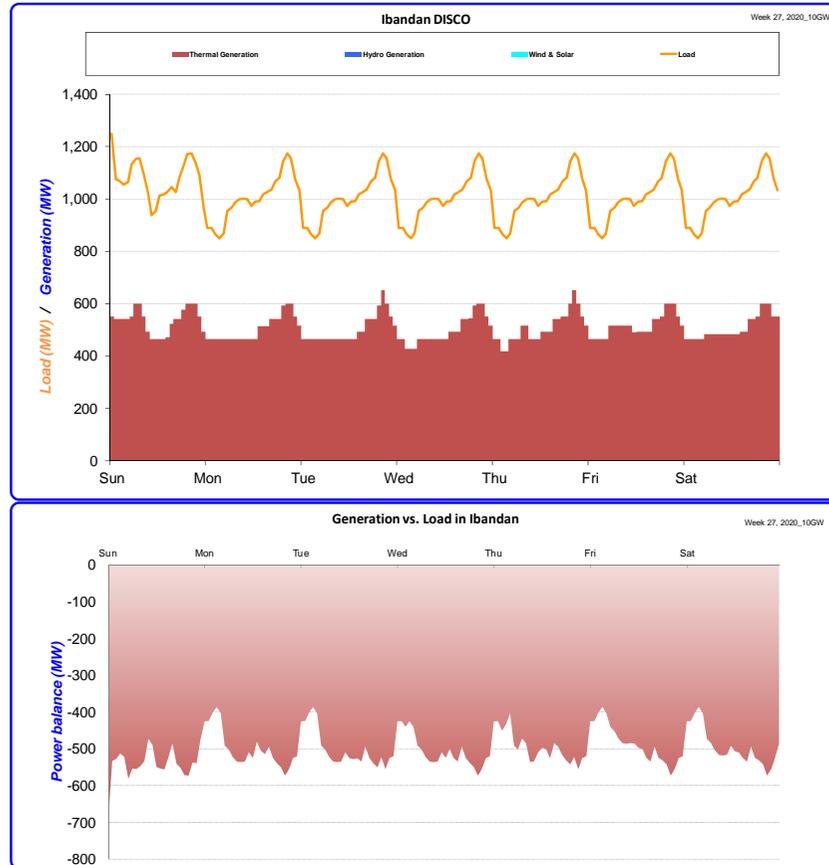
The Benin DISCO in 2020 is a net exporter of power. The exported power reaches 900 MW in the peak load hours. The base and peak load supply is from thermal generation. The exported power goes to the neighboring DISCOs: Abuja (Kaduna, Kano) and Ibandan. Benin DISCO also transfers power from Pt Harco DISCO to the north and west of Nigeria. The existing transmission infrastructure is sufficient for obtaining the power export to the neighboring DISCOs. In the summer season the exported power is higher, due to the lower availability of hydro power in Abuja DISCO.

### Annex 8.4.2 - Summer 2020 - 10GW



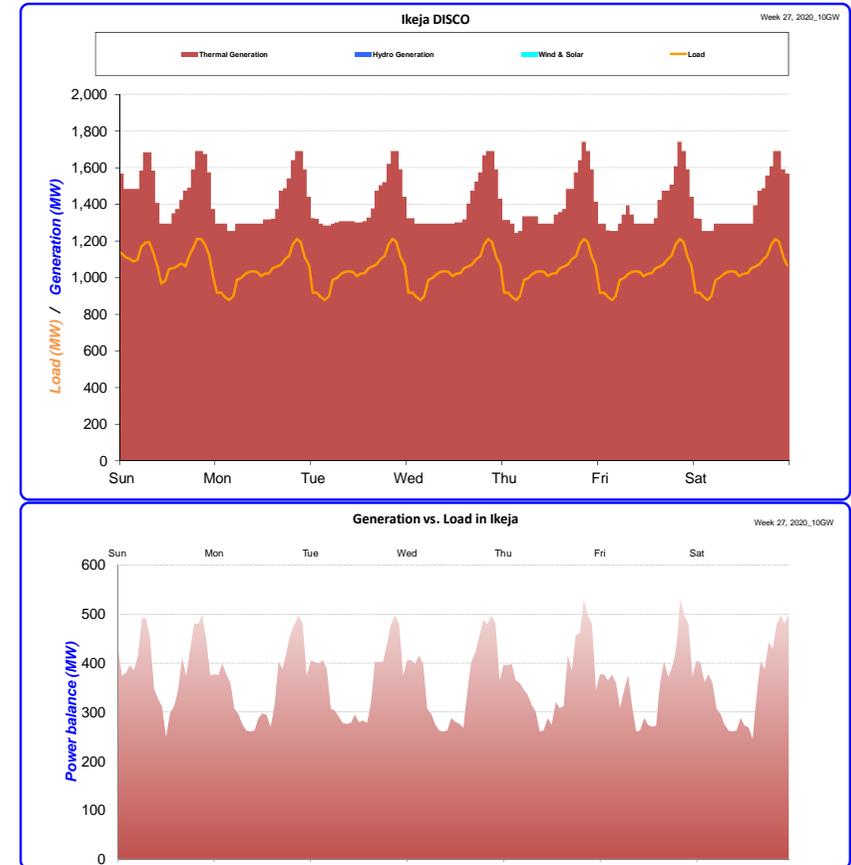
The Pt Harco DISCO in 2020 is a net exporter of power. The exported power reaches 2200MW in the peak load hours. The base and peak load supply is from thermal generation. The exported power goes to the neighboring DISCOs: Benin and further to Abuja (Kaduna, Kano) and Enugu (Jos, Yola). The existing transmission infrastructure is sufficient for obtaining the power export to the neighboring DISCOs. The generation/load balance in the summer season is quite similar to the one of winter season.

### Annex 8.4.2 - Summer 2020 - 10GW



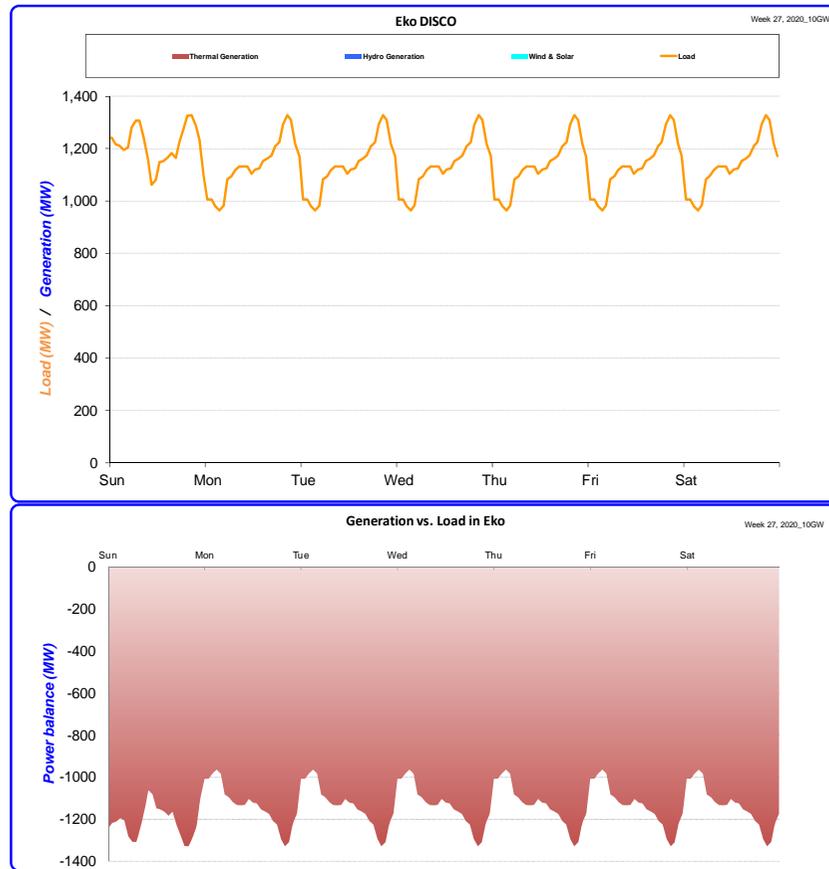
In 2020 Ibandan DISCO remains a net importer of power. The installed thermal power can supply only a third of the load. The imported power peaks to 550 MW and is obtained mainly via transfer from Abuja/Benin DISCO. The generation/load balance in the summer season is quite similar to the one of winter season.

### Annex 8.4.2 - Summer 2020 - 10GW



The Ikeja DISCO in 2020 is a net exporter of power. The exported power reaches 500 MW in the peak load hours. The base and peak load supply is from thermal generation. The exported power goes to the neighboring Eko DISCO. The existing transmission infrastructure is sufficient for obtaining the power export to Eko DISCO.

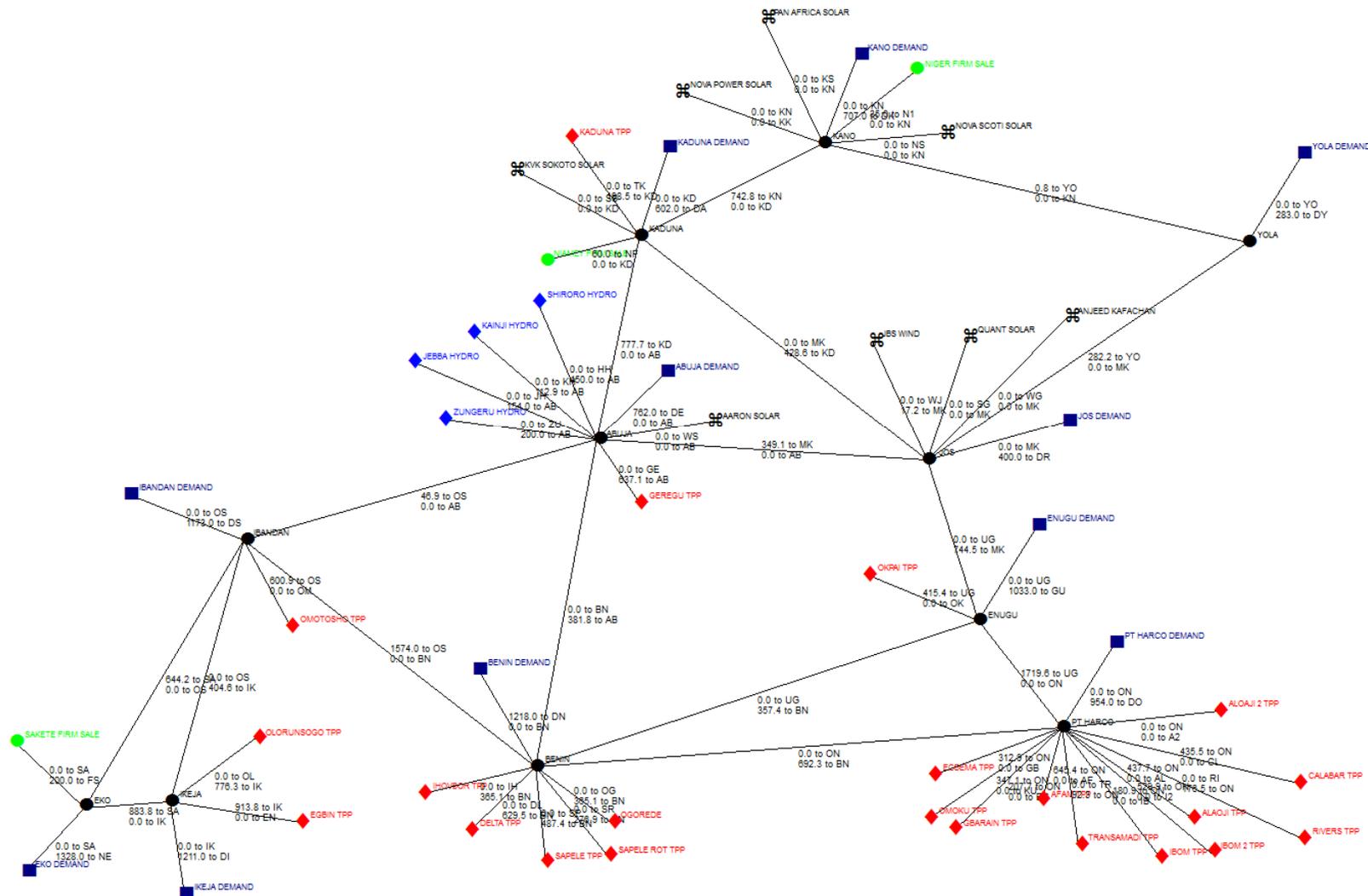
## Annex 8.4.2 - Summer 2020 - 10GW



In 2020 Eko DISCO remains a net importer of power. There is no generation installed. The imported power peaks to 1300 MW and is obtained mainly via transfer from Ikeja/Benin and Ibandan DISCO. The existing transmission infrastructure is sufficient for obtaining the power import from Ikeja and Ibandan DISCO. The generation/load balance in the summer season is quite similar to the one of winter season.

## Annex 8.4.2 - Summer 2020 - 10GW

| Node | Water Links | Transmission Link | Heat Pipeline | Fuel Transport | Year | Week          | Day  | Hour |
|------|-------------|-------------------|---------------|----------------|------|---------------|------|------|
| ame  | None        | Energy Flow       | None          | None           | 2000 | 27: 27 Jul W1 | Sun. | 21   |



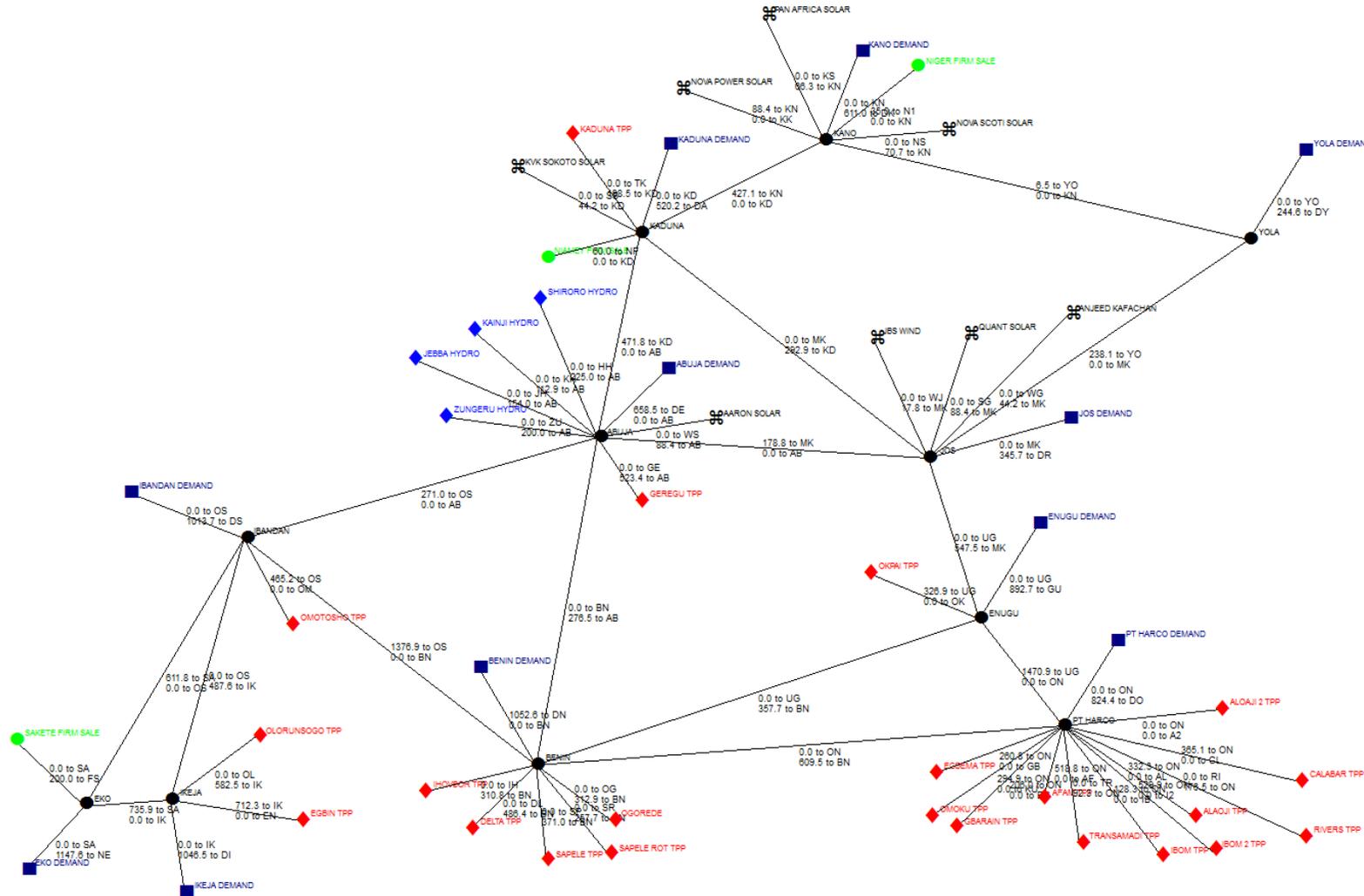
### Annex 8.4.2

### Summer 2020 - 10GW

**Power flow during peak hours:** The power flows between the DISCOs in Nigeria for the peaking hours in summer in 2020 are from the south to the north, from the east to the west. Main power exporters are remaining Benin, Pt Harco and Ikeja. During peaking hours the solar power is not available, so the peaking is further on done by thermal power from the south and mid of the country.

# Annex 8.4.2 - Summer 2020 - 10GW

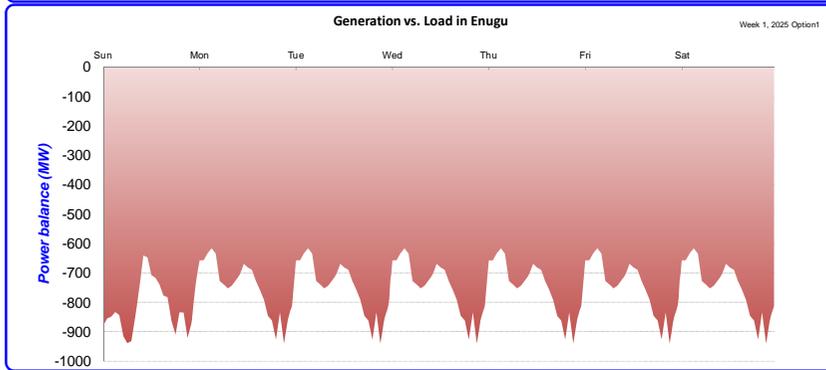
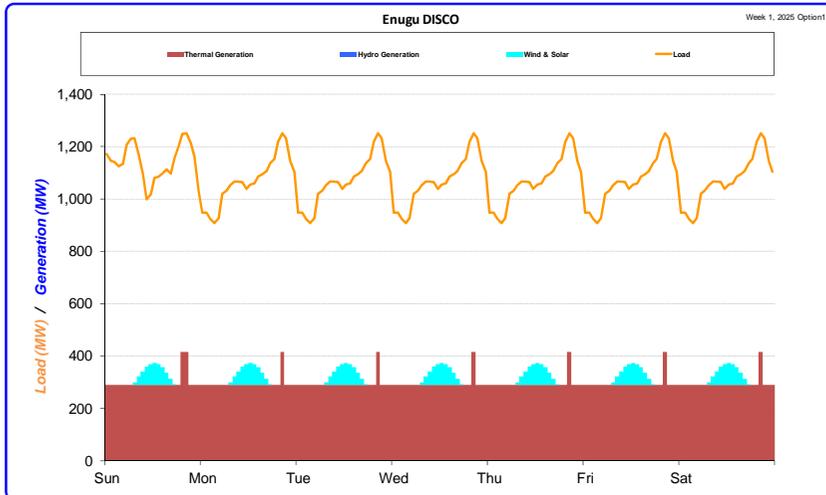
| Node | Water Links | Transmission Link | Heat Pipeline | Fuel Transport | Year | Week          | Day  | Hour |
|------|-------------|-------------------|---------------|----------------|------|---------------|------|------|
| ame  | None        | Energy Flow       | None          | None           | 2000 | 27: 27 Jul W1 | Sun. | 13   |



**Annex 8.4.2  
Summer 2020 - 10GW**

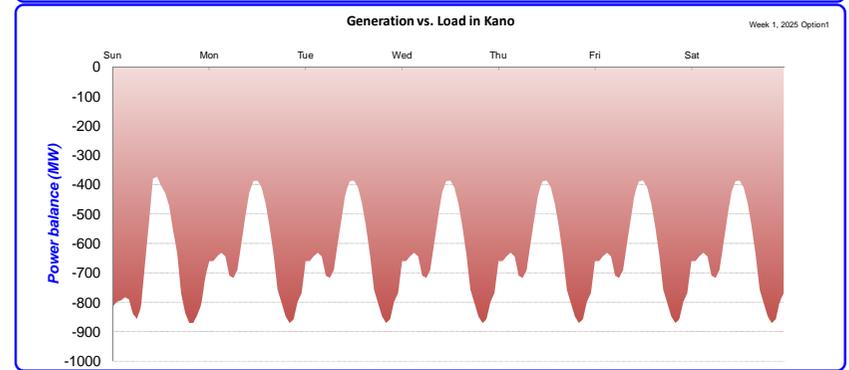
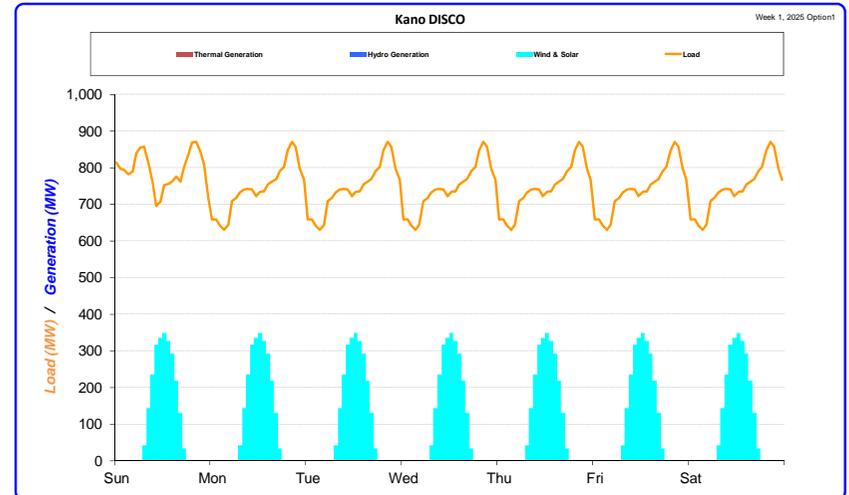
**Power flow during Off-peak hours:** During off - peaking hours the solar power is available, so the power flows from the south/mid of the country to the north are reduced, e.g. from Abuja to Kaduna 471 MW in off peak and 777 MW in peak hours.

### Annex 8.5.1 - Winter 2025 - Option 1



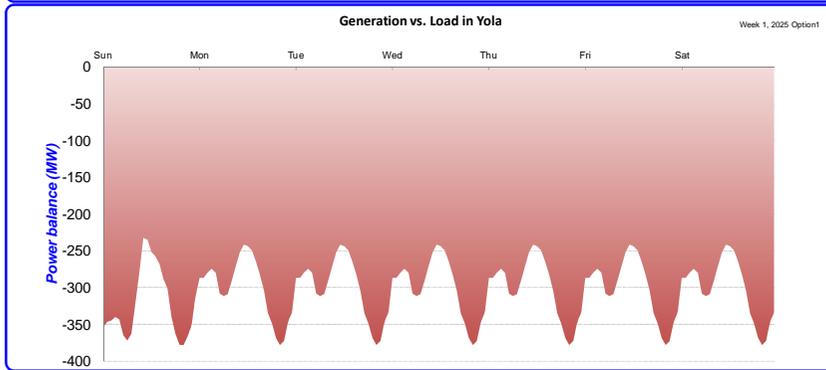
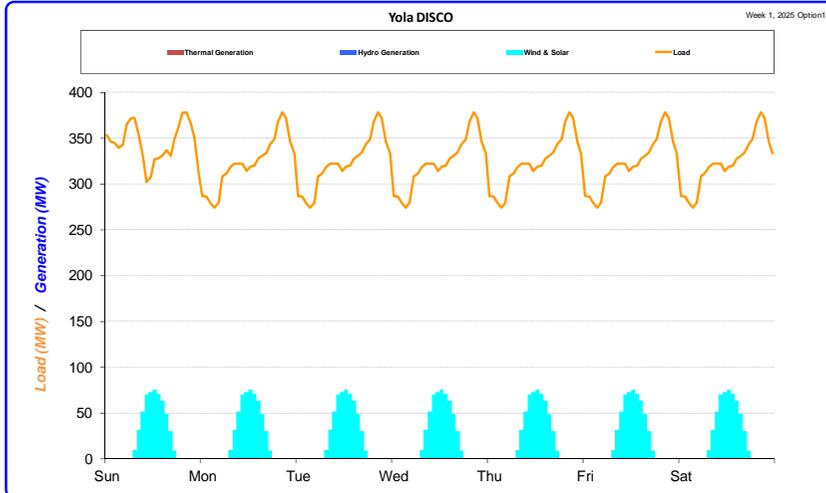
The generation profile of Enugu DISCO is based on thermal power. Small portion of solar power projects will be installed until 2025. The demand of the DISCO is higher than the available generation in 2020. The generation vs. Load Balance shows that the DISCO is a net importer of power. The imported power is from the Pt Harco and Benin DISCO. The peak of imported power reaches 900 MW which can be transferred via the available transmission infrastructure between the three DISCOs.

### Annex 8.5.1 - Winter 2025 - Option 1



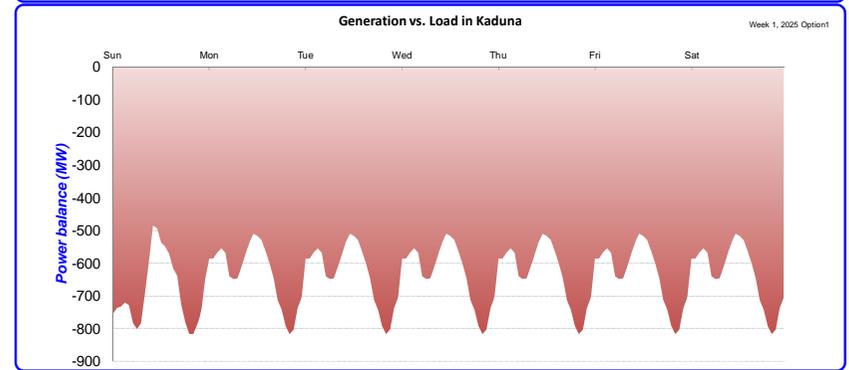
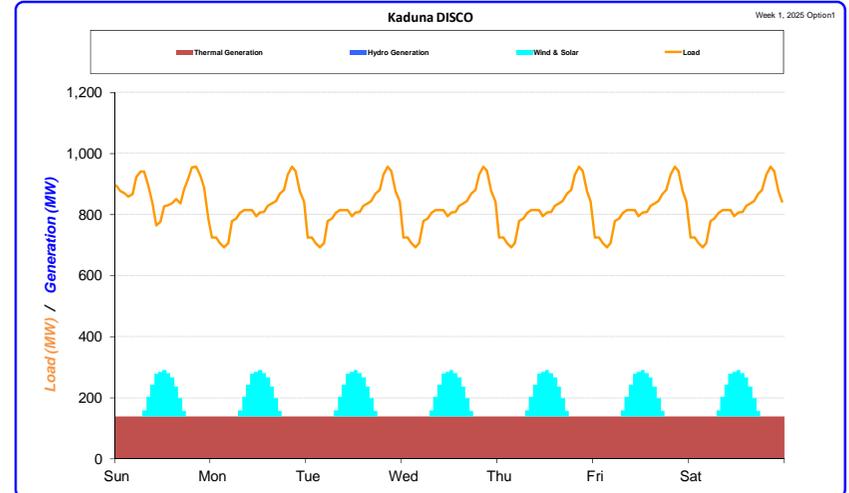
In 2025 Kano DISCO remains a net importer of power. The installed solar power can supply only a local part of the load and has no contribution on lowering the peak demand. The imported power peaks to 850 MW and is obtained mainly via transfer from Kaduna/Abuja DISCO.

### Annex 8.5.1 - Winter 2025 - Option 1



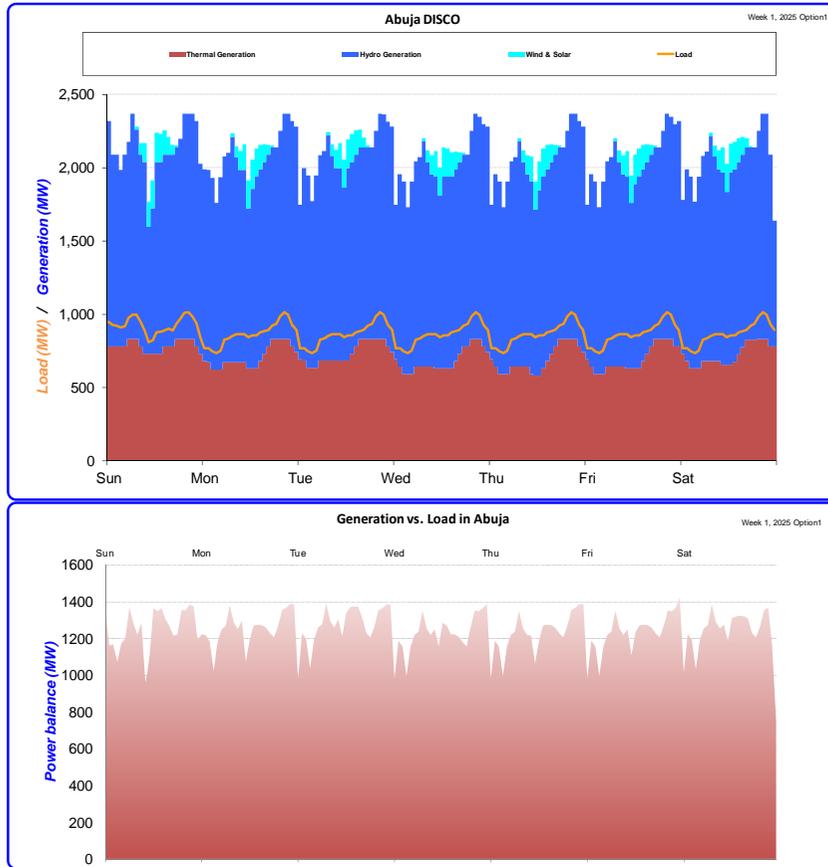
In 2025 Yola DISCO remains a net importer of power. There is no generation installed. The imported power peaks to 350 MW and is obtained mainly via transfer from Pt Harco DISCO.

### Annex 8.5.1 - Winter 2025 - Option 1



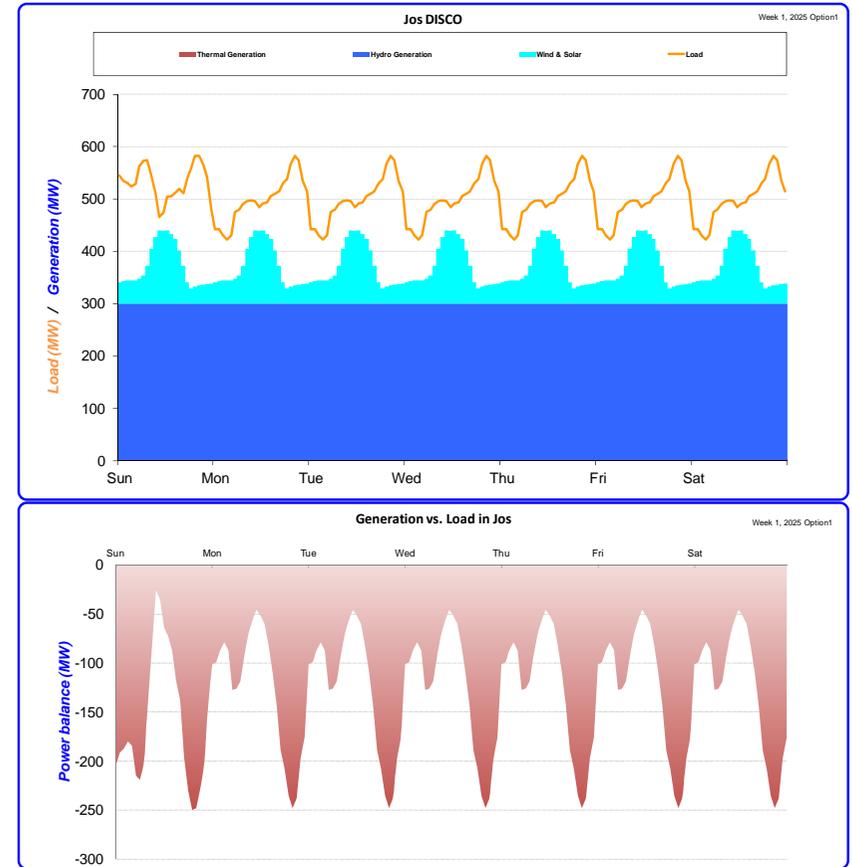
In 2025 Kaduna DISCO remains a net importer of power. The installed thermal and solar power can supply only a fourth of the load and the solar power has no contribution on the lowering the peak demand. The imported power peaks to 800 MW and is obtained mainly via transfer from Abuja/Benin DISCO.

### Annex 8.5.1 - Winter 2025 - Option 1



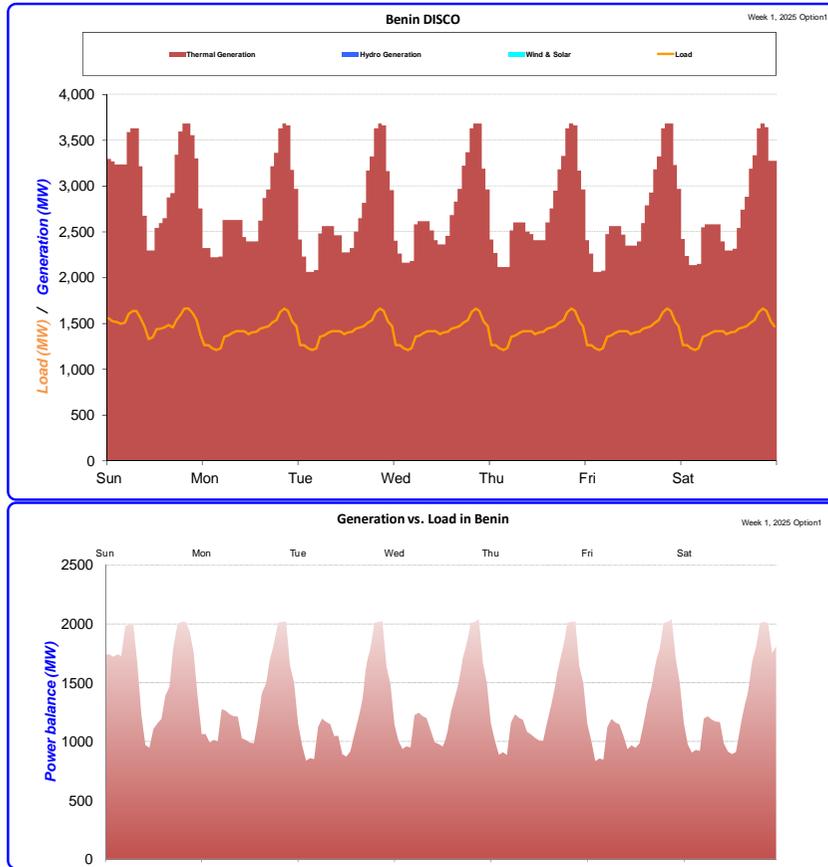
The Abuja DISCO in 2025 is a net exporter of power. The exported power reaches 1300 MW in the peak load hours. The base load supply is from thermal and hydro power in the DISCO and the peaking is done by the available hydro generation. The solar power is also present in the generation/load balance with marginal significance. The exported power goes to the neighboring DISCOs: Kaduna, Kano, Ibandan and Jos. Abuja DISCO also transfers power from Benin DISCO to the north of Nigeria.

### Annex 8.5.1 - Winter 2025 - Option 1



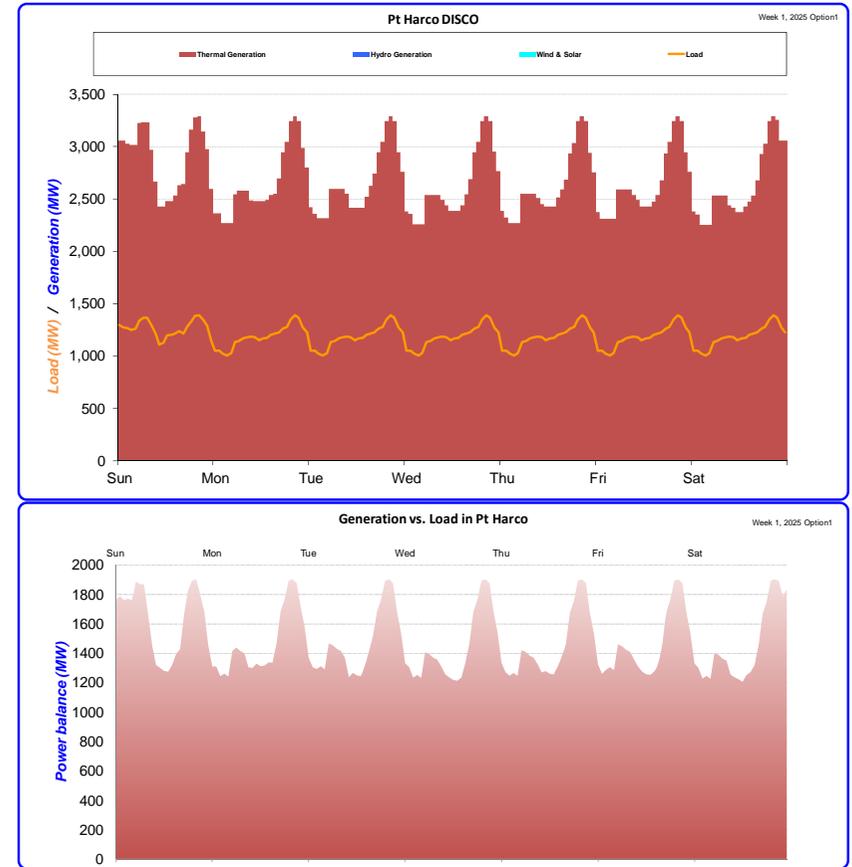
In 2025 Jos DISCO remains a net importer of power. The installed hydro power for the Mambila HPP is considered to be run with one unit of 300 MW, as base load. The installed wind solar power can supply only a local part of the load and has no contribution on the lowering the peak demand. The imported power peaks are reduced compared to 2020 and reach 250 MW and is obtained mainly via transfer from Pt Harco /Abuja DISCO.

### Annex 8.5.1 - Winter 2025 - Option 1



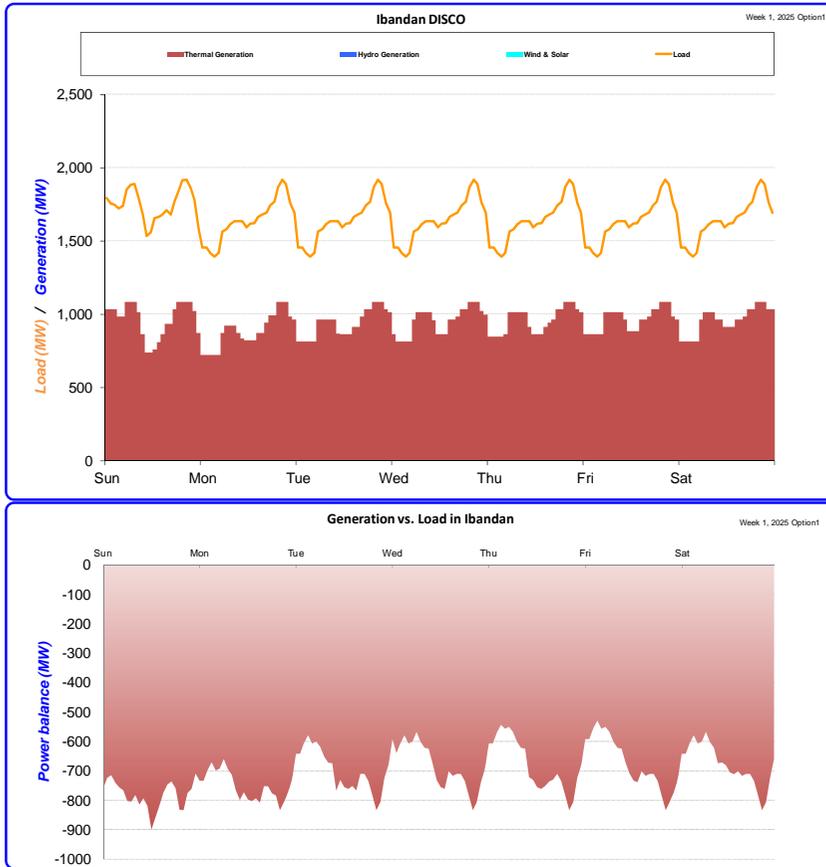
The Benin DISCO in 2025 is a net exporter of power. The exported power reaches 2000 MW in the peak load hours. The base and peak load supply is from thermal generation. The exported power goes to the neighboring DISCOs: Abuja (Kaduna, Kano) and Ibandan. Benin DISCO also transfers power from Pt Harco DISCO to the north and west of Nigeria. The existing transmission infrastructure is sufficient for obtaining the power export to the neighboring DISCOs. Most of the new generation facilities will be installed in Benin DISCO due to the availability of fuel and local infrastructure, as well as good transmission capacity connectivity.

### Annex 8.5.1 - Winter 2025 - Option 1



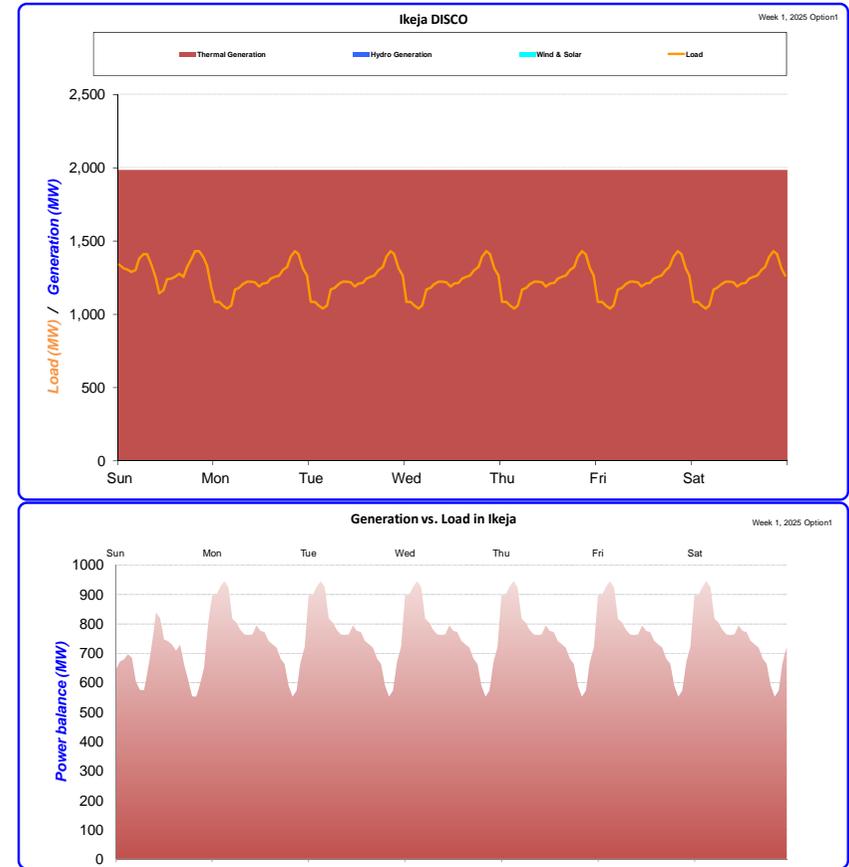
The Pt Harco DISCO in 2025 is a net exporter of power. The exported power reaches 1800MW in the peak load hours. The base and peak load supply is from thermal generation. The exported power goes to the neighboring DISCOs: Benin and further to Abuja (Kaduna, Kano) and Enugu (Jos, Yola). The existing transmission infrastructure is sufficient for obtaining the power export to the neighboring DISCOs. The peaking reaches 1800 MW.

### Annex 8.5.1 - Winter 2025 - Option 1



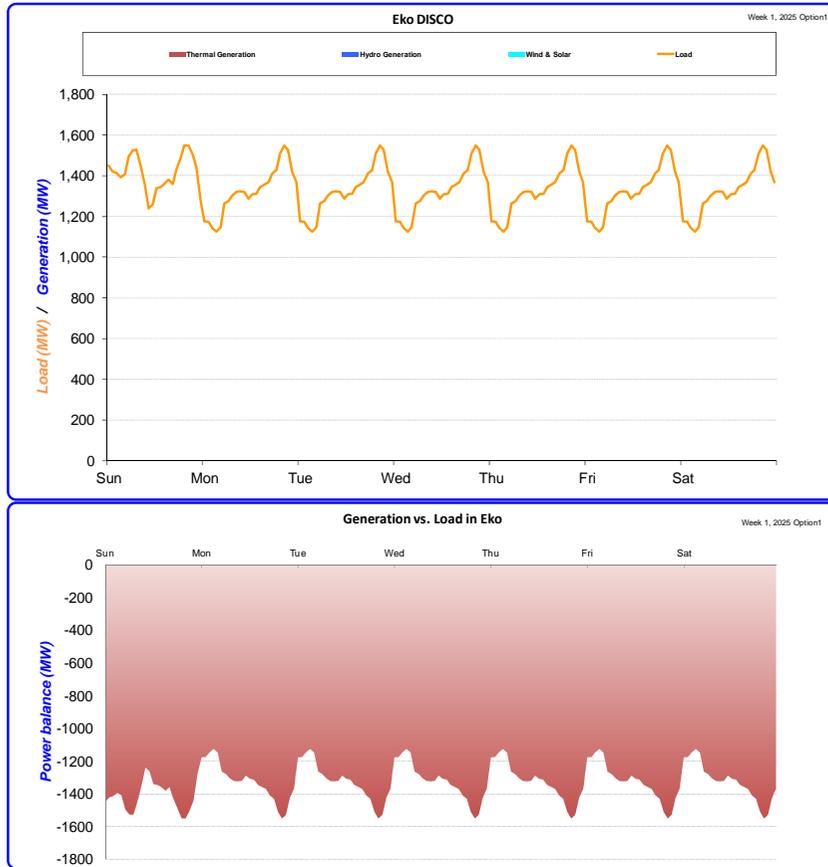
In 2025 Ibandan DISCO remains a net importer of power. The installed thermal power can supply a half of the load. The imported power peaks to 850 MW and is obtained mainly via transfer from Abuja/Benin DISCO.

### Annex 8.5.1 - Winter 2025 - Option 1



The Ikeja DISCO in 2025 is a net exporter of power. The exported power reaches 900 MW in the peak load hours. The base and peak load supply is from thermal generation. The exported power goes to the neighboring Eko DISCO. The existing transmission infrastructure is sufficient for obtaining the power export to Eko DISCO.

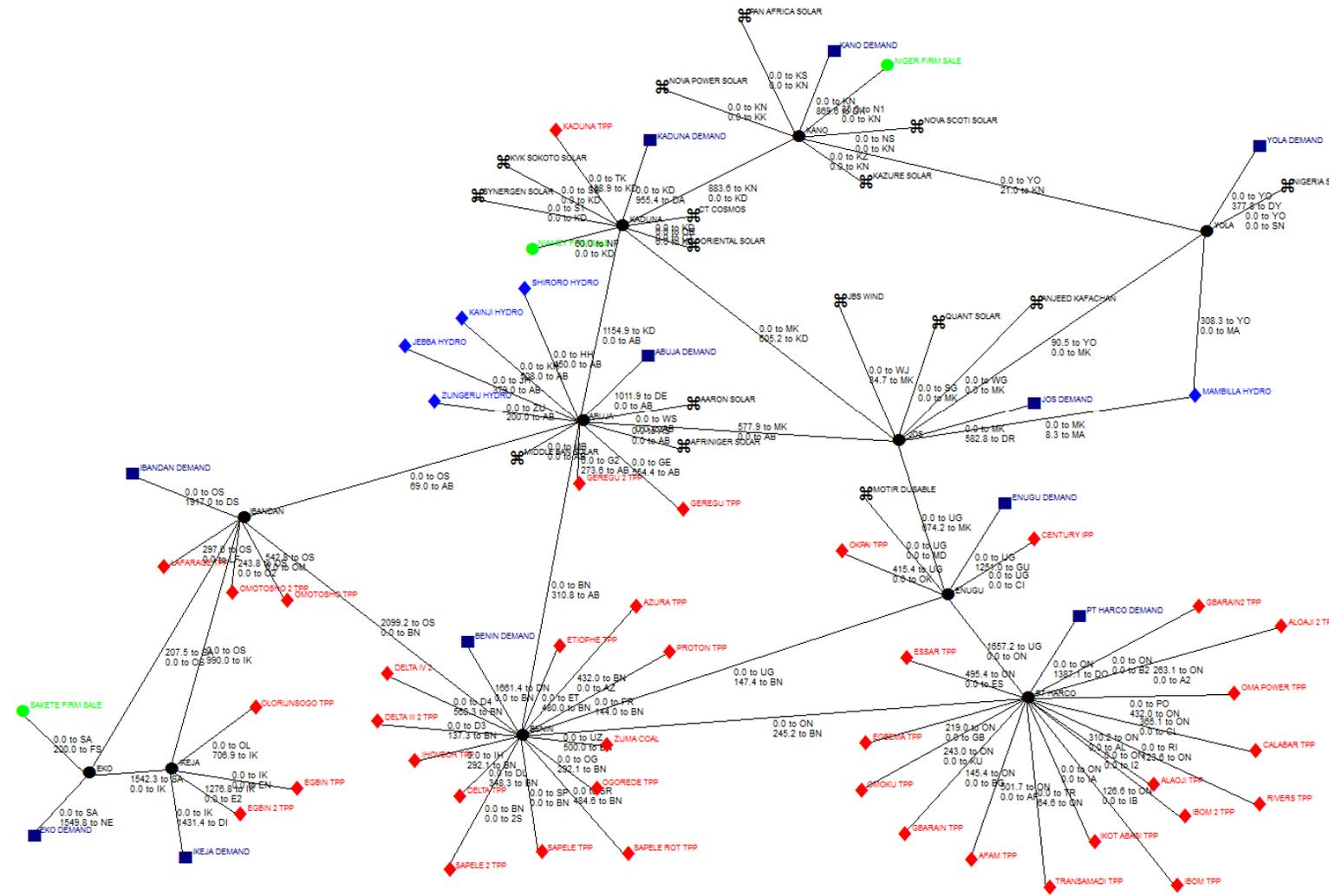
## Annex 8.5.1 - Winter 2025 - Option 1



In 2025 Eko DISCO remains a net importer of power. There is no generation installed. The imported power peaks to 1500 MW and is obtained mainly via transfer from Ikeja/Benin and Ibandan DISCO. The existing transmission infrastructure is sufficient for obtaining the power import from Ikeja and Ibandan DISCO.

# Annex 8.5.1 - Winter 2025 - Option 1

| Node | Water Links | Transmission Link | Heat Pipeline | Fuel Transport | Year | Week        | Day  | Hour |
|------|-------------|-------------------|---------------|----------------|------|-------------|------|------|
| ame  | None        | Energy Flow       | None          | None           | 2000 | 1: 1 Jan W1 | Sun. | 21   |

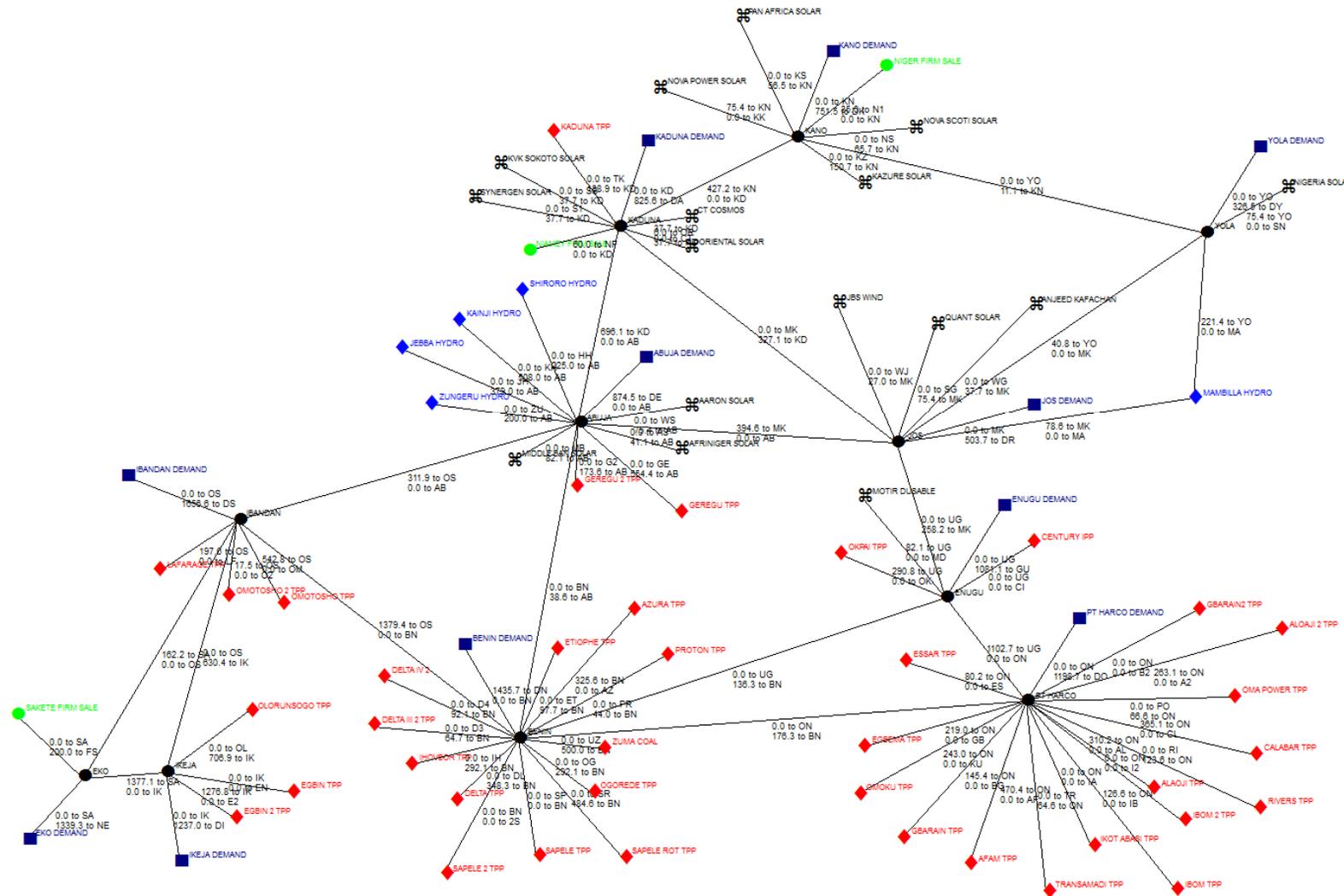


Annex 8.5.1  
Winter 2025  
Option 1

**Power flow during peak hours:** The power flows between the DISCOs in Nigeria for the peaking hours in winter in 2025 are from the south to the north, from the east to the west. Main power exporters are remaining Benin, Pt Harco, Abuja and Ikeja. Due to new generation installed in Ibandan DISCO, also Ibandan can export to Eko and Abuja. During peaking hours the solar power is not available, so the peaking is further on done by thermal power from the south and mid of

# Annex 8.5.1 - Winter 2025 - Option 1

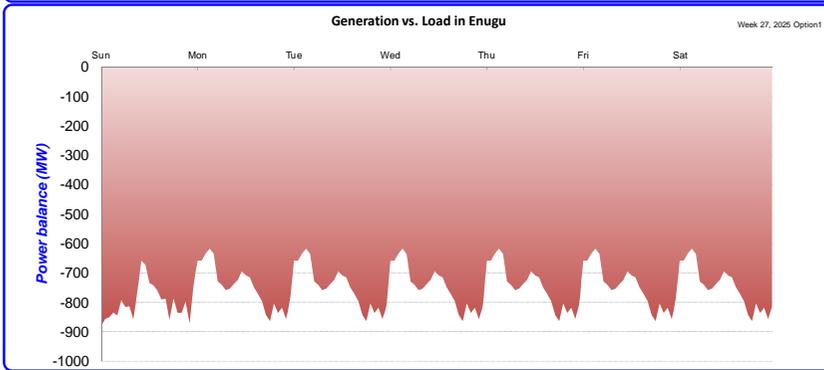
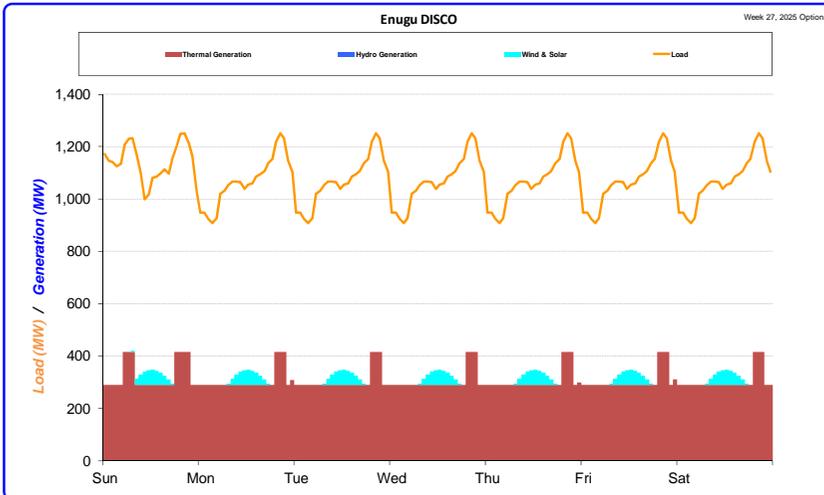
| Node | Water Links | Transmission Link | Heat Pipeline | Fuel Transport | Year | Week        | Day  | Hour |
|------|-------------|-------------------|---------------|----------------|------|-------------|------|------|
| ame  | None        | Energy Flow       | None          | None           | 2000 | 1: 1 Jan W1 | Sun. | 13   |



**Annex 8.5.1  
Winter 2025  
Option 1**

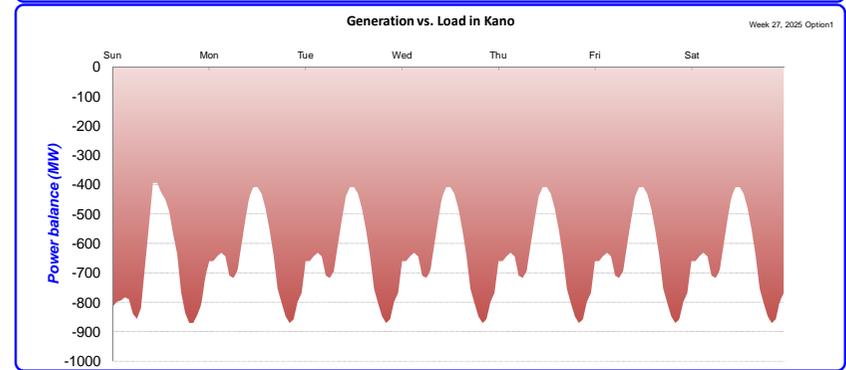
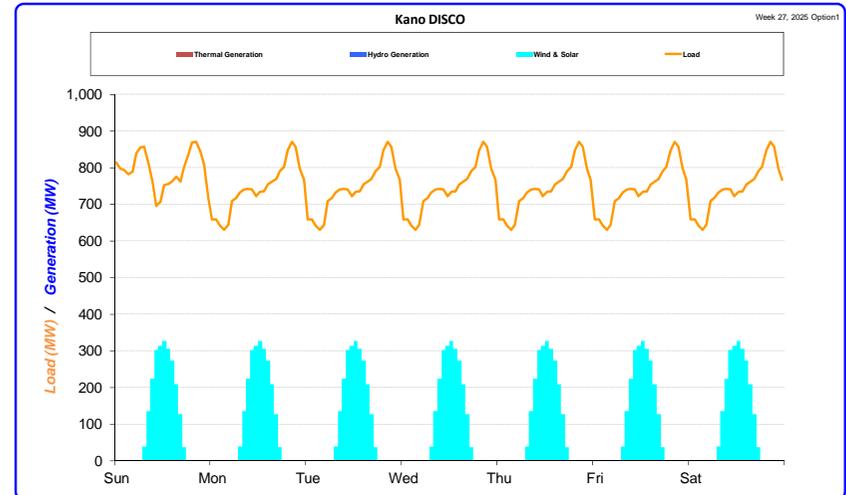
**Power flow during Off-peak hours:** During off - peaking hours the solar power is available, so the power flows from the south/mid of the country to the north are reduced, e.g. from Kaduna to Kano 427 MW in off peak and 883 MW in peak hours.

Annex 8.5.2 - Summer 2025 - Option 1



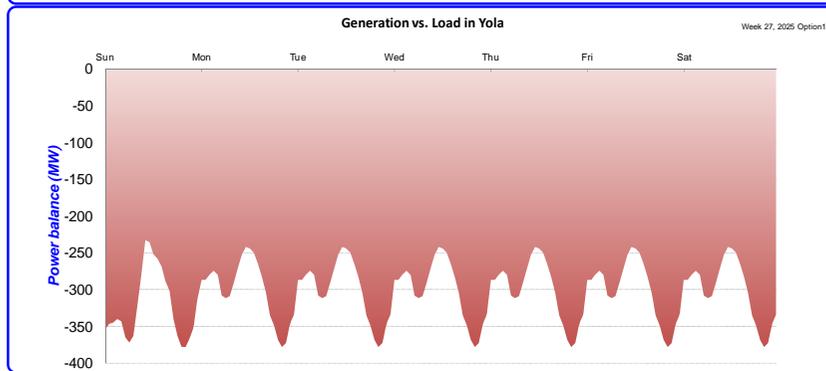
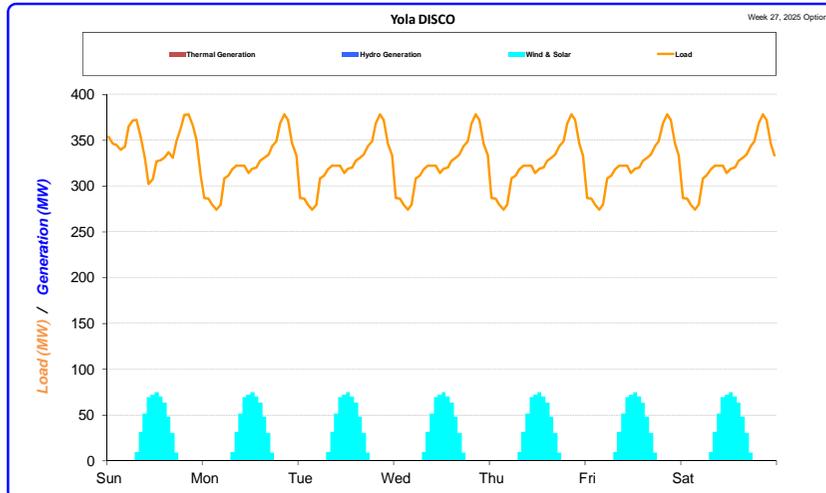
The generation profile of Enugu DISCO is based on thermal power. Small portion of solar power projects will be installed until 2025. The demand of the DISCO is higher than the available generation in 2020. The generation vs. Load Balance shows that the DISCO is a net importer of power. The imported power is from the Pt Harco and Benin DISCO. The peak of imported power reaches 900 MW which can be transferred via the available transmission infrastructure between the three DISCOs. The peaks of peak power indicate a need of new thermal generation e.g higher capacity at Geregu.

Annex 8.5.2 - Summer 2025 - Option 1



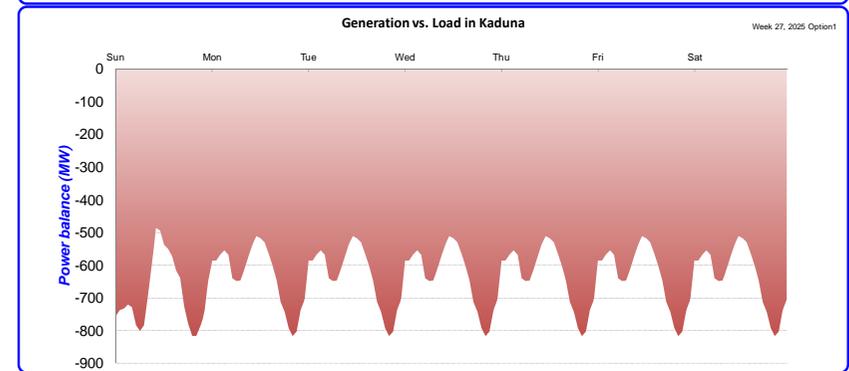
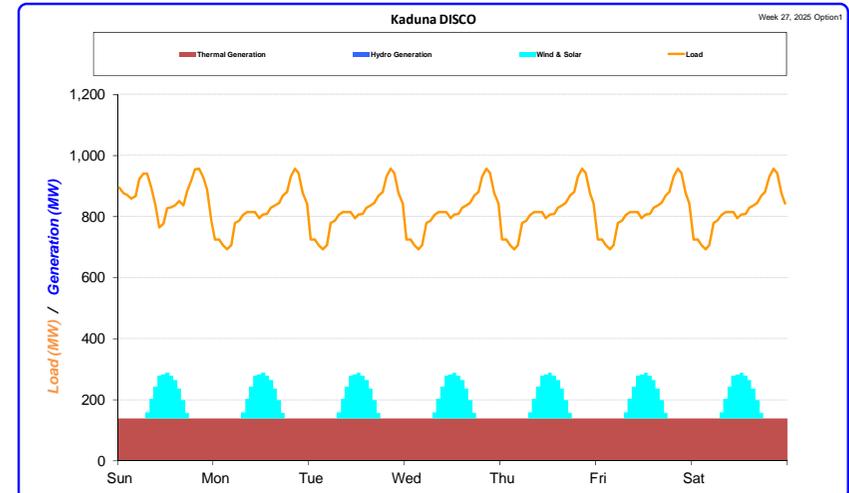
In 2025 Kano DISCO remains a net importer of power. The installed solar power can supply only a local part of the load and has no contribution on the lowering the peak demand. The imported power peaks to 850 MW and is obtained mainly via transfer from Kaduna/Abuja DISCO.

### Annex 8.5.2 - Summer 2025 - Option 1



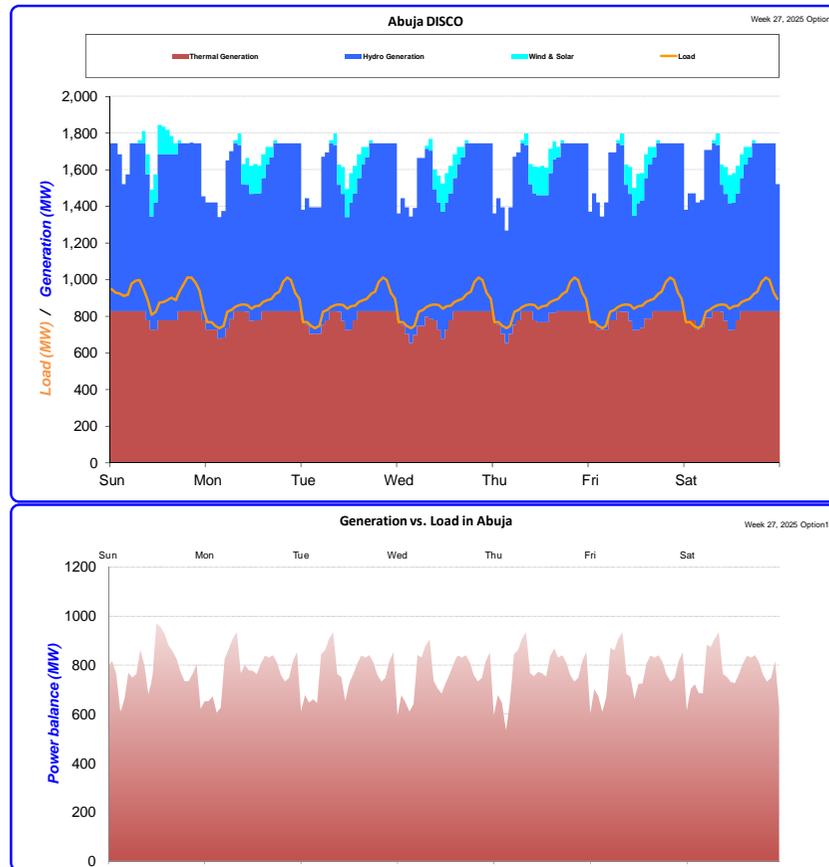
In 2025 Yola DISCO remains a net importer of power. There is no generation installed. The imported power peaks to 3500 MW and is obtained mainly via transfer from Pt Harco DISCO.

### Annex 8.5.2 - Summer 2025 - Option 1



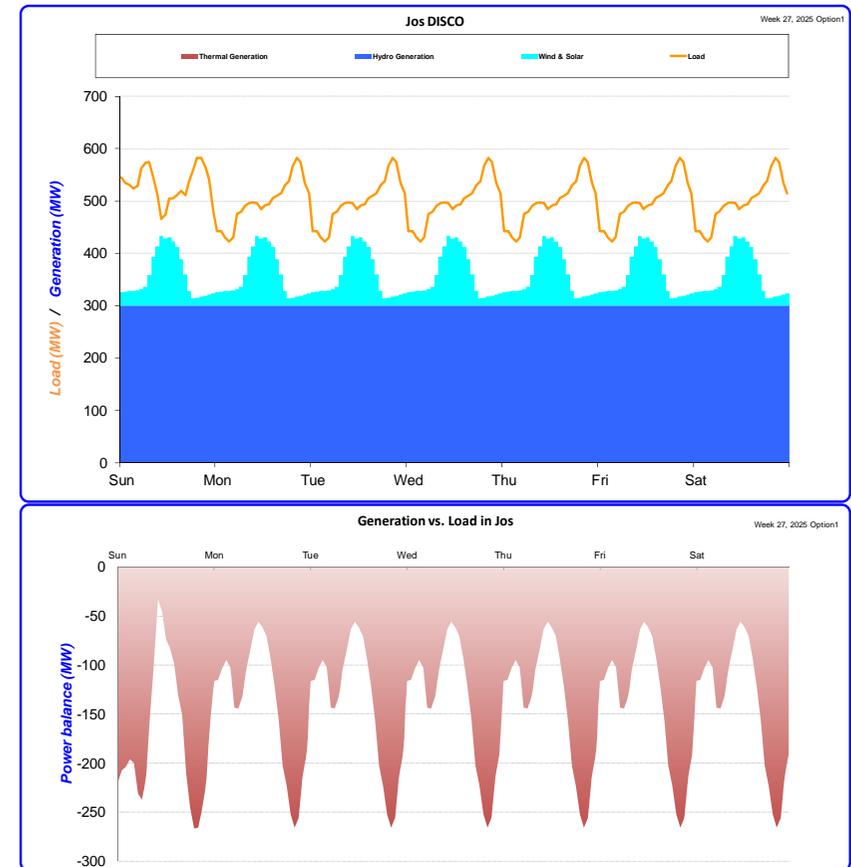
In 2025 Kaduna DISCO remains a net importer of power. The installed thermal and solar power can supply only a fourth of the load and the solar power has no contribution on the lowering the peak demand. The imported power peaks to 800 MW and is obtained mainly via transfer from Abuja/Benin DISCO.

### Annex 8.5.2 - Summer 2025 - Option 1



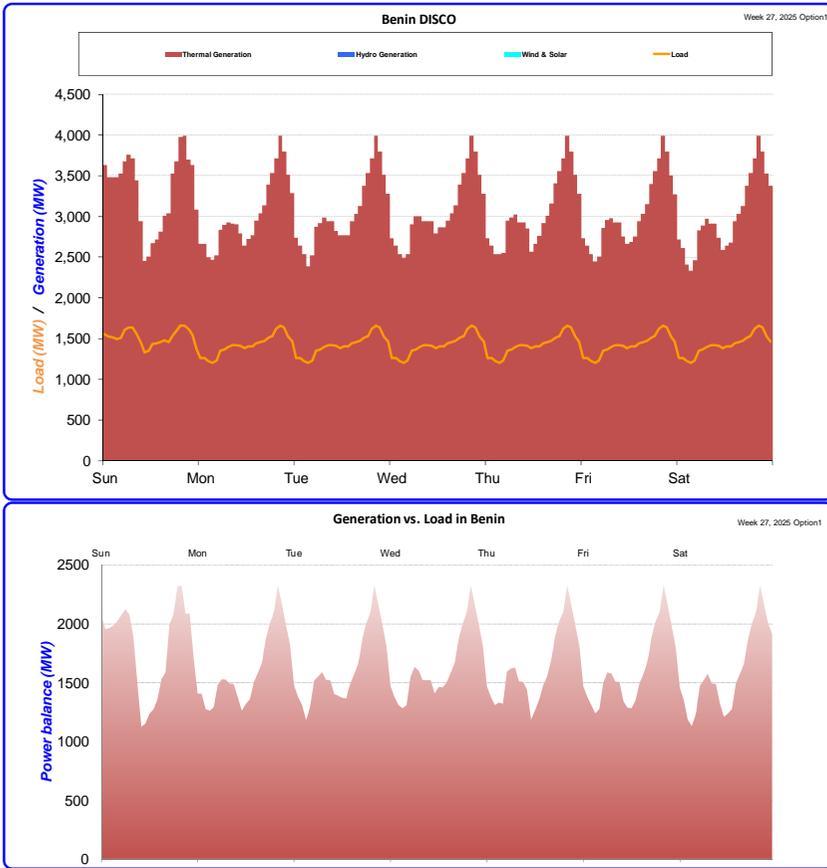
The Abuja DISCO in 2025 is a net exporter of power. The exported power reaches 900 MW in the peak load hours. The base load supply is from thermal and hydro power in the DISCO and the peaking is done by the available hydro generation. The solar power is also present in the generation/load balance with marginal significance. The exported power goes to the neighboring DISCOs: Kaduna, Kano, Ibandan and Jos. Abuja DISCO also transfers power from Benin DISCO to the north of Nigeria. The availability of hydro power in the summer season is lower than in the winter season.

### Annex 8.5.2 - Summer 2025 - Option 1



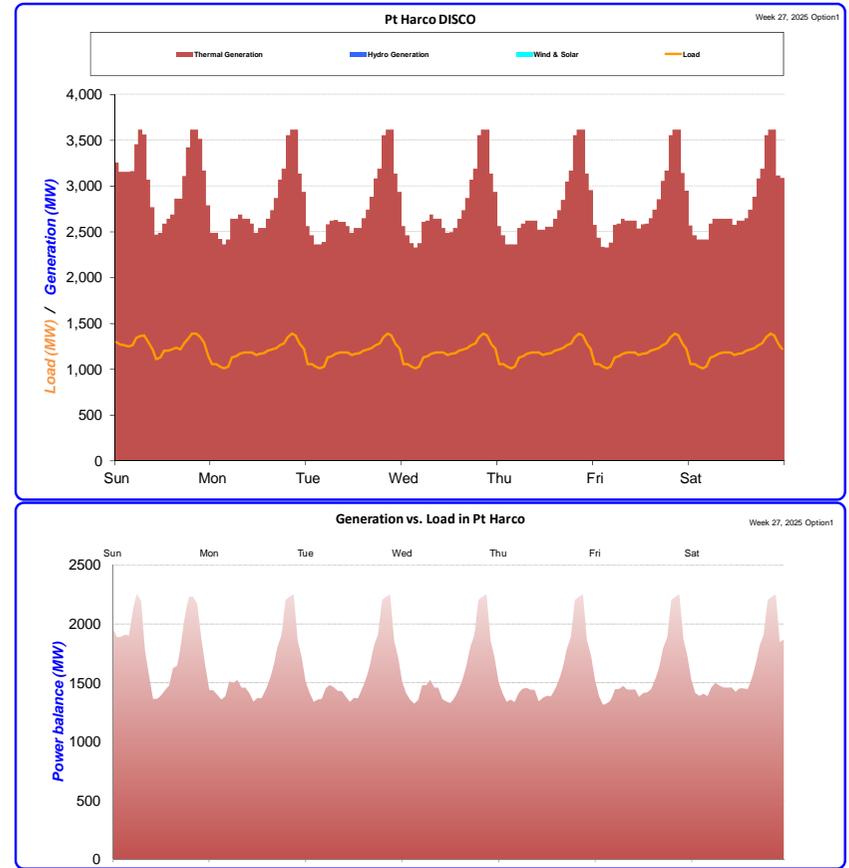
In 2025 Jos DISCO remains a net importer of power. The installed hydro power for the Mambila HPP is considered to be run with one unit of 300 MW, as base load. The installed wind solar power can supply only a local part of the load and has no contribution on the lowering the peak demand. The imported power peaks are reduced compared to 2020 and reach 250 MW and is obtained mainly via transfer from Pt Harco /Abuja DISCO.

Annex 8.5.2 - Summer 2025 - Option 1



The Benin DISCO in 2025 is a net exporter of power. The exported power reaches 2300 MW in the peak load hours. The base and peak load supply is from thermal generation. The exported power goes to the neighboring DISCOs: Abuja (Kaduna, Kano) and Ibandan. Benin DISCO also transfers power from Pt Harco DISCO to the north and west of Nigeria. The existing transmission infrastructure is sufficient for obtaining the power export to the neighboring DISCOs. Most of the new generation facilities will be installed in Benin DISCO due to the availability of fuel and local infrastructure, as well as good transmission capacity connectivity. The exports in the summer season are higher due to a lower availability of hydro power.

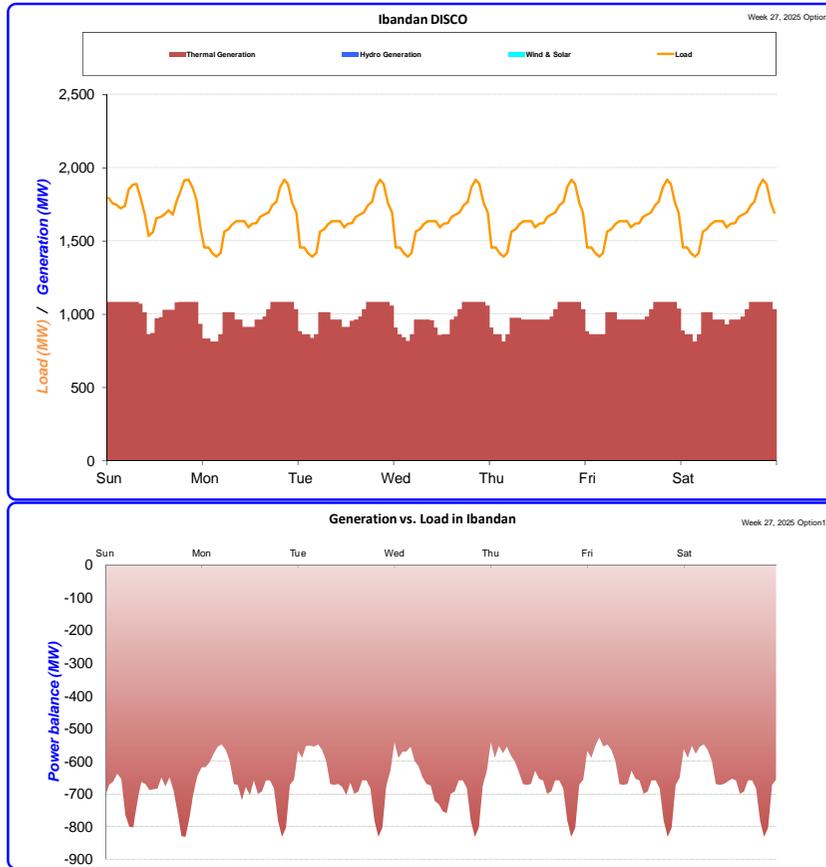
Annex 8.5.2 - Summer 2025 - Option 1



The Pt Harco DISCO in 2025 is a net exporter of power. The exported power reaches 2200MW in the peak load hours. The base and peak load supply is from thermal generation. The exported power goes to the neighboring DISCOs: Benin and further to Abuja (Kaduna, Kano) and Enugu (Jos, Yola). The existing transmission infrastructure is sufficient for obtaining the power export to the neighboring DISCOs.

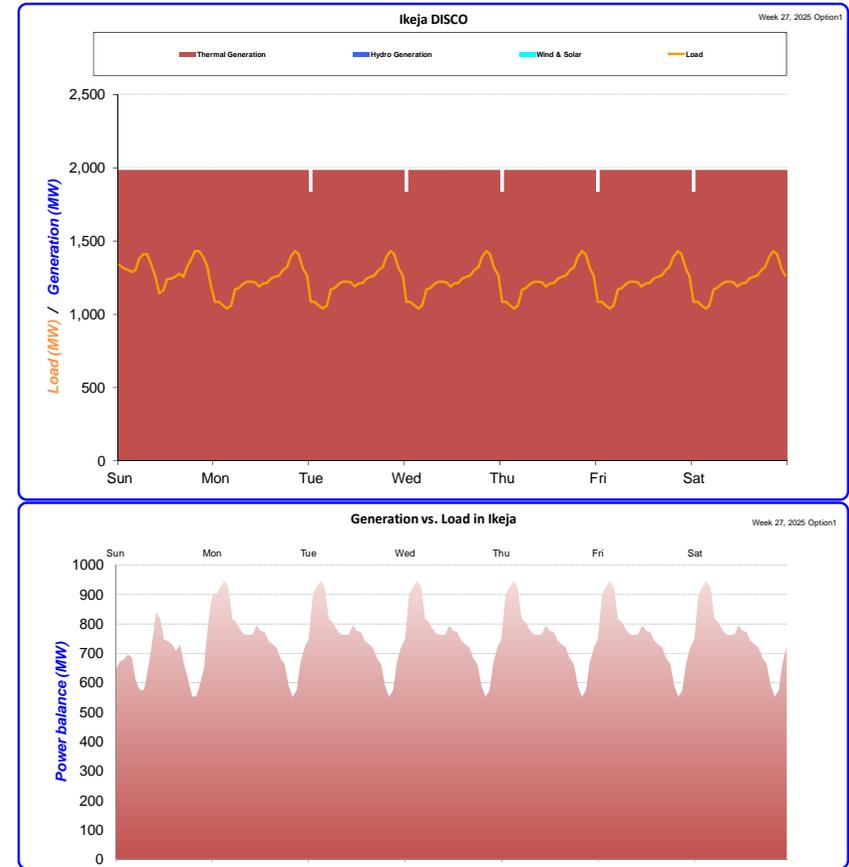
The exports in the summer season are higher due to a lower availability of hydro power.

### Annex 8.5.2 - Summer 2025 - Option 1



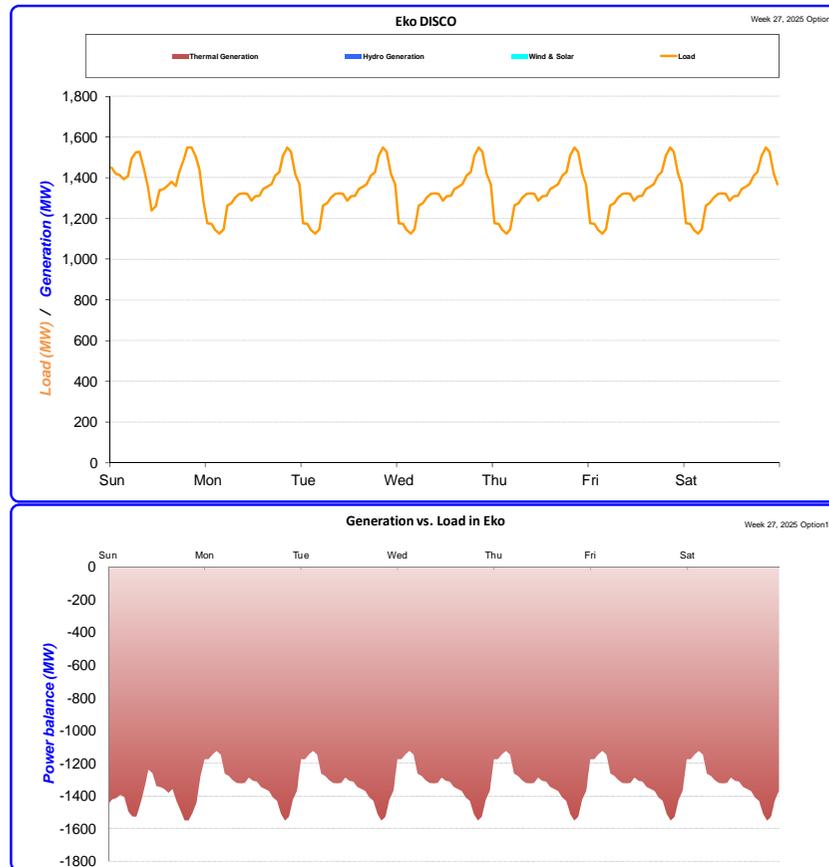
In 2025 Ibandan DISCO remains a net importer of power. The installed thermal power can supply a half of the load. The imported power peaks to 800 MW and is obtained mainly via transfer from Abuja/Benin DISCO.

### Annex 8.5.2 - Summer 2025 - Option 1



The Ikeja DISCO in 2025 is a net exporter of power. The exported power reaches 900 MW in the peak load hours. The base and peak load supply is from thermal generation. The exported power goes to the neighboring Eko DISCO. The existing transmission infrastructure is sufficient for obtaining the power export to Eko DISCO.

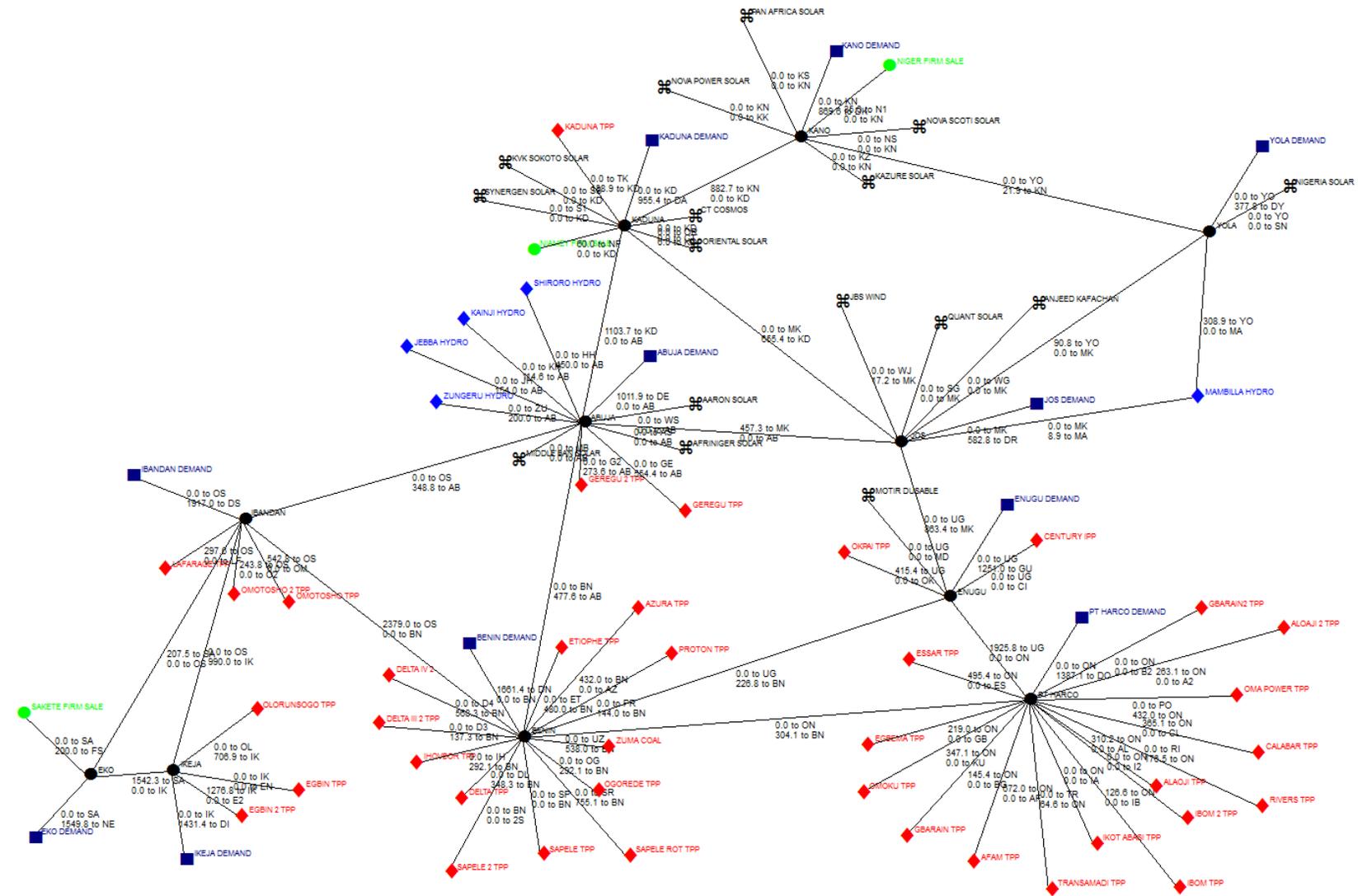
## Annex 8.5.2 - Summer 2025 - Option 1



In 2025 Eko DISCO remains a net importer of power. There is no generation installed. The imported power peaks to 1500 MW and is obtained mainly via transfer from Ikeja/Benin and Ibandan DISCO. The existing transmission infrastructure is sufficient for obtaining the power import from Ikeja and Ibandan DISCO.

# Annex 8.5.2 - Summer 2025 - Option 1

| Node | Water Links | Transmission Link | Heat Pipeline | Fuel Transport | Year | Week          | Day  | Hour |
|------|-------------|-------------------|---------------|----------------|------|---------------|------|------|
| ame  | None        | Energy Flow       | None          | None           | 2000 | 27: 27 Jul W1 | Sun. | 21   |

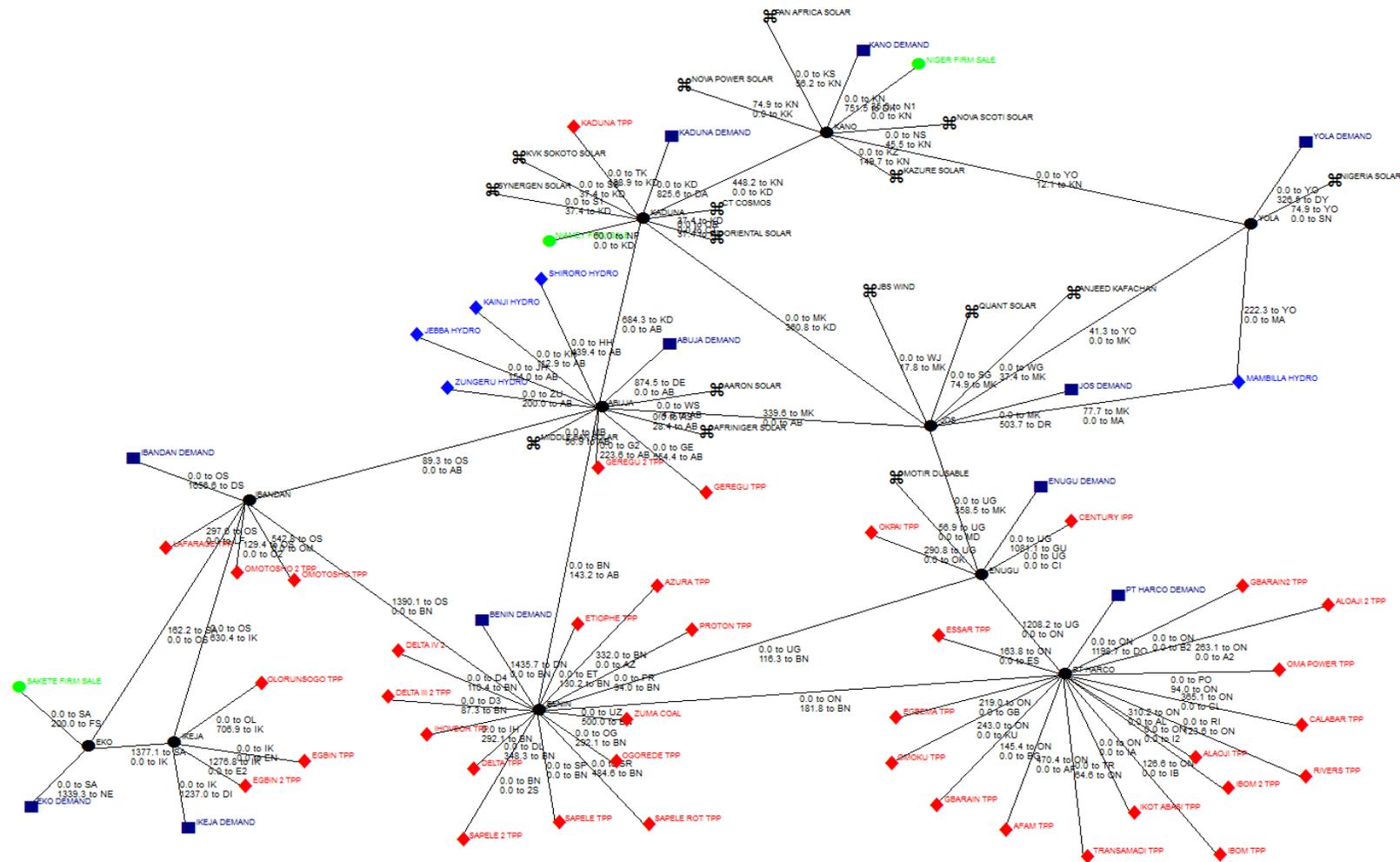


**Annex 8.5.2  
Summer 2025  
Option 1**

**Power flow during peak hours:** The power flows between the DISCOs in Nigeria for the peaking hours in summer in 2025 are from the south to the north, from the east to the west. Main power exporters are remaining Benin, Pt Harco and Ikeja. During peaking hours the solar power is not available, so the peaking is further on done by thermal power from the south and mid of the country.

# Annex 8.5.2 - Summer 2025 - Option 1

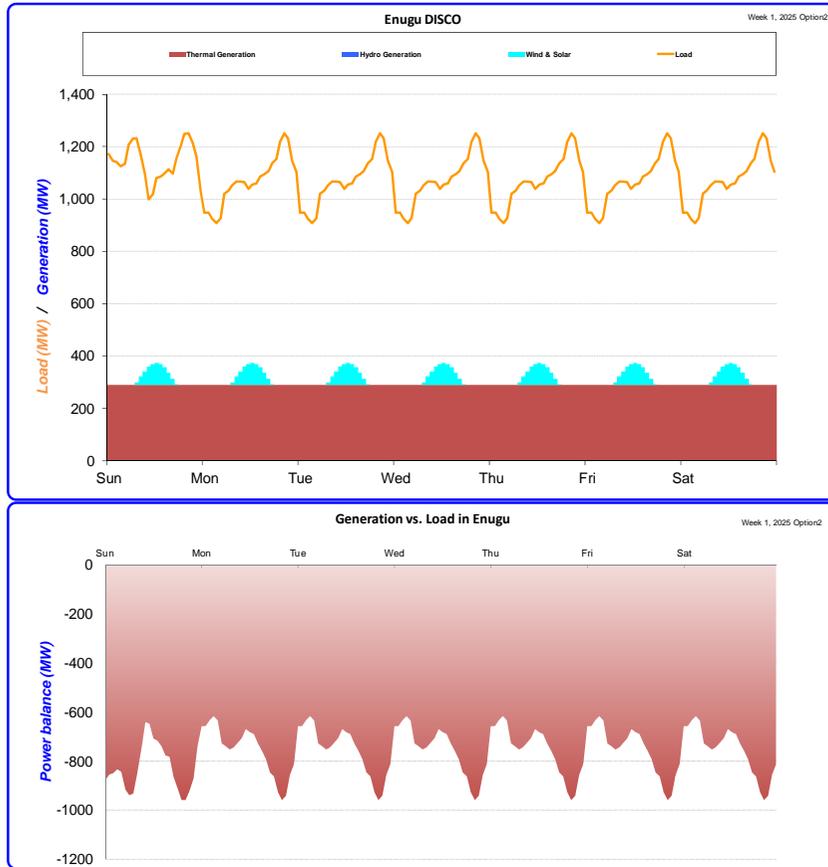
| Node | Water Links | Transmission Link | Heat Pipeline | Fuel Transport | Year | Week          | Day  | Hour |
|------|-------------|-------------------|---------------|----------------|------|---------------|------|------|
| ame  | None        | Energy Flow       | None          | None           | 2000 | 27: 27 Jul W1 | Sun. | 13   |



Annex 8.5.2  
Summer 2025  
Option 1

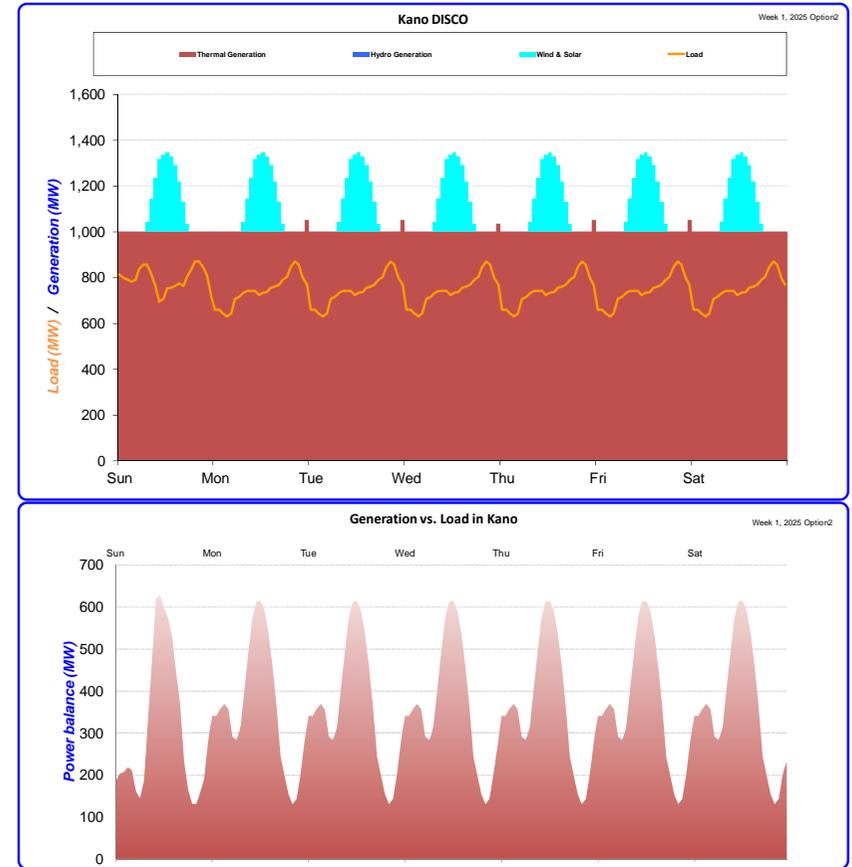
**Power flow during Off-peak hours:** During off - peaking hours the solar power is available, so the power flows from the south/mid of the country to the north are reduced, e.g. from Kaduna to Kano 448 MW in off peak and 882 MW in peaking hours.

### Annex 8.5.3 - Winter 2025 - Option 2



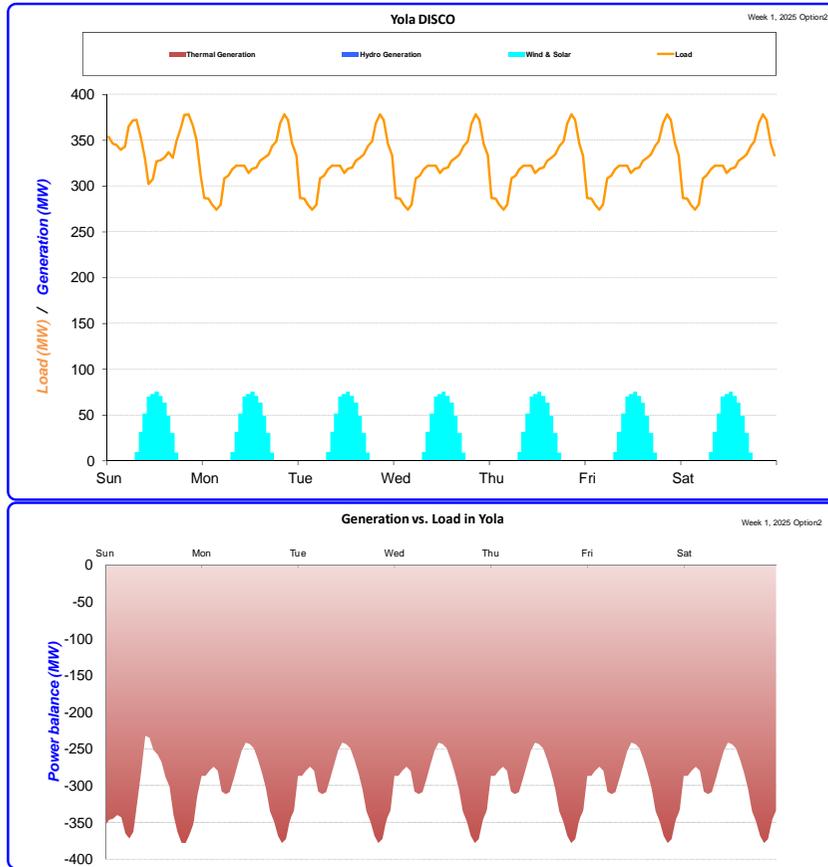
The generation profile of Enugu DISCO is based on thermal power. Small portion of solar power projects will be installed until 2025. The demand of the DISCO is higher than the available generation in 2020. The generation vs. Load Balance shows that the DISCO is a net importer of power. The imported power is from the Pt Harco and Benin DISCO. The peak of imported power reaches 900 MW which can be transferred via the available transmission infrastructure between the three DISCOs.

### Annex 8.5.3 - Winter 2025 - Option 2



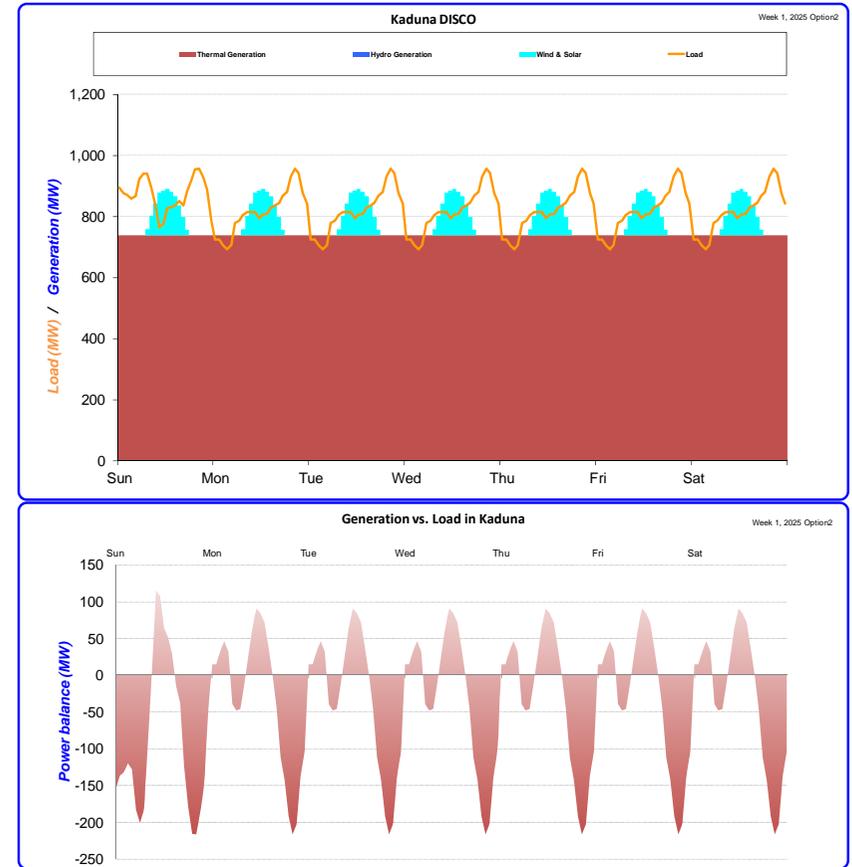
In 2025 Kano DISCO in Option 2 becomes a net exporter of power, due to installed thermal power plants. The installed solar power supplements to the power export which reaches about 600 MW in the peaking hours. The exported power goes to Kaduna and Abuja DISCOs and even further. The available transmission infrastructure is sufficient to enable these power exports.

### Annex 8.5.3 - Winter 2025 - Option 2



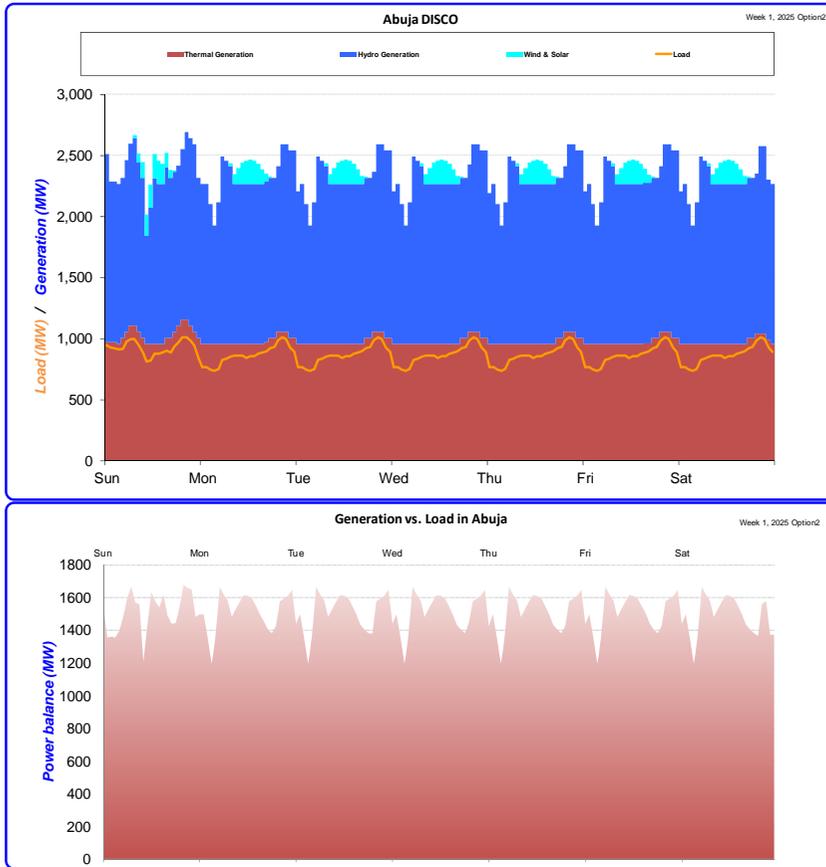
In 2025 Yola DISCO remains a net importer of power. There is no generation installed. The imported power peaks to 350 MW and is obtained mainly via transfer from Pt Harco DISCO.

### Annex 8.5.3 - Winter 2025 - Option 2



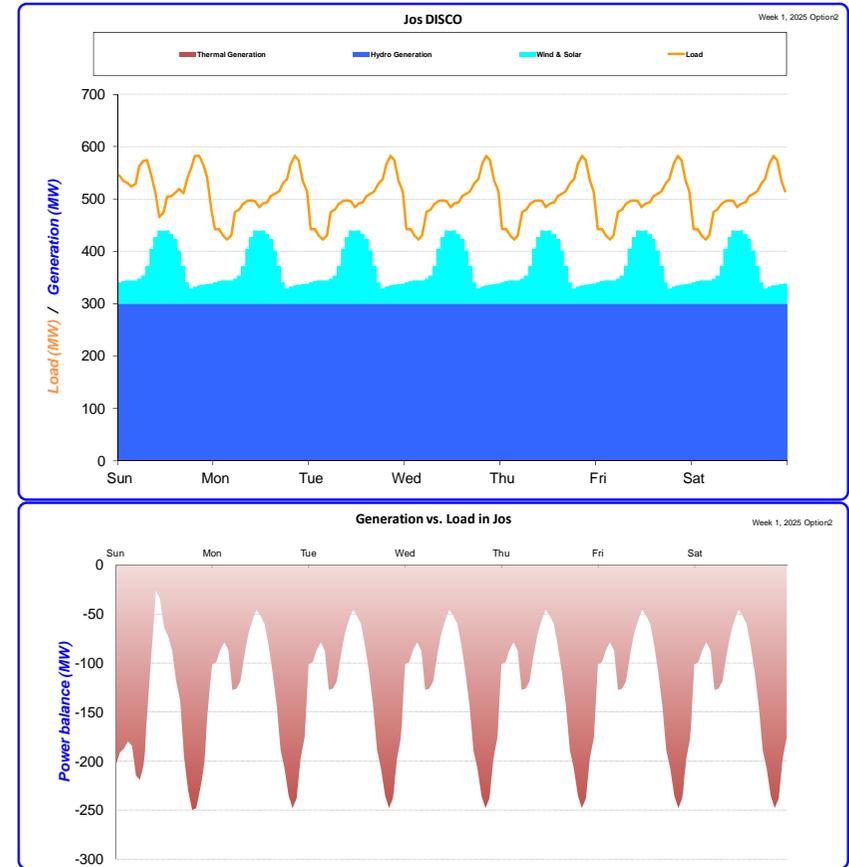
In 2025 Kaduna DISCO remains partly a net importer of power. The installed additional thermal and solar power can supply only the base load and the solar power has no contribution on the lowering the peak demand. The imported power peaks to 200 MW and is obtained mainly via transfer from Abuja/Benin DISCO. The exported power peaks up to 100 MW goes to Abuja and Jos DISCO. The available transmission infrastructure is sufficient to enable these power exports.

### Annex 8.5.3 - Winter 2025 - Option 2



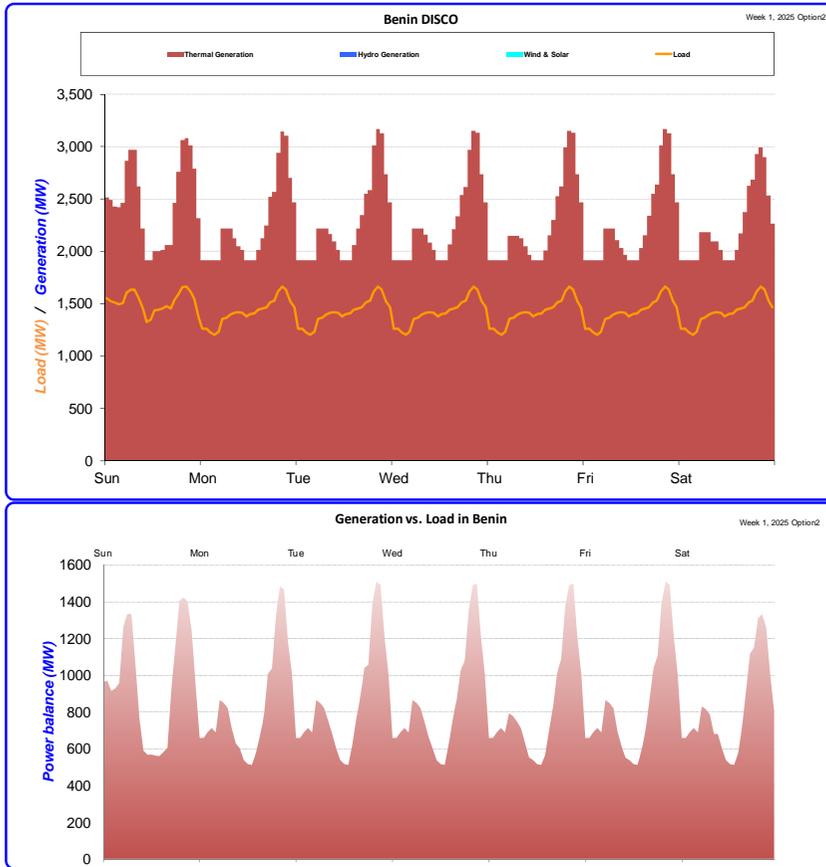
The Abuja DISCO in 2025 is a net exporter of power. The exported power reaches 1600 MW in the peak load hours. The base load supply is from thermal and hydro power in the DISCO and the peaking is done by the available hydro generation. The solar power is also present in the generation/load balance with marginal significance. The exported power goes to the neighboring DISCOs: Benin, Ibandan and Jos. The available transmission infrastructure is sufficient to enable these power exports.

### Annex 8.5.3 - Winter 2025 - Option 2



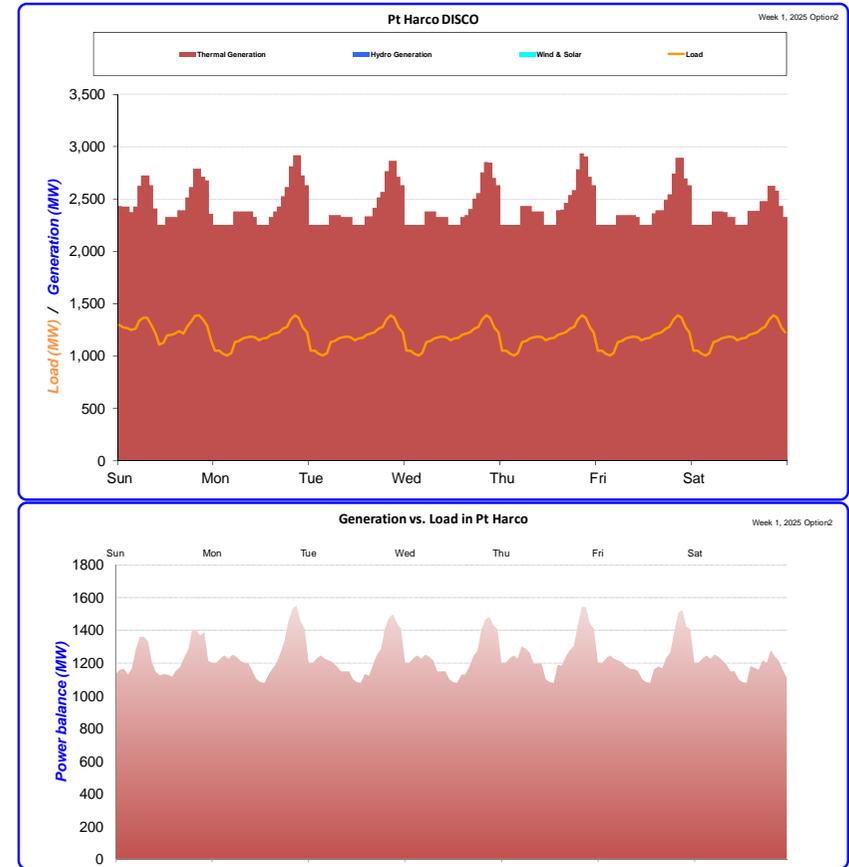
In 2025 Jos DISCO remains a net importer of power. The installed hydro power for the Mambila HPP is considered to be run with one unit of 300 MW, as base load. The installed wind solar power can supply only a local part of the load and has no contribution on the lowering the peak demand. The imported power peaks are reduced compared to 2020 and reach 250 MW and is obtained mainly via transfer from Pt Harco /Abuja DISCO.

### Annex 8.5.3 - Winter 2025 - Option 2



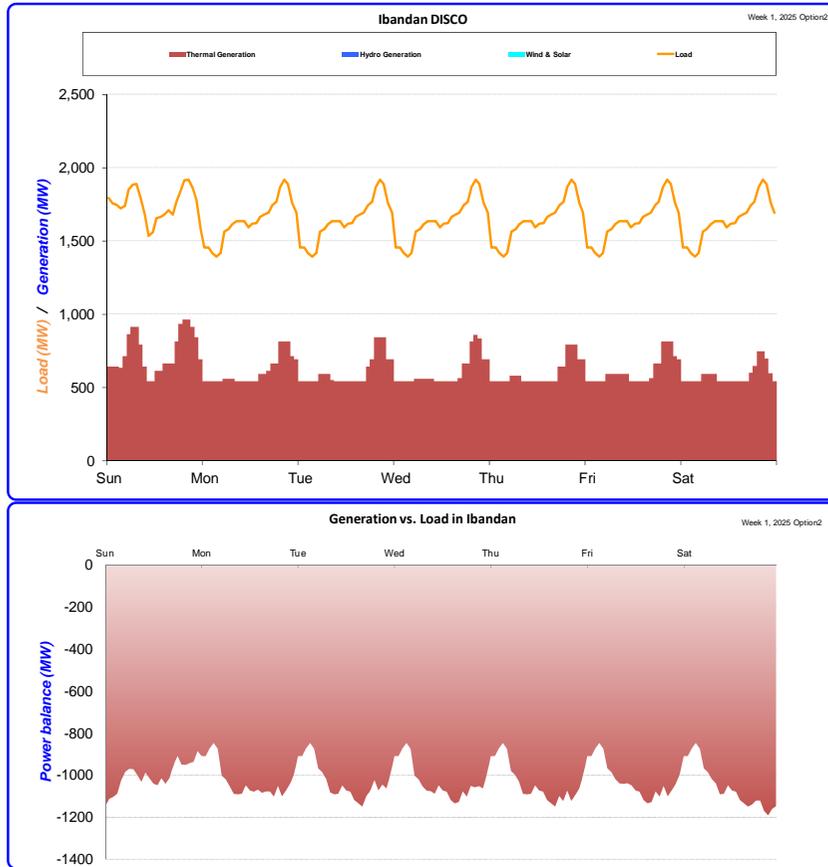
The Benin DISCO in 2025 is a net exporter of power. The exported power reaches 1400 MW in the peak load hours. The base and peak load supply is from thermal generation. The exported power goes to the neighboring DISCO Ibandan. Benin DISCO also transfers power from Pt Harco DISCO to the west of Nigeria. The existing transmission infrastructure is sufficient for obtaining the power export to the neighboring DISCOs. Most of the new generation facilities will be installed in Benin DISCO due to the availability of fuel and local infrastructure, as well as good transmission capacity connectivity. In option 2, due to the thermal generation options in the North: Kano, Kaduna and Abuja, the power export is reduced compared to Option 1 (where was 2000 MW).

### Annex 8.5.3 - Winter 2025 - Option 2



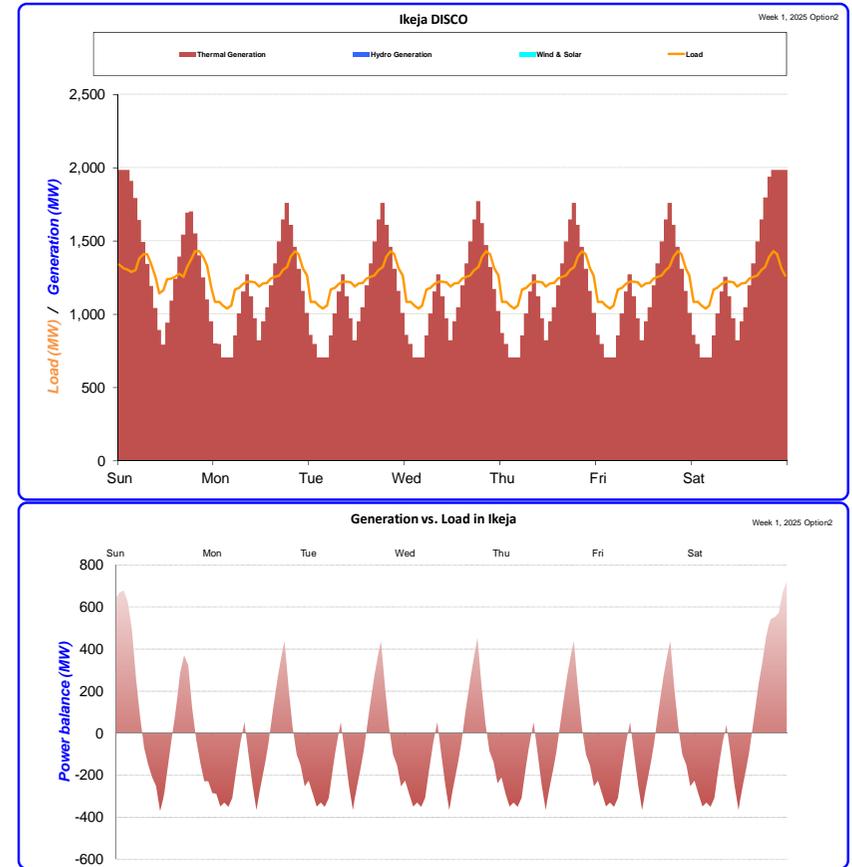
The Pt Harco DISCO in 2025 is a net exporter of power. The exported power reaches 1400MW in the peak load hours. The base and peak load supply is from thermal generation. The exported power goes to the neighboring DISCOs: Benin and Enugu (Jos, Yola). The existing transmission infrastructure is sufficient for obtaining the power export to the neighboring DISCOs. In option 2, due to the thermal generation options in the North: Kano, Kaduna and Abuja, the power export is reduced compared to Option 1 (where was 1800MW).

### Annex 8.5.3 - Winter 2025 - Option 2



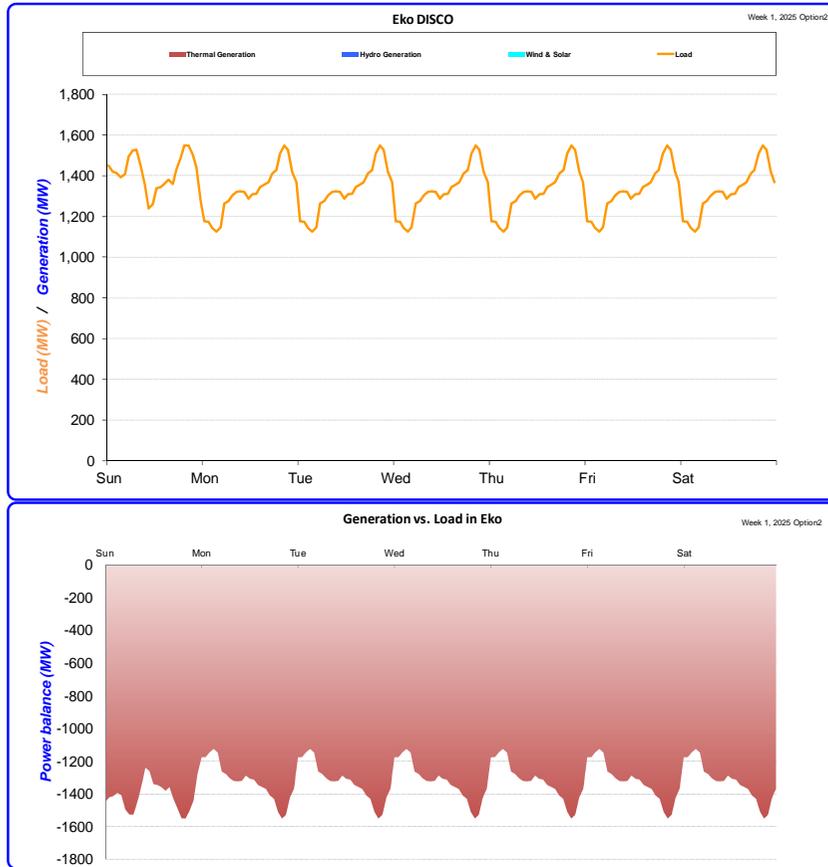
In 2025 Ibandan DISCO remains a net importer of power. The installed thermal power can supply a half of the load. The imported power peaks to 1200 MW and is obtained mainly via transfer from Abuja/Benin DISCO.

### Annex 8.5.3 - Winter 2025 - Option 2



The Ikeja DISCO in 2025 is a net exporter of power. The exported power reaches 600 MW in the peak load hours. The base and peak load supply is from thermal generation. The exported power goes to the neighboring Eko DISCO. The existing transmission infrastructure is sufficient for obtaining the power export to Eko DISCO.

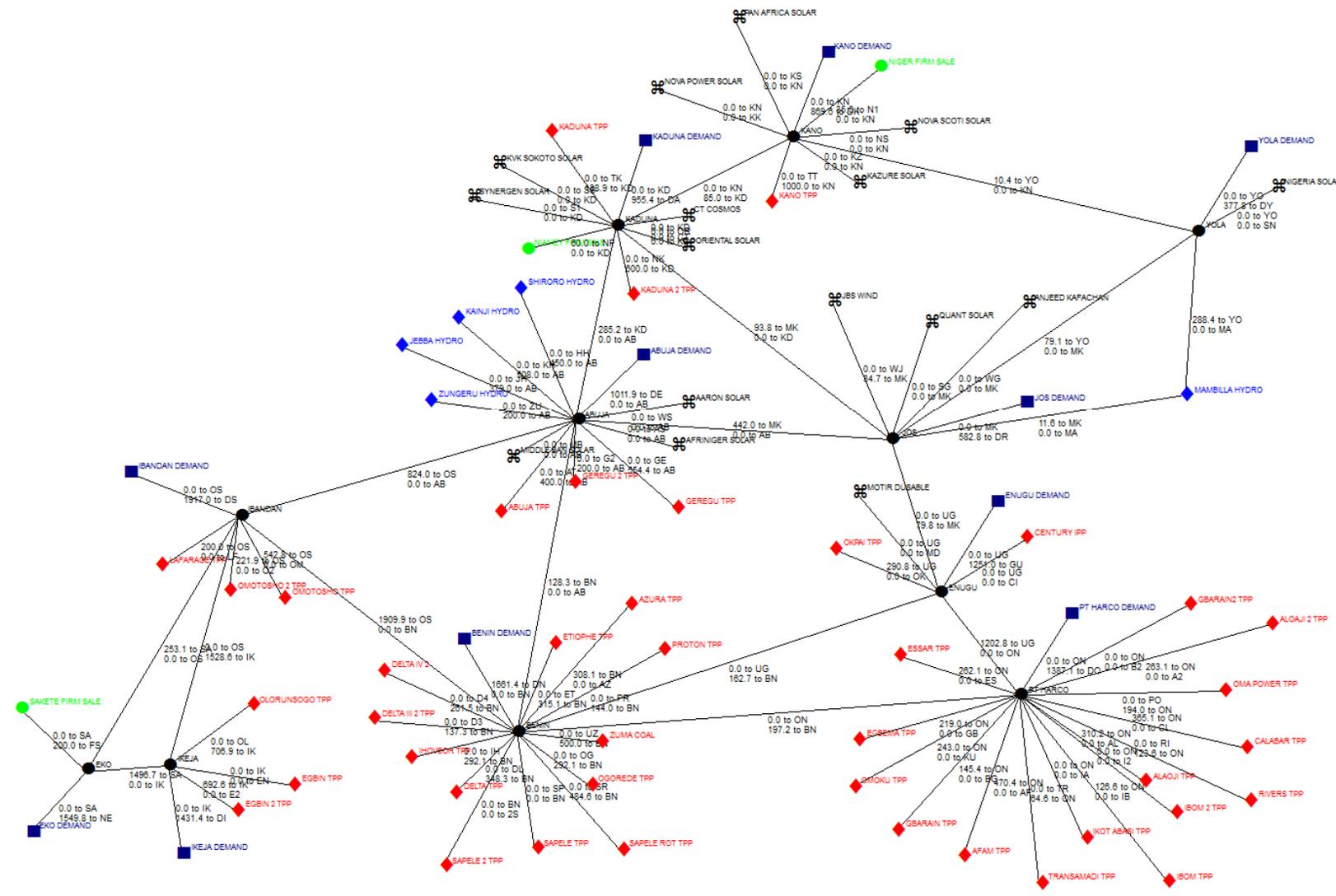
## Annex 8.5.3 - Winter 2025 - Option 2



In 2025 Eko DISCO remains a net importer of power. There is no generation installed. The imported power peaks to 1500 MW and is obtained mainly via transfer from Ikeja/Benin and Ibandan DISCO. The existing transmission infrastructure is sufficient for obtaining the power import from Ikeja and Ibandan DISCO.

# Annex 8.5.3 - Winter 2025 - Option 2

| Node | Water Links | Transmission Link | Heat Pipeline | Fuel Transport | Year | Week        | Day  | Hour |
|------|-------------|-------------------|---------------|----------------|------|-------------|------|------|
| ame  | None        | Energy Flow       | None          | None           | 2000 | 1: 1 Jan W1 | Sun. | 21   |

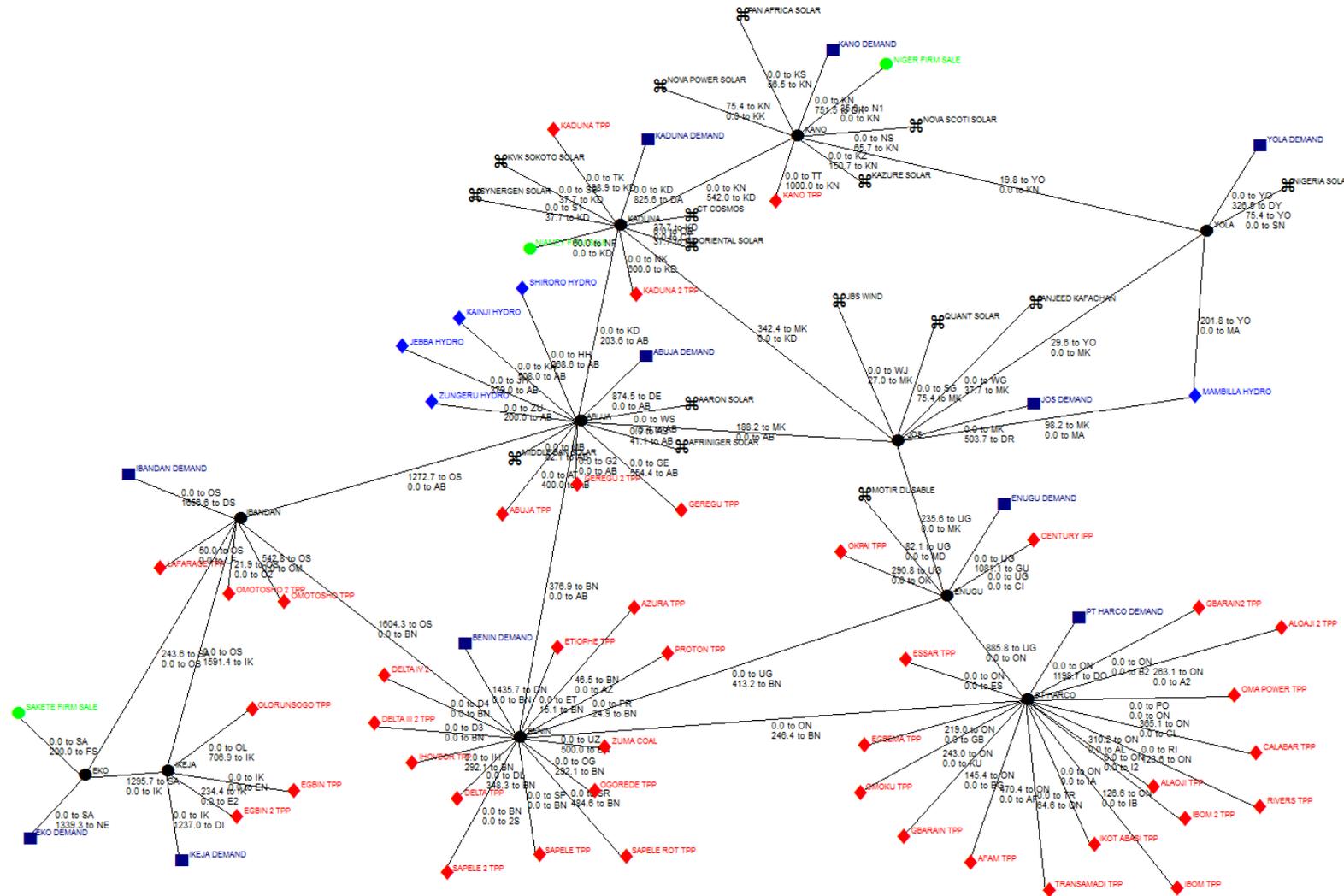


**Annex 8.5.3  
Winter 2025  
Option 2**

**Power flow during peak hours:** The power flows between the DISCOs in Nigeria for the peaking hours in winter in 2025 for the Option 2 are different than the ones for Option 1. The power flows are still from the south to the north, but also from Abuja to Benin, and unchangeably from the east to the west. Main power exporters are remaining Benin, Pt Harco, Abuja and Ikeja, but also Kano. Due to new generation installed in Ibandan DISCO, also Ibandan can export to Eko. Due to new generation installed in Kano DISCO, also Kano can export to Kaduna and further from Abuja to Benin. During peaking hours the solar power is not available, so the peaking is further on done by thermal power from the south and mid of the country.

# Annex 8.5.3 - Winter 2025 - Option 2

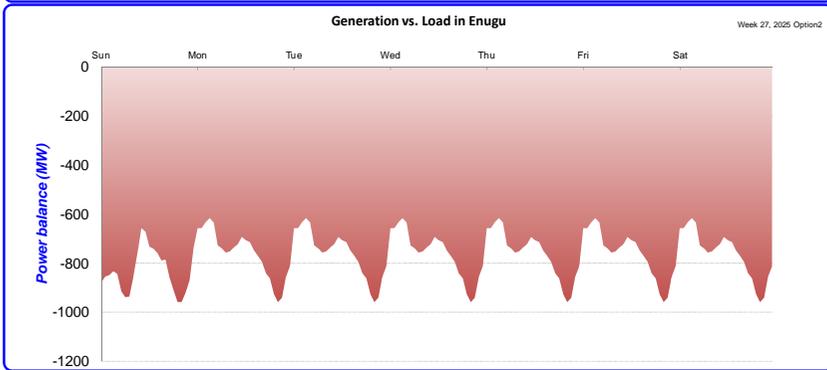
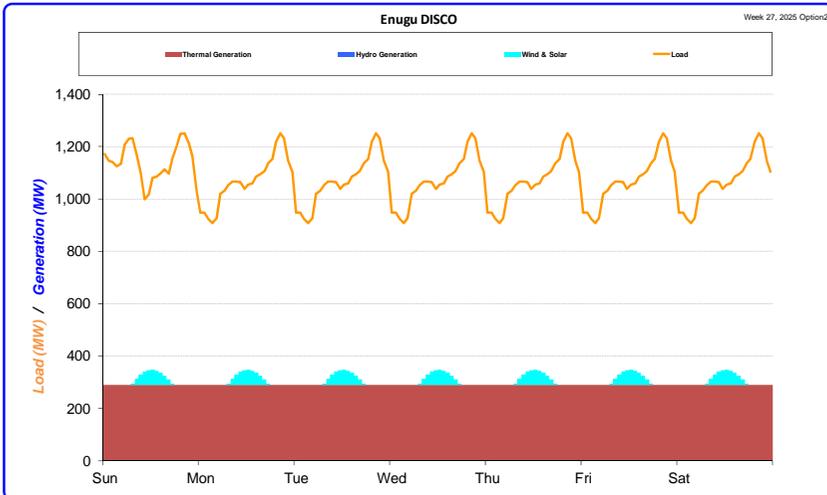
| Node | Water Links | Transmission Link | Heat Pipeline | Fuel Transport | Year | Week        | Day  | Hour |
|------|-------------|-------------------|---------------|----------------|------|-------------|------|------|
| ame  | None        | Energy Flow       | None          | None           | 2000 | 1: 1 Jan W1 | Sun. | 13   |



**Annex 8.5.3  
Winter 2025  
Option 2**

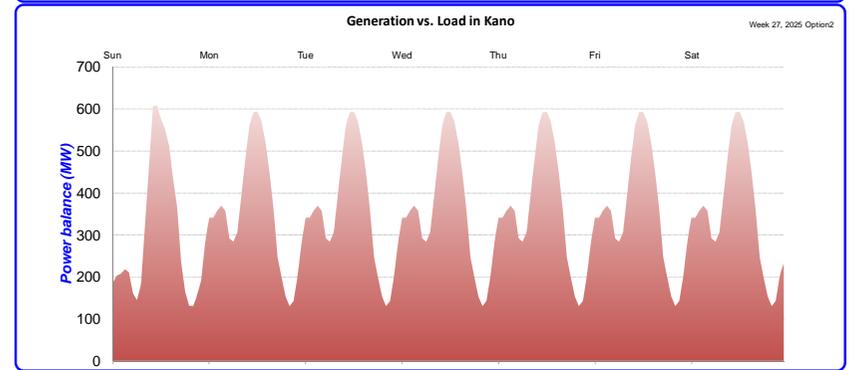
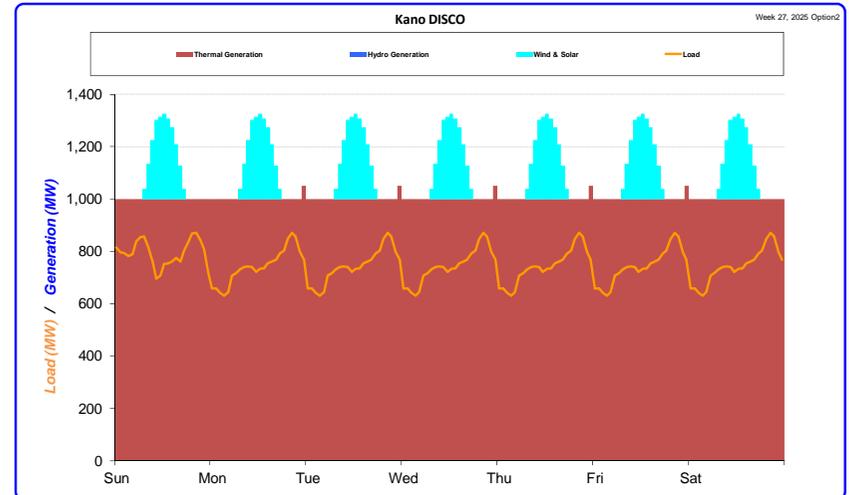
**Power flow during Off-peak hours:** During off - peaking hours the solar power is available, so the power flows from the north/mid of the country to the south west are increased, e.g. from Abuja to Benin 376 MW in off peak and 128 MW in peak hours.

Annex 8.5.4 - Summer 2025 - Option 2



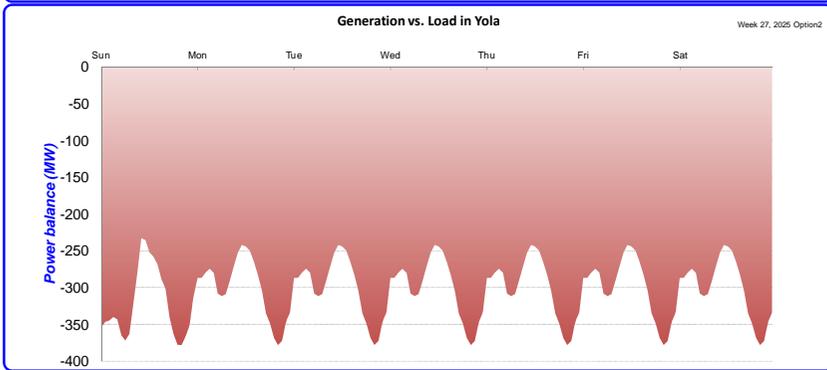
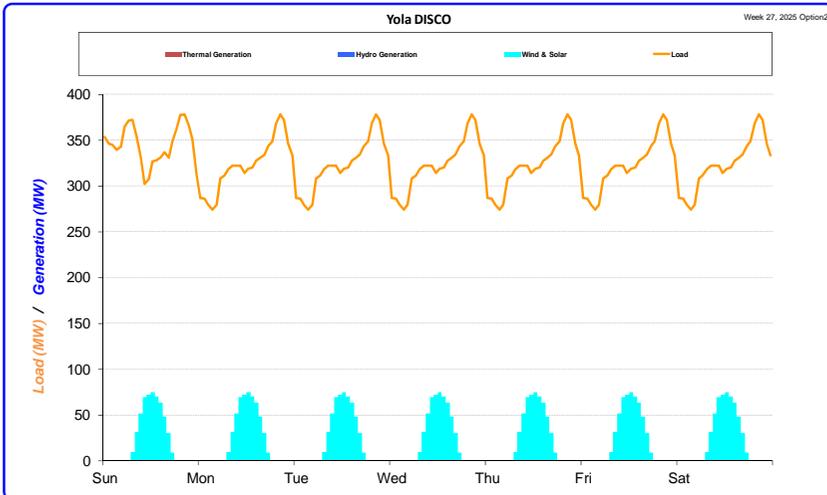
The generation profile of Enugu DISCO is based on thermal power. Small portion of solar power projects will be installed until 2025. The demand of the DISCO is higher than the available generation in 2020. The generation vs. Load Balance shows that the DISCO is a net importer of power. The imported power is from the Pt Harco and Benin DISCO. The peak of imported power reaches 900 MW which can be transferred via the available transmission infrastructure between the three DISCOs.

Annex 8.5.4 - Summer 2025 - Option 2



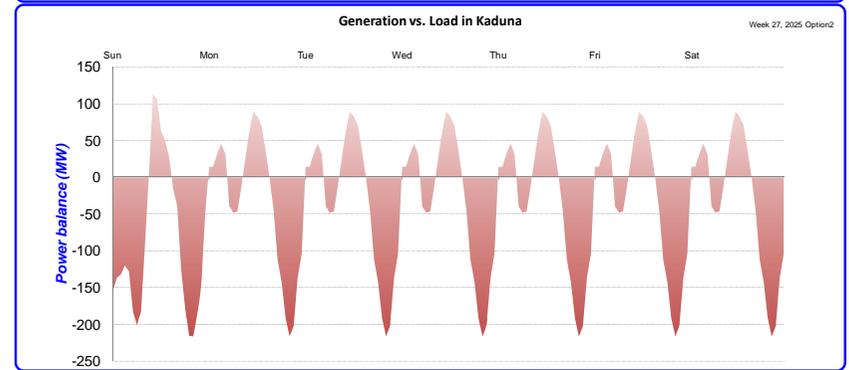
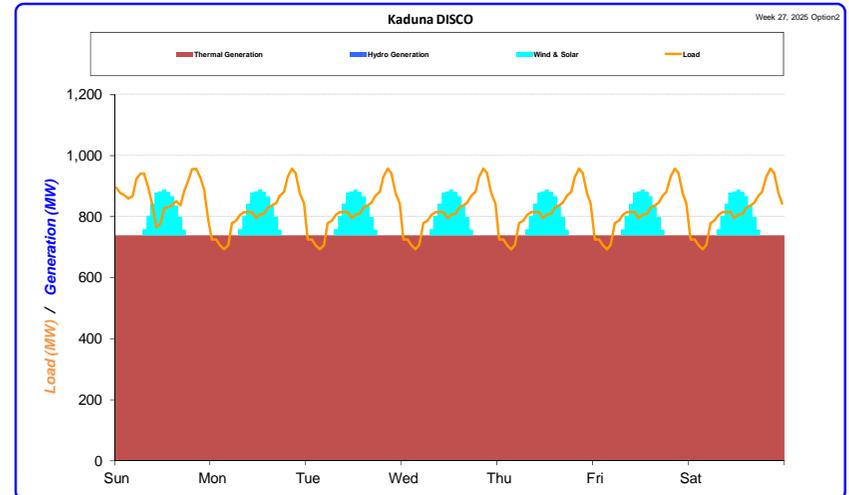
In 2025 Kano DISCO in Option 2 becomes a net exporter of power, due to installed thermal power plants. The installed solar power supplements to the power export which reaches about 600 MW in the peaking hours. The exported power goes to Kaduna and Abuja DISCOs and even further. The available transmission infrastructure is sufficient to enable these power exports.

Annex 8.5.4 - Summer 2025 - Option 2



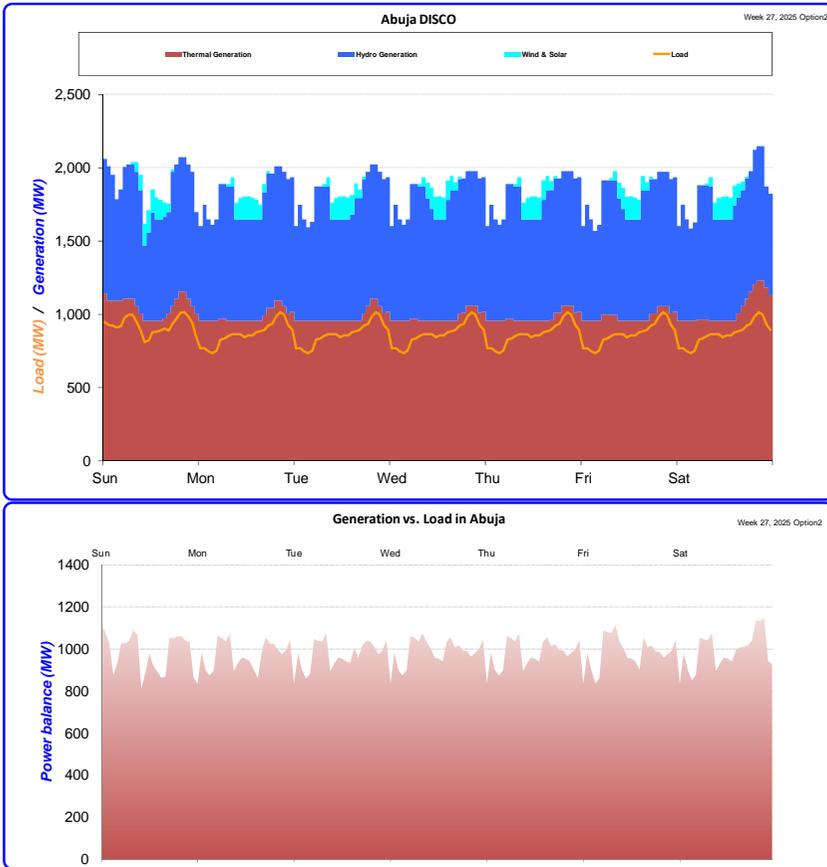
In 2025 Yola DISCO remains a net importer of power. There is no generation installed. The imported power peaks to 350 MW and is obtained mainly via transfer from Pt Harco DISCO.

Annex 8.5.4 - Summer 2025 - Option 2



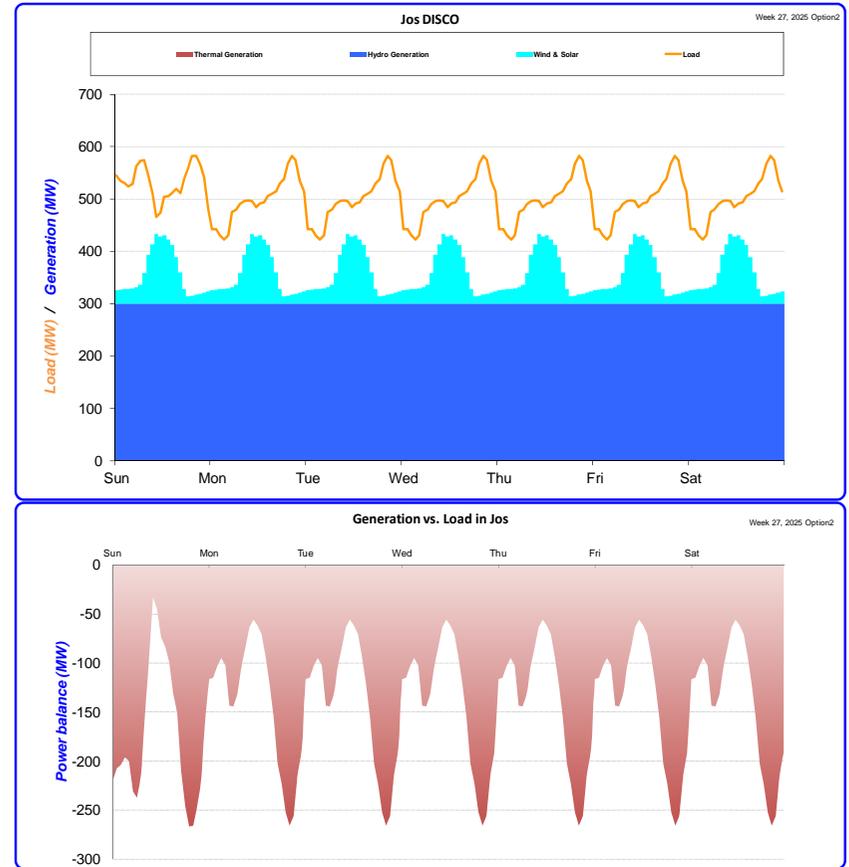
In 2025 Kaduna DISCO remains partly a net importer of power. The installed additional thermal and solar power can supply only the base load and the solar power has no contribution on the lowering the peak demand. The imported power peaks to 200 MW and is obtained mainly via transfer from Abuja/Benin DISCO. The exported power peaks up to 100 MW goes to Abuja and Jos DISCO. The available transmission infrastructure is sufficient to enable these power exports.

Annex 8.5.4 - Summer 2025 - Option 2



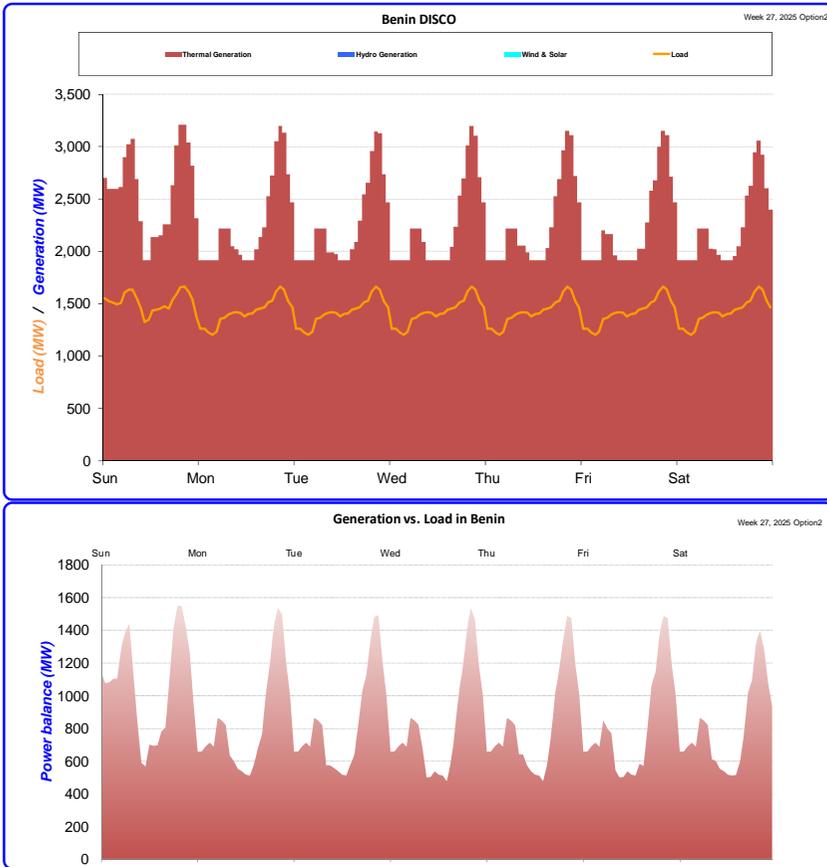
The Abuja DISCO in 2025 is a net exporter of power. The exported power reaches 1100 MW in the peak load hours. The base load supply is from thermal and hydro power in the DISCO and the peaking is done by the available hydro generation. The solar power is also present in the generation/load balance with marginal significance. The exported power goes to the neighboring DISCOs: Benin, Ibandan and Jos. The available transmission infrastructure is sufficient to enable these power exports. The power export is lower than in the winter season due to less hydro power availability.

Annex 8.5.4 - Summer 2025 - Option 2



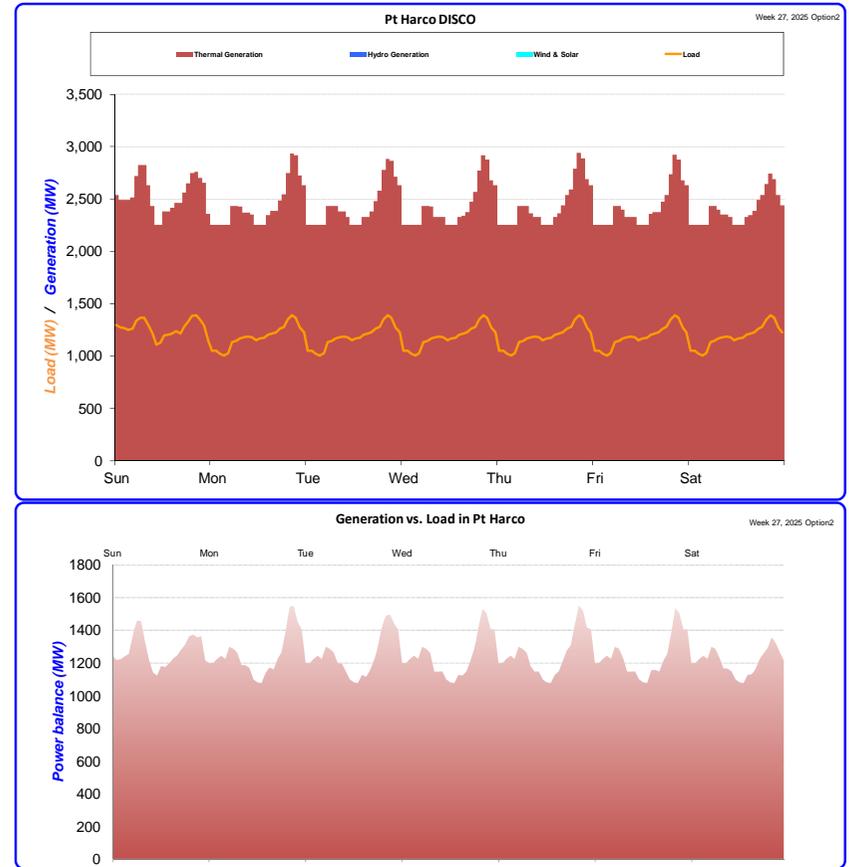
In 2025 Jos DISCO remains a net importer of power. The installed hydro power for the Mambila HPP is considered to be run with one unit of 300 MW, as base load. The installed wind solar power can supply only a local part of the load and has no contribution on the lowering the peak demand. The imported power peaks are reduced compared to 2020 and reach 250 MW and is obtained mainly via transfer from Pt Harco /Abuja DISCO.

Annex 8.5.4 - Summer 2025 - Option 2



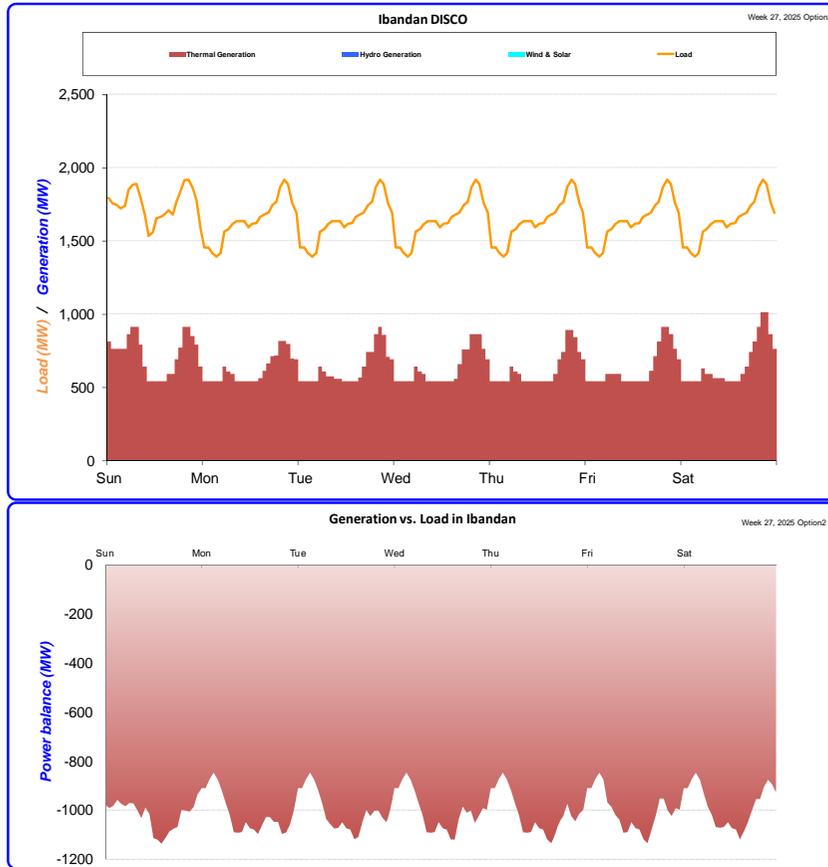
The Benin DISCO in 2025 is a net exporter of power. The exported power reaches 1500 MW in the peak load hours. The base and peak load supply is from thermal generation. The exported power goes to the neighboring DISCO Ibandan. Benin DISCO also transfers power from Pt Harco DISCO to the west of Nigeria. The existing transmission infrastructure is sufficient for obtaining the power export to the neighboring DISCOs. Most of the new generation facilities will be installed in Benin DISCO due to the availability of fuel and local infrastructure, as well as good transmission capacity connectivity. In option 2, due to the thermal generation options in the North: Kano, Kaduna and Abuja, the power export is reduced compared to Option 1 (where was 2000 MW).

Annex 8.5.4 - Summer 2025 - Option 2



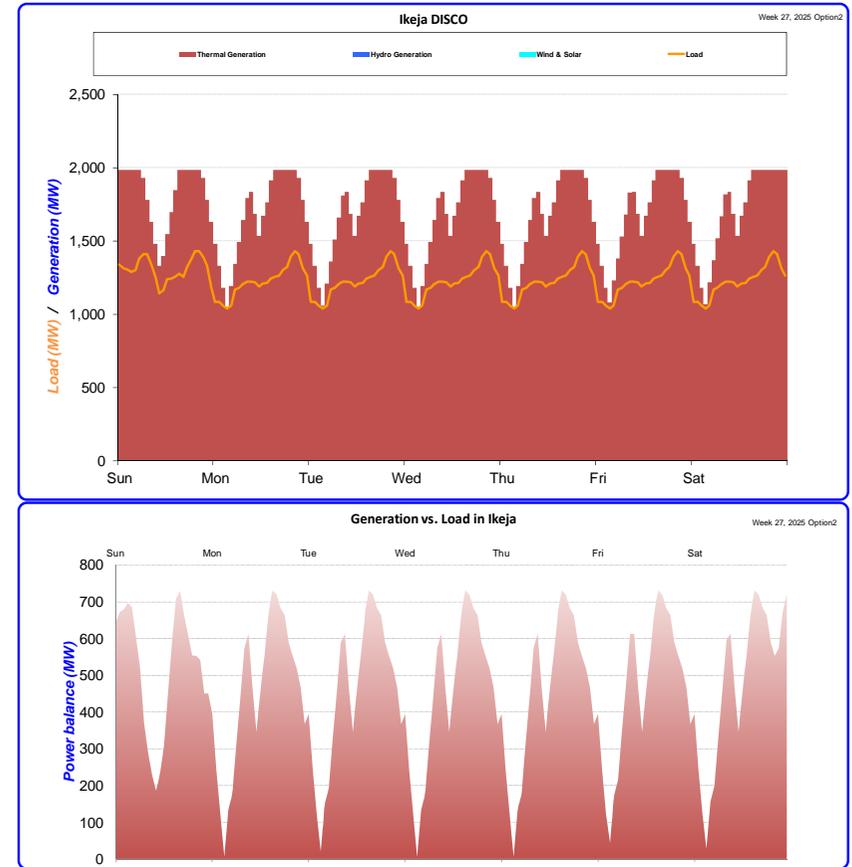
The Pt Harco DISCO in 2025 is a net exporter of power. The exported power reaches 1400MW in the peak load hours. The base and peak load supply is from thermal generation. The exported power goes to the neighboring DISCOs: Benin and Enugu (Jos, Yola). The existing transmission infrastructure is sufficient for obtaining the power export to the neighboring DISCOs. In option 2, due to the thermal generation options in the North: Kano, Kaduna and Abuja, the power export is reduced compared to Option 1 (where was 1800MW).

### Annex 8.5.4 - Summer 2025 - Option 2



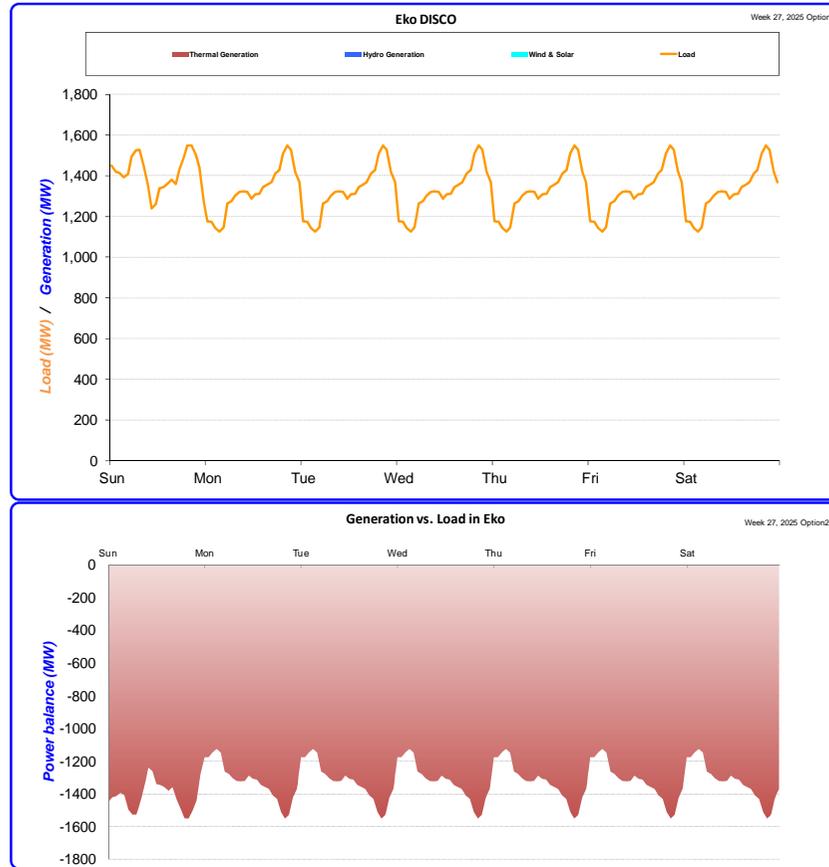
In 2025 Ibandan DISCO remains a net importer of power. The installed thermal power can supply a half of the load. The imported power peaks to 1100 MW and is obtained mainly via transfer from Abuja/Benin DISCO.

### Annex 8.5.4 - Summer 2025 - Option 2



The Ikeja DISCO in 2025 is a net exporter of power. The exported power reaches 700 MW in the peak load hours. The base and peak load supply is from thermal generation. The exported power goes to the neighboring Eko DISCO. The existing transmission infrastructure is sufficient for obtaining the power export to Eko DISCO.

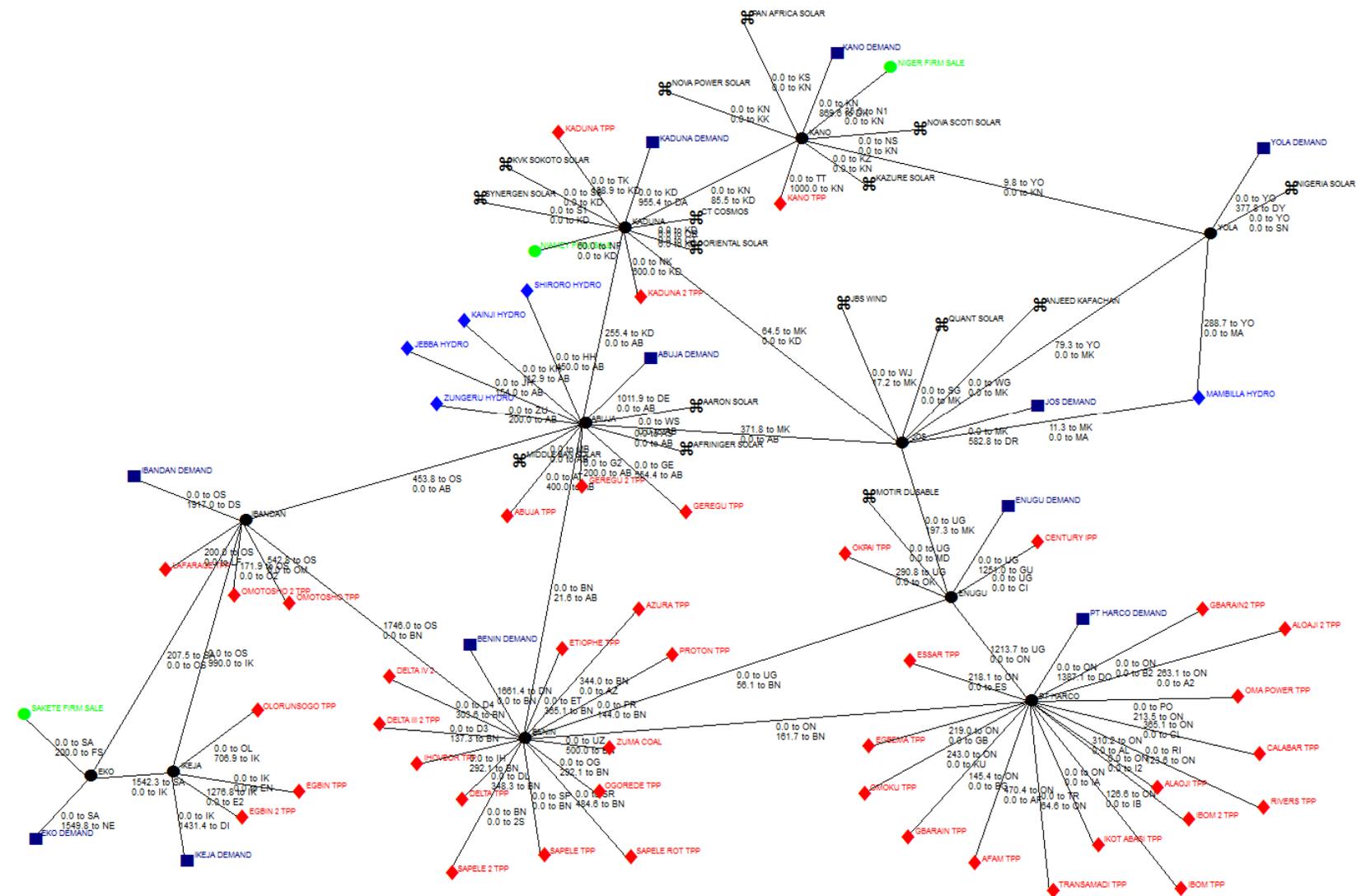
## Annex 8.5.4 - Summer 2025 - Option 2



In 2025 Eko DISCO remains a net importer of power. There is no generation installed. The imported power peaks to 1500 MW and is obtained mainly via transfer from Ikeja/Benin and Ibandan DISCO. The existing transmission infrastructure is sufficient for obtaining the power import from Ikeja and Ibandan DISCO.

# Annex 8.5.4 - Summer 2025 - Option 2

| Node | Water Links | Transmission Link | Heat Pipeline | Fuel Transport | Year | Week          | Day  | Hour |
|------|-------------|-------------------|---------------|----------------|------|---------------|------|------|
| ame  | None        | Energy Flow       | None          | None           | 2000 | 27: 27 Jul W1 | Sun. | 21   |

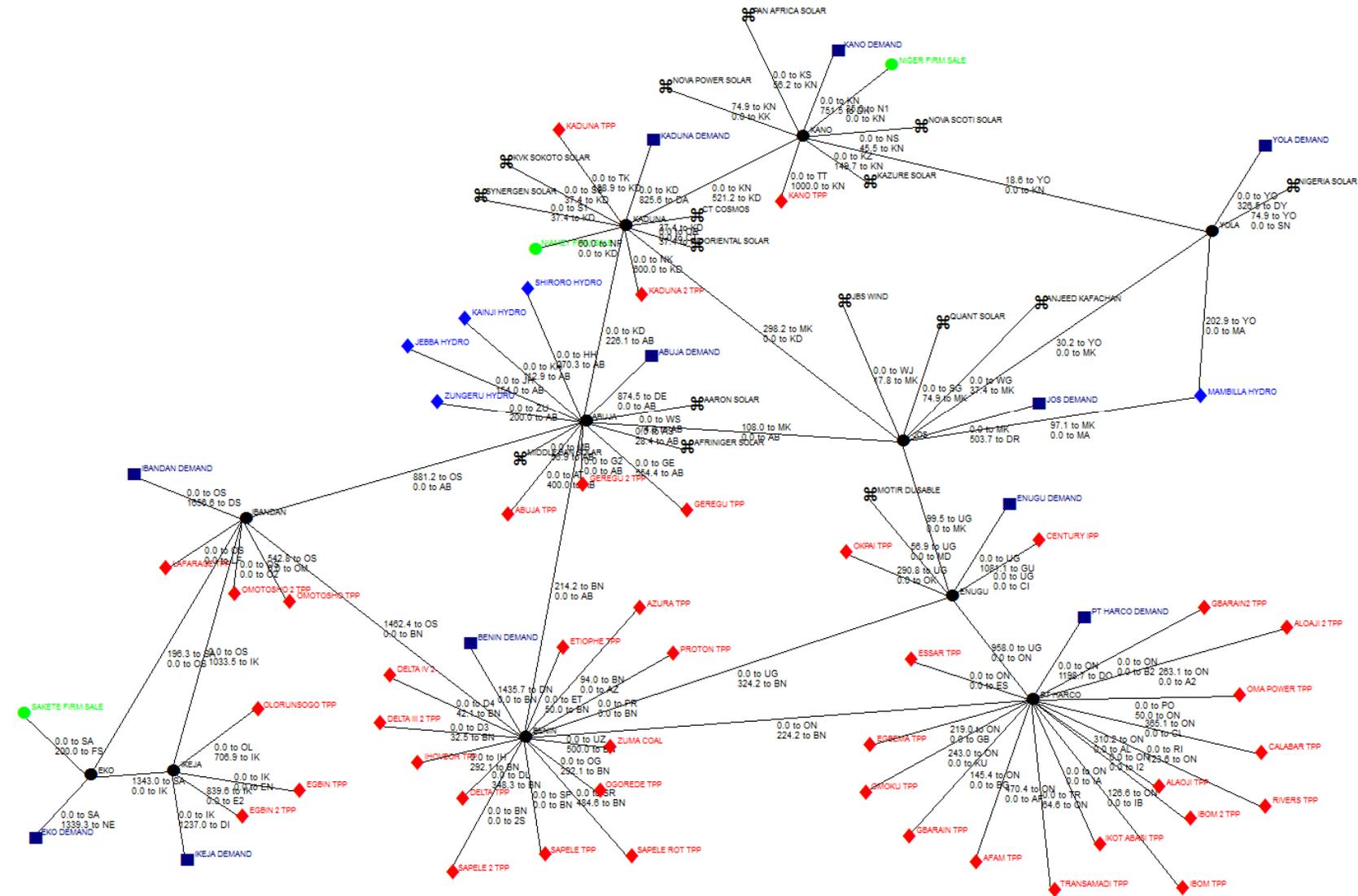


**Annex 8.5.4  
Summer 2025  
Option 2**

**Power flow during peak hours:** The power flows between the DISCOs in Nigeria for the peaking hours in summer in 2025 for the Option 2 are different than the ones for Option 1. The power flows are still from the south to the north, but also from Abuja to Benin, and unchangeably from the east to the west. Main power exporters are remaining Benin, Pt Harco, Abuja and Ikeja, but also Kano. Due to new generation installed in Ibandan DISCO, also Ibandan can export to Eko. Due to new generation installed in Kano DISCO, also Kano can export to Kaduna and further from Abuja to Benin. During peaking hours the solar power is not available, so the peaking is further on done by thermal power from the south and mid of the country.

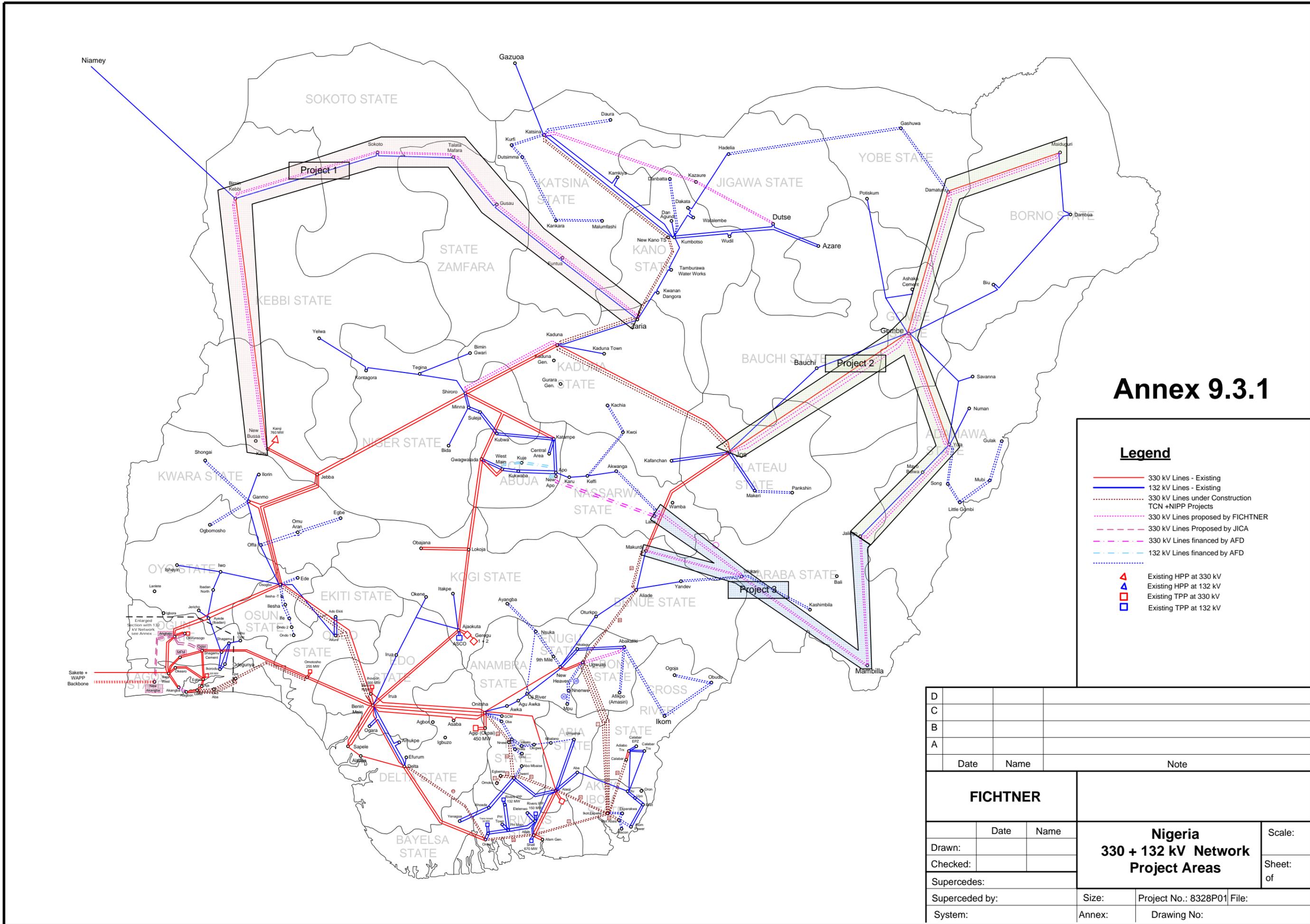
# Annex 8.5.4 - Summer 2025 - Option 2

| Node | Water Links | Transmission Link | Heat Pipeline | Fuel Transport | Year | Week          | Day  | Hour |
|------|-------------|-------------------|---------------|----------------|------|---------------|------|------|
| ame  | None        | Energy Flow       | None          | None           | 2000 | 27: 27 Jul W1 | Sun. | 13   |



**Annex 8.5.4  
Summer 2025  
Option 2**

**Power flow during Off-peak hours:** During off - peaking hours the solar power is available, so the power flows from the north/mid of the country to the south west are increased, e.g. from Abuja to Benin 214 MW in off peak and 22 MW in peak hours.



# Annex 9.3.1

## Legend

- 330 kV Lines - Existing
- 132 kV Lines - Existing
- - - 330 kV Lines under Construction TCN +NIPP Projects
- - - 330 kV Lines Proposed by FICHTNER
- - - 330 kV Lines Proposed by JICA
- - - 330 kV Lines financed by AFD
- - - 132 kV Lines financed by AFD
- ▲ Existing HPP at 330 kV
- ▲ Existing HPP at 132 kV
- Existing TPP at 330 kV
- Existing TPP at 132 kV

|                 |        |                      |   |
|-----------------|--------|----------------------|---|
| D               |        |                      |   |
| C               |        |                      |   |
| B               |        |                      |   |
| A               |        |                      |   |
|                 | Date   | Name                 | Note  |
| <b>FICHTNER</b> |        |                      |   |
| Drawn:          | Date   | Name                 | <b>Nigeria<br/>330 + 132 kV Network<br/>Project Areas</b> |
| Checked:        |        |                      |   |
| Supercedes:     |        |                      | Scale:  |
| Superceded by:  |        |                      | Sheet:<br>of  |
| System:         | Annex: | Project No.: 8328P01 | File:   |
|                 |        | Drawing No:          |   |

**Nigeria Electricity and Gas Improvement Project  
Transmission Expansion Plan**

**FICHTNER**

**Financial Assessment  
Project 1: 330 kV North West Ring**

**Annex 10.1**

| Year      | Cal. Year    | Investm.<br>cost<br>US\$m | O&M<br>cost<br>US\$m | Total<br>cost<br>US\$m | Energy<br>transmitted<br>GWh | Revenue<br>US\$m | Net Cash<br>Flow<br>US\$m |
|-----------|--------------|---------------------------|----------------------|------------------------|------------------------------|------------------|---------------------------|
| -7        | 2018         | 110.8                     |                      | 110.8                  |                              |                  | -110.8                    |
| -6        | 2019         | 110.8                     |                      | 110.8                  |                              |                  | -110.8                    |
| -5        | 2020         |                           | 2.2                  | 2.2                    | 455                          | 3.9              | 1.7                       |
| -4        | 2021         | 96.5                      | 2.2                  | 98.7                   | 523                          | 4.5              | -94.3                     |
| -3        | 2022         | 96.5                      | 3.2                  | 99.7                   | 600                          | 5.1              | -94.6                     |
| -2        | 2023         | 96.5                      | 4.1                  | 100.7                  | 690                          | 5.9              | -94.8                     |
| -1        | 2024         | 96.5                      | 5.1                  | 101.6                  | 792                          | 6.7              | -94.9                     |
| 1         | 2025         |                           | 6.1                  | 6.1                    | 2,510                        | 21.4             | 15.3                      |
| 2         | 2026         |                           | 6.1                  | 6.1                    | 2,885                        | 24.6             | 18.5                      |
| 3         | 2027         |                           | 6.1                  | 6.1                    | 3,316                        | 28.2             | 22.2                      |
| 4         | 2028         |                           | 6.1                  | 6.1                    | 3,811                        | 32.5             | 26.4                      |
| 5         | 2029         |                           | 6.1                  | 6.1                    | 4,381                        | 37.3             | 31.2                      |
| 6         | 2030         |                           | 6.1                  | 6.1                    | 5,036                        | 42.9             | 36.8                      |
| 7         | 2031         |                           | 6.1                  | 6.1                    | 5,789                        | 49.3             | 43.2                      |
| 8         | 2032         |                           | 6.1                  | 6.1                    | 6,655                        | 56.7             | 50.6                      |
| 9         | 2033         |                           | 6.1                  | 6.1                    | 7,650                        | 65.2             | 59.1                      |
| 10        | 2034         |                           | 6.1                  | 6.1                    | 8,795                        | 74.9             | 68.8                      |
| 11        | 2035         |                           | 6.1                  | 6.1                    | 10,110                       | 86.1             | 80.1                      |
| 12        | 2036         |                           | 6.1                  | 6.1                    | 10,115                       | 86.2             | 80.1                      |
| 13        | 2037         |                           | 6.1                  | 6.1                    | 10,120                       | 86.2             | 80.1                      |
| 14        | 2038         |                           | 6.1                  | 6.1                    | 10,120                       | 86.2             | 80.1                      |
| 15        | 2039         |                           | 6.1                  | 6.1                    | 10,120                       | 86.2             | 80.1                      |
| 16        | 2040         |                           | 6.1                  | 6.1                    | 10,120                       | 86.2             | 80.1                      |
| 17        | 2041         |                           | 6.1                  | 6.1                    | 10,120                       | 86.2             | 80.1                      |
| 18        | 2042         |                           | 6.1                  | 6.1                    | 10,120                       | 86.2             | 80.1                      |
| 19        | 2043         |                           | 6.1                  | 6.1                    | 10,120                       | 86.2             | 80.1                      |
| 20        | 2044         |                           | 6.1                  | 6.1                    | 10,120                       | 86.2             | 80.1                      |
| 21        | 2045         |                           | 6.1                  | 6.1                    | 10,120                       | 86.2             | 80.1                      |
| 22        | 2046         |                           | 6.1                  | 6.1                    | 10,120                       | 86.2             | 80.1                      |
| 23        | 2047         |                           | 6.1                  | 6.1                    | 10,120                       | 86.2             | 80.1                      |
| 24        | 2048         |                           | 6.1                  | 6.1                    | 10,120                       | 86.2             | 80.1                      |
| 25        | 2049         |                           | 6.1                  | 6.1                    | 10,120                       | 86.2             | 80.1                      |
| 26        | 2050         |                           | 6.1                  | 6.1                    | 10,120                       | 86.2             | 80.1                      |
| 27        | 2051         |                           | 6.1                  | 6.1                    | 10,120                       | 86.2             | 80.1                      |
| 28        | 2052         |                           | 6.1                  | 6.1                    | 10,120                       | 86.2             | 80.1                      |
| 29        | 2053         |                           | 6.1                  | 6.1                    | 10,120                       | 86.2             | 80.1                      |
| 30        | 2054         |                           | 6.1                  | 6.1                    | 10,120                       | 86.2             | 80.1                      |
| 31        | 2055         |                           | 6.1                  | 6.1                    | 10,120                       | 86.2             | 80.1                      |
| 32        | 2056         |                           | 6.1                  | 6.1                    | 10,120                       | 86.2             | 80.1                      |
| 33        | 2057         |                           | 6.1                  | 6.1                    | 10,120                       | 86.2             | 80.1                      |
| 34        | 2058         |                           | 6.1                  | 6.1                    | 10,120                       | 86.2             | 80.1                      |
| 35        | 2059         |                           | 6.1                  | 6.1                    | 10,120                       | 86.2             | 80.1                      |
| NPV       | <b>1.15%</b> | 584.7                     | 176.9                | 757.4                  | 226,724.5                    | 1,931.5          | 1174.1                    |
|           | <b>2%</b>    | 568.4                     | 147.4                | 708.9                  | 182,724                      | 1556.6           | 847.8                     |
|           | <b>4%</b>    | 532.9                     | 99.8                 | 620.3                  | 113,621.1                    | 968.0            | 347.7                     |
| FIRR      | 6.79%        |                           |                      |                        |                              |                  |                           |
| B/C ratio | 2.55         |                           |                      |                        |                              |                  |                           |
| Payback   | 19.8         | years                     |                      |                        |                              |                  |                           |

**Nigeria Electricity and Gas Improvement Project  
Transmission Expansion Plan**

**FICHTNER**

**Financial Assessment  
Project 2: 330 kV North East Ring**

**Annex 10.2**

| Year      | Cal. Year    | Investm.<br>cost<br>US\$m | O&M<br>cost<br>US\$m | Total<br>cost<br>US\$m | Energy<br>transmitted<br>GWh | Revenue<br>US\$m | Net Cash<br>Flow<br>US\$m |
|-----------|--------------|---------------------------|----------------------|------------------------|------------------------------|------------------|---------------------------|
| -7        | 2018         | 165.6                     |                      | 165.6                  |                              |                  | -165.6                    |
| -6        | 2019         | 165.6                     |                      | 165.6                  |                              |                  | -165.6                    |
| -5        | 2020         |                           | 3.3                  | 3.3                    | 45                           | 0.4              | -2.9                      |
| -4        | 2021         | 107.0                     | 3.3                  | 110.3                  | 49                           | 0.4              | -109.9                    |
| -3        | 2022         | 107.0                     | 4.4                  | 111.4                  | 53                           | 0.5              | -111.0                    |
| -2        | 2023         | 107.0                     | 5.5                  | 112.5                  | 57                           | 0.5              | -112.0                    |
| -1        | 2024         | 107.0                     | 6.5                  | 113.5                  | 62                           | 0.5              | -113.0                    |
| 1         | 2025         |                           | 7.6                  | 7.6                    | 67                           | 0.6              | -7.0                      |
| 2         | 2026         |                           | 7.6                  | 7.6                    | 75                           | 0.6              | -7.0                      |
| 3         | 2027         |                           | 7.6                  | 7.6                    | 97                           | 0.8              | -6.8                      |
| 4         | 2028         |                           | 7.6                  | 7.6                    | 499                          | 4.3              | -3.3                      |
| 5         | 2029         |                           | 7.6                  | 7.6                    | 937                          | 8.0              | 0.4                       |
| 6         | 2030         |                           | 7.6                  | 7.6                    | 1,415                        | 12.1             | 4.5                       |
| 7         | 2031         |                           | 7.6                  | 7.6                    | 1,930                        | 16.4             | 8.8                       |
| 8         | 2032         |                           | 7.6                  | 7.6                    | 2,544                        | 21.7             | 14.1                      |
| 9         | 2033         |                           | 7.6                  | 7.6                    | 3,221                        | 27.4             | 19.8                      |
| 10        | 2034         |                           | 7.6                  | 7.6                    | 3,958                        | 33.7             | 26.1                      |
| 11        | 2035         |                           | 7.6                  | 7.6                    | 4,760                        | 40.5             | 33.0                      |
| 12        | 2036         |                           | 7.6                  | 7.6                    | 4,861                        | 41.4             | 33.8                      |
| 13        | 2037         |                           | 7.6                  | 7.6                    | 4,963                        | 42.3             | 34.7                      |
| 14        | 2038         |                           | 7.6                  | 7.6                    | 4,963                        | 42.3             | 34.7                      |
| 15        | 2039         |                           | 7.6                  | 7.6                    | 4,963                        | 42.3             | 34.7                      |
| 16        | 2040         |                           | 7.6                  | 7.6                    | 4,963                        | 42.3             | 34.7                      |
| 17        | 2041         |                           | 7.6                  | 7.6                    | 4,963                        | 42.3             | 34.7                      |
| 18        | 2042         |                           | 7.6                  | 7.6                    | 4,963                        | 42.3             | 34.7                      |
| 19        | 2043         |                           | 7.6                  | 7.6                    | 4,963                        | 42.3             | 34.7                      |
| 20        | 2044         |                           | 7.6                  | 7.6                    | 4,963                        | 42.3             | 34.7                      |
| 21        | 2045         |                           | 7.6                  | 7.6                    | 4,963                        | 42.3             | 34.7                      |
| 22        | 2046         |                           | 7.6                  | 7.6                    | 4,963                        | 42.3             | 34.7                      |
| 23        | 2047         |                           | 7.6                  | 7.6                    | 4,963                        | 42.3             | 34.7                      |
| 24        | 2048         |                           | 7.6                  | 7.6                    | 4,963                        | 42.3             | 34.7                      |
| 25        | 2049         |                           | 7.6                  | 7.6                    | 4,963                        | 42.3             | 34.7                      |
| 26        | 2050         |                           | 7.6                  | 7.6                    | 4,963                        | 42.3             | 34.7                      |
| 27        | 2051         |                           | 7.6                  | 7.6                    | 4,963                        | 42.3             | 34.7                      |
| 28        | 2052         |                           | 7.6                  | 7.6                    | 4,963                        | 42.3             | 34.7                      |
| 29        | 2053         |                           | 7.6                  | 7.6                    | 4,963                        | 42.3             | 34.7                      |
| 30        | 2054         |                           | 7.6                  | 7.6                    | 4,963                        | 42.3             | 34.7                      |
| 31        | 2055         |                           | 7.6                  | 7.6                    | 4,963                        | 42.3             | 34.7                      |
| 32        | 2056         |                           | 7.6                  | 7.6                    | 4,963                        | 42.3             | 34.7                      |
| 33        | 2057         |                           | 7.6                  | 7.6                    | 4,963                        | 42.3             | 34.7                      |
| 34        | 2058         |                           | 7.6                  | 7.6                    | 4,963                        | 42.3             | 34.7                      |
| 35        | 2059         |                           | 7.6                  | 7.6                    | 4,963                        | 42.3             | 34.7                      |
| NPV       | <b>1.15%</b> | 732.3                     | 222.8                | 950.5                  | 100,865.3                    | 859.3            | -91.2                     |
|           | <b>2%</b>    | 713.2                     | 185.9                | 891.5                  | 80,191                       | 683.2            | -208.3                    |
|           | <b>4%</b>    | 671.5                     | 126.3                | 784.1                  | 48,080.2                     | 409.6            | -374.5                    |
| FIRR      | 0.63%        |                           |                      |                        |                              |                  |                           |
| B/C ratio | 0.90         |                           |                      |                        |                              |                  |                           |
| Payback   | 38.1         | years                     |                      |                        |                              |                  |                           |

**Nigeria Electricity and Gas Improvement Project  
Transmission Expansion Plan**

**FICHTNER**

**Financial Assessment  
Project 3: 330 kV Lines for Mambilla HPP**

**Annex 10.3**

| Year      | Cal. Year | Investm.<br>cost<br>US\$m | O&M<br>cost<br>US\$m | Total<br>cost<br>US\$m | Energy<br>transmitted<br>GWh | Revenue<br>US\$m | Net Cash<br>Flow<br>US\$m |
|-----------|-----------|---------------------------|----------------------|------------------------|------------------------------|------------------|---------------------------|
| -7        |           |                           |                      |                        |                              |                  |                           |
| -6        |           |                           |                      |                        |                              |                  |                           |
| -5        |           |                           |                      |                        |                              |                  |                           |
| -4        |           |                           |                      |                        |                              |                  |                           |
| -3        | 2022      | 113.3                     |                      | 113.3                  |                              |                  | -113.3                    |
| -2        | 2023      | 113.3                     |                      | 113.3                  |                              |                  | -113.3                    |
| -1        | 2024      | 113.3                     |                      | 113.3                  |                              |                  | -113.3                    |
| 1         | 2025      |                           | 3.4                  | 3.4                    | 501                          | 4.3              | 0.9                       |
| 2         | 2026      |                           | 3.4                  | 3.4                    | 1,503                        | 12.8             | 9.4                       |
| 3         | 2027      |                           | 3.4                  | 3.4                    | 2,004                        | 17.1             | 13.7                      |
| 4         | 2028      |                           | 3.4                  | 3.4                    | 2,505                        | 21.3             | 17.9                      |
| 5         | 2029      |                           | 3.4                  | 3.4                    | 3,006                        | 25.6             | 22.2                      |
| 6         | 2030      |                           | 3.4                  | 3.4                    | 3,507                        | 29.9             | 26.5                      |
| 7         | 2031      |                           | 3.4                  | 3.4                    | 4,008                        | 34.1             | 30.7                      |
| 8         | 2032      |                           | 3.4                  | 3.4                    | 4,509                        | 38.4             | 35.0                      |
| 9         | 2033      |                           | 3.4                  | 3.4                    | 5,010                        | 42.7             | 39.3                      |
| 10        | 2034      |                           | 3.4                  | 3.4                    | 5,010                        | 42.7             | 39.3                      |
| 11        | 2035      |                           | 3.4                  | 3.4                    | 5,010                        | 42.7             | 39.3                      |
| 12        | 2036      |                           | 3.4                  | 3.4                    | 5,010                        | 42.7             | 39.3                      |
| 13        | 2037      |                           | 3.4                  | 3.4                    | 5,010                        | 42.7             | 39.3                      |
| 14        | 2038      |                           | 3.4                  | 3.4                    | 5,010                        | 42.7             | 39.3                      |
| 15        | 2039      |                           | 3.4                  | 3.4                    | 5,010                        | 42.7             | 39.3                      |
| 16        | 2040      |                           | 3.4                  | 3.4                    | 5,010                        | 42.7             | 39.3                      |
| 17        | 2041      |                           | 3.4                  | 3.4                    | 5,010                        | 42.7             | 39.3                      |
| 18        | 2042      |                           | 3.4                  | 3.4                    | 5,010                        | 42.7             | 39.3                      |
| 19        | 2043      |                           | 3.4                  | 3.4                    | 5,010                        | 42.7             | 39.3                      |
| 20        | 2044      |                           | 3.4                  | 3.4                    | 5,010                        | 42.7             | 39.3                      |
| 21        | 2045      |                           | 3.4                  | 3.4                    | 5,010                        | 42.7             | 39.3                      |
| 22        | 2046      |                           | 3.4                  | 3.4                    | 5,010                        | 42.7             | 39.3                      |
| 23        | 2047      |                           | 3.4                  | 3.4                    | 5,010                        | 42.7             | 39.3                      |
| 24        | 2048      |                           | 3.4                  | 3.4                    | 5,010                        | 42.7             | 39.3                      |
| 25        | 2049      |                           | 3.4                  | 3.4                    | 5,010                        | 42.7             | 39.3                      |
| 26        | 2050      |                           | 3.4                  | 3.4                    | 5,010                        | 42.7             | 39.3                      |
| 27        | 2051      |                           | 3.4                  | 3.4                    | 5,010                        | 42.7             | 39.3                      |
| 28        | 2052      |                           | 3.4                  | 3.4                    | 5,010                        | 42.7             | 39.3                      |
| 29        | 2053      |                           | 3.4                  | 3.4                    | 5,010                        | 42.7             | 39.3                      |
| 30        | 2054      |                           | 3.4                  | 3.4                    | 5,010                        | 42.7             | 39.3                      |
| 31        | 2055      |                           | 3.4                  | 3.4                    | 5,010                        | 42.7             | 39.3                      |
| 32        | 2056      |                           | 3.4                  | 3.4                    | 5,010                        | 42.7             | 39.3                      |
| 33        | 2057      |                           | 3.4                  | 3.4                    | 5,010                        | 42.7             | 39.3                      |
| 34        | 2058      |                           | 3.4                  | 3.4                    | 5,010                        | 42.7             | 39.3                      |
| 35        | 2059      |                           | 3.4                  | 3.4                    | 5,010                        | 42.7             | 39.3                      |
| NPV       | 1.15%     | 332.2                     | 97.5                 | 426.5                  | 121,666.1                    | 1,036.5          | 610.0                     |
|           | 2%        | 326.7                     | 85.0                 | 406.8                  | 101,634                      | 865.8            | 459.1                     |
|           | 4%        | 314.4                     | 63.4                 | 370.8                  | 68,591.1                     | 584.3            | 213.6                     |
| FIRR      | 7.31%     |                           |                      |                        |                              |                  |                           |
| B/C ratio | 2.43      |                           |                      |                        |                              |                  |                           |
| Payback   | 15.7      |                           | years                |                        |                              |                  |                           |