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NEWSLETTER

TRANSMISSION COMPANY OF NIGERIA (TCN)

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AfDB MEET WITH TCN ON FINAL APPRAISAL OF NTEP1 TO IMPROVE BULK ELECTRICITY SUPPLY TO THE NORTHEAST

By Grace Sambe-Jauro

Cross section of participants at the meeting

As part of its high-power sector mission in Nigeria, the African Development Bank (AfDB) has met with the Transmission Company of Nigeria (TCN), for its final appraisal on the Nigerian Transmission Expansion Program (NTEP1), under the Transmission Rehabilitation and Expansion Program (TREP) to improve the quality and reliability of bulk electricity supply to the northeast region.

A team led by Mr. Phillipe Ossouca Jnr, met with the management of TCN on Monday 1st July 2019 at the TCN Corporate Head Quarters, Abuja. According to him the purpose of their visit was to assess the financial and technical readiness including documents TCN had on ground with regards to the NTEP1 project.

According to Mr. Ossouca, the project appraisal report would be presented to the Board of AfDB by the end of July 2019, and part of the report will be on how they view the project and government's contribution to it. The project which is estimated to cost $200M is intended to boost electricity supply to the northeast. It became necessary due to relapse in electricity supply, as well as the need to boost economic activities in the region. He therefore, assured TCN of AfDB's support to Nigeria and TCN in supplying efficient and quality electricity within the country, thus boosting economic growth.

In his response the MD/CEO, TCN Mr. Usman Gur Mohammed appreciated the team for the visit, assuring them that staff in charge of the NTEP1 project will be on ground to work with them and provide necessary documents and answers needed.

He disclosed that NTEP2 is on the radar, and that the projects under NTEP2 includes the construction of eleven (11) 132/33kV substations and the provision of line bay extension to six (6) existing 132/33kV substations in the northeast region.

Dr. S.T. Garba, Assistant Director, International Affairs Federal Ministry of Finance, reiterated the ministry's commitment towards the commencement of the project, and urged TCN to hasten the process of the Environmental Impact Assessment (EIA), which was stalling the progress of the project.

The Project Manager, TCN Project Implementation Unit, (AfDB PIU) Engr. A. M. Abdulazeez reported that 'Invitation for Prequalification' of contractors to supply project materials would be published later within the Month of July 2019, revealing that the first prequalification advert if for Contractors for the Engineering design, Procurement, Manufacture, Supply, Construction & Commissioning of 330/132/33kV Substations.

Also, in attendance at the meeting were, Devinder Goyal, Arkins Kabungo, Chigozim Egeowh from AfDB, Engr. Victor Adewunmi (Head TSP) TCN, Engr. M.J. Lawal (Head ISO) TCN, Mr. Isa Dutse (ED F&A) TCN, Engr. R.A. Bako Project Coordinator TCN (AfDB PIU) and Hadiza Tanko from the Federal Ministry of Finance.

MD/CEO TCN, Mr. Usman Gur Mohammed and Ebonyi state governor, Mr David Umahi

EBONYI STATE GOVERNMENT SEEKS MORE PARTNERSHIP WITH TCN ON BULK POWER DELIVERY

By Gabriel N. Gandu

Ebonyi State government has sought for more partnership with the Transmission Company of Nigeria (TCN) in delivering bulk power under the Eligible Customer policy, to boost socio-economic activities in the state.

The state governor, Mr David Umahi made this known when he paid a courtesy visit on the Managing Director/Chief Executive Officer, TCN, Mr Usman Gur Mohammed on Thursday, 4th July, 2019 at the Corporate Headquarters in Abuja. He said with the rising number of industries in the state, electricity was fundamental to development and job creation.

Mr Umahi who commended TCN on the Eligible Customer Policy gave assurance that his administration was ready to take the necessary steps in getting steady and quality power supply to Ebonyi. He also stated that he would be delighted if on-going TCN projects like the Substation at Amasere was completed within a realistic timeline and if any assistance was needed, his administration was willing to assist.

He further explained that the state government would soon sign two additional Memorandum of Understanding (MoU), which he called the International Market, stating that it had been evaluated and very viable. According to him, three new government houses would be built, a Secretariat, a Teaching Hospital, an Ecumenical Centre and a School of Nursing and under the Industrial and Private Industrial Cluster; a battery factory, a solar power plant and an Indomie factory, and all these entailed steady power supply to be fully functional.

In his response, the MD/CEO, TCN, U. G Mohammed who lauded the efforts of the governor, assured him of TCN's willingness to the partner with the state. He noted that significant investment had been made in the transmission network with funding from multilateral donor agencies to the sum of $1.6 billion dollars under the Transmission and Rehabilitation Programme (TREP), in order to expand the grid.

According to him, the primary objective of the Eligible Customer was to create a direct link between the electricity customer and TCN thereby sidestepping the electricity distribution companies (DiScos), whom he said needed significant investment in their network.

Mr Gur also expressed optimism towards on-going projects in the state and directed TCN engineers to look into the Amasere Substation and get the contractor back on site for timely delivery.

INTERVIEW WITH THE GM MARKET OPERATIONS

Question: In the last few weeks, the Market Operator had issued Suspension and Disconnection Orders to some Distribution companies (Discos)from the market as well as the National Grid, tell us what inspired the decision?

Answer: It might be necessary to take you back to how we started; the Nigerian Electricity Market was designed to evolve in stages. In 2004, the first stage called "Pre-Transitional Stage" started. This stage was meant to test the Market, test the Rules and Compliance. It gave room for some of the pre-conditions for Transitional Electricity Market(TEM) to be completed. This stage took about 15 (Fifteen) years before commencement of TEM in 2015.

In 2015, the Regulator felt that the pre-conditions had been reasonably met for TEM to start. Some consultants insisted that the pre-conditions be fully met before Transitional Electricity Market (TEM) commences. The Regulator flagged off TEM because some operators insisted that a better part of the pre-conditions had been met and that the Market can transit into TEM. And so in 2015 the Transitional Electricity Market started.

TEM is designed to be driven by bi-lateral contracts, in other words, customers sign contracts or Power Purchase Agreement. Power Purchase Agreement is sacrosanct, the two parties have to comply strictly with the contract. Also, a lot of participants would enlist into the market including the NBETs Bulk Buyers or Bulk Traders as we know it today. That's how TEM commenced.

One of the major conditions for TEM is that the Distribution Companies would post a Letter of Credit (LC) or guarantee to the Market Operator and the Market Operator would fall back to the guarantee assuming a Disco short pays its monthly invoice. And when this happens, the Disco is expected to replenish the guarantee.

Recall that from 2015, the transactions on energy and capacity were handed over to NBET and the Market Operator faced the Market Administration processes and services charge payment from Discos. This involves service charge for TCN which is made up of TSP, SO MO, ancillary services, the NERC and of course NBET.These make up the services charge that the MO collects from Discos.

When TEM commenced, within the first and second month, the distribution companies didn't comply with the operation of the

Some Discos were suspended in the last one week. We went through our records and discovered that three of them failed to update guarantees posted and were suspended from the Market

guarantees which was intended to stabilize the market. When an attempt was made to fall back or have recourse to the guarantee, the discos went to court and obtained an injunction stopping both NBET and MO.

Probably because of lack of will power, the MO and NBET have not been able to implement this part of the Market Rule. As I speak, the outstanding bill on services charged as at March 2019 is N263b, services only, this does not include energy and capacity handled by the NBET.

Now this N263b is made up of 65% or 66% short fall every month. Averagely what the discos pay to MO is in the neighborhood of 30% to 35%.

For providers of services, there are projects to be executed, salaries to paid and other overheads. For TCN, 30% cannot do it because when we do our budget before ISAP through NERC, you present those typical expenses that you must make within the year in order to function properly. But 30% will not enable us operate efficiently.

It will interest you to know that the market demands that ancillary services which would stabilize the grid is paid 100% irrespective of payment made in the market. So what that translates to is that when participants make this 30% or 35% as the case may be, the ancillary services invoice which today is in the neighborhood of N372m is taken out in full so whatever remains is pro-rated among these service providers. That is to say, service providers' invoice is still less than 35%. This has affected our services.

Lack of fund has hampered our services.

However we are of the opinion that instead of the government to cancel privatization, we should rather enforce compliance of the Market Rules. This compliance enforcement is what we have commenced.

We had to first look at the records for discos whose Letter of Credit (LCs) have expired or are deficient in line with the Market Rule. Some Discos were suspended in the last one week. We went through our records and discovered that three of them failed to update guarantees posted and were suspended from the Market. They were duly notified; you must have seen the publications in the newspapers which is a requirement of the Market Rule. We did the needful, by serving them notices, one of the Discos called for a Public Hearing which was granted. The Disco came here and the Public Hearing was conducted. Public Hearing does not connote that everything you say will be taken as genuine excuse. The committee looked into their submission and discovered that it was not a good excuse for non-compliance. They were therefore suspended in line with the Market Rule.

The good news is that today, the three Discos involved have fully complied. Renewing and posting adequate security deposits as required by the Market Rule.

You must also know that every Disco has a regulatory department whose duty it is to go through their records always to find out whether their operating documents are up to date or not. It's like a driver caught by Vehicle Inspection Officers (VIO) with expired papers, you don't tell them to give you grace of a month or two to renew when you have already violated the rule. The Market Rule defined clearly fines for violations. These fines rang from L1 to L4 as the case may be, these three companies have also complied by paying the fine as well as doing the needful in posting the adequate security deposit.

Question: Is this peculiar to distribution companies?

Answer: Every market participant signed an agreement with the Market Operator and depending on what you do, we have

generators, distribution companies and also eligible customers. Each of them signed a Participation Agreement depending on what their transactions are in the market. This agreement make the Market Rules binding on every participant. We have braced up to make sure that the Market Rules are complied with, so it's not peculiar to Distribution Companies alone.
Distribution companies are only a subset of participants in the market and they're eleven. The number of eligible customers is also increasing, every eligible customer has also signed Market Participation Agreement making the Market Rules binding on them.

Question: So how will this trend now benefit the electricity market, the power sector and country in general?

Answer: I think so far we've been receiving some commendation that at least, for once, the needful is being done in the market and that's instilling discipline in the market. What has actually brought the market to the low level it is today is indiscipline and the lack of will-power to make sure the Rules are enforced. If the service providers get their revenue in time and in full, they will be very efficient, the staff salary and the other attendant overheads that impact on services to the market would be adequately taken care of.

Today, if the Discos comply with the Market Rules, it means services rendered to the market will be efficient. The Market Operator conducts Metering Evaluation and Energy Audit, aside services provided by TCN. There is equally the confirmation of metering data which is used for billing and settlement statements in the market. This is the soul of the market.
I tell you honestly, since the Market Operator started market administration, we have never had scandals nor upsets, we've never gone for Dispute Resolution Panel for wrong data records. And so we are proud to say that.
Again, in the last one year, the transmission losses have remained below 8.05%.That means we have not exceeded the transmission loss threshold. Being under 8.05% means that more revenue comes into TCN, this is an index of transmission efficiency of TCN. This translates to efficient evacuation of power from generation to distribution networks. Today TCN is geared up in making sure that the needful is done and the transmission services are carried out efficiently. You can agree this is for the improvement of the market.

Question: Are there other new developments that the Market Operator intends to initiate to further improve participation by all players in the market?

Answer: Yes, making sure that Security Deposits are up-to-date is the first step, but security deposits being in the bank does not give us any service. The sole idea is that this security deposits is placed there as confidence for the service providers and at the end of each month, if a Disco fails to pay its invoices 100%, we will fall back on this security deposits to fill up the shortfall in invoice payment. This action is planned to be the market stabilizer but hitherto it has not been working.

The Disco is notified, before the next billing cycle and is expected that the Disco refills this security deposit. Now what is the security deposits amount? It is the average of three times the typical monthly invoice of the Discos. This means that the market s secured for three months. The LC operation is the confidence service providers have in the market but unfortunately the Discos don't take it serious.

The Discos should replenish the guarantee before the next billing cycle. And the Market Rule say at the stage when Discos can't maintain its security deposits they don't leave the market with confidence, the confidence being the security deposits and if the market doesn't have confidence in you, your licence is suspended. This means a Disco can lose its license by non-performance.

In other words, instead of the government to say that a Discos license is suspended, the Disco suspends itself through poor performance. This means by the process of rules enforcement, compliance and performance, a Disco can exit the market or be sustained in the market.

The May 2019 settlement statements and bills have been completed and we have already notified all the Discos that we expect their payment 100%. On the expiration of this notice, we will fall back on their security deposits and fill up the payment gap invoices.That's how we want to create confidence in the market and it is inline with the Market Rule.

Question:Is there any other information the Market Operator wants to tell the general public?

Answer: I want to use this opportunity to tell the consuming public that electricity is not a social good that the government will provide without payment by the consumers. Today, electricity is one factor that can bring about industrialization in Nigeria as in China and the USA. We are expecting that anyone that consumes electricity should be able to pay. It's an obligation.

Sometimes when our phones run out of airtime, we are usually under pressure to go and recharge and everyone recharges. But when it comes to electricity, instead of recharging people tend to shunt their meters and do all sorts of things in the distribution network. We are using this opportunity to advise the consuming public, to pay as you consume.

Now there is a mass metering programme going on and we are sure by the time it is successfully completed everybody will be metered and there would be noestimated billing. All hands should be on deck to ensure that Nigerian Electricity Market survives. For now, it's on life-support.

TCN COMPLETES 1ST PHASE OF NEW EKIM SUBSTATION, AKWA-IBOM STATE

The first phase of the ongoing brand new Transmission Substation in Ekim, Akwa Ibom State has been completed and energised. This phase comprise a 60MVA 132/33kV power transformer and three outgoing 33kV feeder bays. The transformer was energized early this month.

With the complition of the first phase of the substation, TCN engineers have commenced the installation of the 2nd phase which also comprises of a 60MVA transformer and three feeder bays.

The Ekim Transmission Substation project is being executed by TCN in collaboration with the Akwa Ibom State Government. While TCN provides and installs the transformers, switchgears and gantries using its in-house engineers, the Akwa Ibom State Government is providing all the civil works associated with the execution of the project.

Having energized the first phase of the project, TCN now has available, additional 48MW of bulk power supply for PHEDC to off take, through the three feeders, to its customers such as the Akwa Ibom State University, Coconut Oil Refinery, Meter Manufacturing Factory, Syringe Factory, Ikot Abasi and Onna LGAs, Easter Obolo as well as Mkpat Enin. It is expected that with more supply to PHEDC through the new substation, these customers would experience more hours of stable and sustained power supply.

The Ekim transmission substation is one of the new transmission substation projects TCN has successfully executed within the last one year. Several other transmission projects are also ongoing nationwide in line with its Transmission Rehabilitation and Expansion Programme aimed at growing a robust transmission grid.

TCN TARGET 10,000MW WITH SEVEN CRITICAL INVESTMENT IN TRANSMISSION LINES

By Eric Ephraim Ene

The Transmission Company of Nigeria (TCN), said it was targeting to raise the transmission wheeling capacity to 10,000 megawatts (MW) from the present 8,100MW by reconductoring seven critical transmission lines in the country.

The Managing Director/CEO, Mr. Usman Gur Mohammed who gave this indication at a quarterly press conference on Wednesday, 10th July 2019, in Abuja, said this was aimed at further stabilizing the grid and that as part of the efforts to attain this target, TCN would procure high capacity quad conductors that would enable transmission lines carry more bulk power.

According to him, the seven critical transmission lines TCN plans to put the Quad Conductor include; Onitsha Awka-Oji River line, the Ikeja-West - Alimosho – Ogba - Ota line, and the Alimosho– Alausa line. Others are, Kaduna – Zaria – Funtua – Gusau line, BirninKebbi – Sokoto, Aba – Itu, and Kumbotso Dan Agundi 132 kV transmission line. "By doing this, he noted, we are going to recover between 2,000 to 3,000MW which means the grid will shift from 8,100MW to at least 10,000MW".

Mr. Mohammed also disclosed that TCN was executing some other critical transmission projects with the $1.661 billion multi-lateral donor fund it has secured, part of which is funding the on-going "Abuja Feeding Scheme" which on completion, would add 2no 330kV and 3no 132kV new transmission substations in Abuja, which would boost bulk power to the Federal Capital Territory and its environs, while the Northern Corridor Project evaluation study was ongoing.

MD/CEO TCN, Mr. Usman Gur Mohammed during his presentation at the dinner

He added that evaluation process was on going for the first phase of the Nigerian Transmission Expansion Project (NTEP) which would build a 330kV line from Alaoji in Abia state to Onitsha in Anambra and will correct current system disturbances in that axis.

He appealed to distribution companies (Discos) to step up investment in their networks in order to complement the enormous investment from the transmission and generation companies in the Nigeria electricity value chain.

On the recent sanctions of Four Discos in the country by the Market Operator, Mr. Mohammed stated that the Eko, Ikeja Portharcourt and Enugu Discos were suspended because of their non-compliance with the Market Rule agreement and that when they complied, the suspension was lifted. He noted that Participants in the Nigerian Electricity Market need to obey the market rules in order to ensure sanity in the system.

Mr. Mohammed made these known while answering questions from journalists at the press conference, noted that the on-going massive investments in transmission across the country were a part of the conditions precedent for the separation of TSP and ISO.

Cross section of TCN management staff and pressmen

PHOTO PAGE

Management Team led by MD/CEO, Usman Gur Mohammed paid courtesy visit on the Senate Leadership and presented TCN's achievements and challenges on Tuesday, 16th July

MD/CEO, Usman Gur Mohammed and former NERC Chairman, Dr Sam Amadi were panelists at the last Nextier Power Dialogue with the theme; "Evaluating Transmission Link for a Competitive Electricity Market" on 17th July in Abuja.

The newly elected executives of the National Union of Electricity Employees, NUEE, TCN HQ Chapter led by Comrade Chris Adah being formally presented to TCN Management Team on 19th July at TCN Corporate HQ, Abuja

Training of Field Engineering staff of TCN on the maintenance of advance circuit breakers by CG Power Solutions Ltd, India

THE SMART WAY

Engr. Chukwuemeka Chiatula
System Planning Dept.
Transmission Company of Nigeria
Abuja, Nigeria
chukwuemeka.chiatula@gmail.com

Engr. Jacob Tsado
Electrical and Electronics Engineering
Federal University of Technology
Minna, Nigeria
tsadojacob@futminna.edu.ng

Bemdoo Saka
System Planning Dept.
Transmission Company of Nigeria
Abuja, Nigeria
bemsaka@gmail.com

Steve Adeshina
Computer Engineering Dept.
Nile University of Nigeria
Abuja, Nigeria
steveadeshina@yahoo.com

Thomas Sadiq
Computer Engineering Dept.
Nile University of Nigeria
Abuja, Nigeria
sadiqthomas@nileuniversity.edu.ng

Abstract—The growing awareness of carbon emissions in power generation, increased electricity demands and difficulties associated with integration of energy storage in network systems cannot be overemphasized. The reduction of pollution through renewable energy integration, energy efficiency and conservation practices via better end-to-end electricity management awareness, and also through energy storage systems in the existing grid pose some difficulties which call for the development of a more flexible and controllable power grid, the intelligent power grid also known as the Smart Grid.

The Smart Grid is believed to be the future of the electric power network which promises improved efficiency, reliability and safety and allows integration of renewable and alternative sources of energy, through automated control and modern communication technologies. In this sense, the electricity supply network is maintained in an available, live, interactive and interconnected manner allowing a two-way transfer of information in real-time.

The principal characteristics of the Smart Grid includes the following: it is self-healing; empowers and incorporates the consumer to be electricity-management conscious and allows two-way communication between them and the utility; tolerates security attacks; provides enhanced power quality and accommodates a wide variety of distributed generation. Incorporating all these characteristics into the existing system will pose challenges as well as opportunities. This paper gives an overview of the different Smart Grid agents proposed and implemented such as Advanced Metering Infrastructure (AMI), renewable energy options, monitoring and command, Plug-in Hybrid Electric Vehicle (PHEV) and energy storage devices. These agents were placed in phases to show the different progressive stages of the Smart Grid integration into the existing power system. The impact of the transformation of the existing power grid to the future grid was broken down into three stages: The End-User Experience Sphere, the Smart Grid Sphere and the Systems Sphere. Defining these stages in Smart Grid maturity will give us a concept of a pathway towards achieving the solution goals of the intelligent grid.

Keywords—Smart Grid, advanced metering infrastructure plug-in hybrid electric vehicle, renewable energy.

I. INTRODUCTION

As seen in the world advancement, the growing demand for electricity on the grid to be more efficient, reliable, safe to operate and highly controllable is becoming a challenge today. This complexity increases simultaneously with the growing demand of renewable energy integration which includes wind and solar farms. To be able to rise above these challenges brought about by the

increase in the size of the network, increase in the complexity and amount of data to be processed, the power needs intelligence at all levels and spheres, in the component, area or system level to be able to handle the complexity []. A smart data processing capability is needed in the important decision making for performance and control. For this intelligent system to be somewhat visible smart agent such as Advanced Metering Infrastructure (AMI), Flexible Alternating Current Transmission System (FACTS) devices, sensors, renewable energies and others will have to be deployed to handle the growing complexity of the system. Therefore, integrating these smart agents into the traditional grid to cover lose ends where the latter lacks, this will give birth to a new system called the Smart Grid.

In this paper, the traditional grid and the smart grid were compared. Secondly, an overview of the smart agents integrated in the existing system as well as the integration of the smart agents in phases were addressed with the maturity level of different spheres of stakeholders. This will create a concept of a stage-by-stage implementation of smart agents to achieve a solution goal of Smart Grid delivery.

II. SMART GRID

The intelligent Grid is an advancement in power which has the capability to monitor its health in real-time, predict its behavior and adapt to new environments such as generation technologies, distributed resources and optimization of responses to the smart appliances. It is a tool that allows electric utilities to focus on evolving true business drivers by ensuring low cost end-to-end power delivery control and a more secure infrastructure. The Grid is considered to have observability with nodes data integration and analysis to support advances in system control operation. To be able to achieve this improved reliability and economic power delivery, information flow and secure integrated communication is proposed. The main objectives of a Smart Grid are to reduce the energy prices and to ensure low carbon footprint.

A. Characteristics of Smart Grid

A Smart Grid is characterized by the following [2]:

- Enables informed participation by consumers
- Accommodates all generation and storage options
- Enables new products and services
- Provides good power quality for a range of needs
- Optimizes asset utilization and operation efficiency

III. CONVENTIONAL GRID AND INTELLIGENT GRID

Table I gives an overview of the different characteristics of the two grids: The Conventional Grid and Smart Grid. This table will help open the loopholes in the conventional grid which will be the basis of the defined roadmap to be accomplished in the paper [] [].

TABLE I. CONVENTIONAL GRID VERSUS SMART GRID

Conventional Grid	Smart Grid
One-way power flow	Two-way power flow
Unidirectional communication	Bidirectional communication
Inefficient demand response (passive customer	Efficient demand response (Interactive customer)
Centralized power generation	Accommodation of a wide range of distributed renewable generation and storage options
Fossil fuel based power generation	More environmentally friendly generation
Manual operation	Automated operation (self-healing)
Prediction operation (e.g. matching of supply and demand based on forecast and historical information)	Real-time operation (e.g. matching of supply and demand based on real-time information)
Conventional household appliances	Smart appliances

IV. SMART GRID AGENTS

The Smart Grid agents are mainly a set of individual technologies that span through the entire system ranging from the generation through to the transmission and distribution to various types of electricity consumers. Some of these agents have been deployed and will continue to mature in its application and technology.

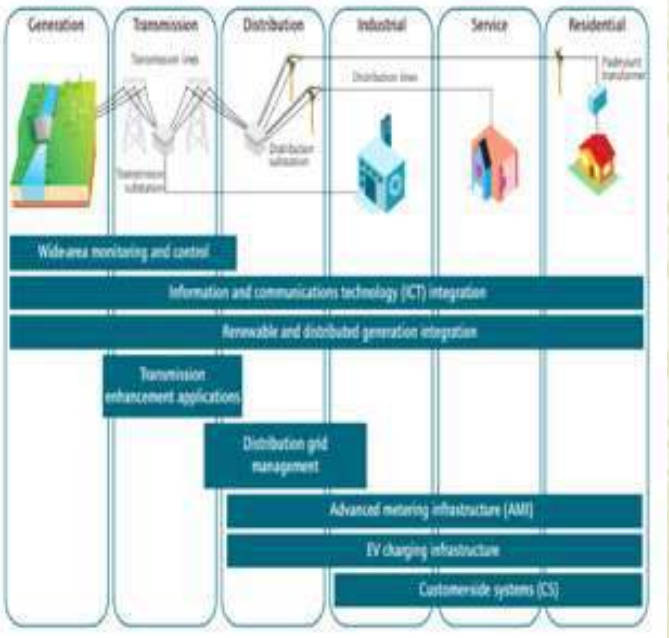


Fig. 1. Smart Grid Technology Areas [2]

Fig. 1 demonstrates the smartly integrated system showing where the smart agents have been integrated in the areas in the grid system.

A. Advanced Metering Infrastcuture

In AMI technology, earlier smart meters sent electricity usage readings back to the utilities. This eliminated the need for the reader to physically be present to take the readings. The advancement of smart meters has allowed a bidirectional information flow, where the change in prices in near real-time will be relayed to the end-users which will in turn take possible action in energy saving.

The AMI technology functions are []:

- Provides the time-of-use pricing information
- Ability to collect, store and report customer energy consumption
- Detect theft or losses
- Determine the location and outages remotely through the smart meter functions or applications

B. Plug-in Hybrid Electric Vehicle (PHEV)

The AMI technology is paving way for another type of technology which is PHEV. For this to work well, customers have to be more engaged in bidirectional information flow which will play a crucial part in the development of the system. Another area of impact is the security measures that should be taken by the government for the protection of privacy of the end-users [].

This technology comes with hybrid cars. When the electricity is not expensive, the energy is stored in batteries of cars and when the electricity becomes expensive, the electricity stored in the cars can be sold back at a profit to the grid [6], [7], [11]. The impact will depend on a number of factors such as individual behavior (e.g. daily driving, habits), how charging is priced and the development of the charging structure. The network operators will also increase the level of monitoring on the network and control of the power requirements in those areas [].

C. Improved Transmission Applications

The technologies developed in this type of application are the Flexible AC Transmission Systems (FACTS) and High Voltage DC (HVDC). When the power system expansion is limited due to space for installations of new equipment, securing locations for substation and transmission lines or if the transmission limit is reached under defined contingency conditions, these FACTS devices will provide benefits which rise above the challenges mentioned through improved utilization of existing transmission assets, increased transmission system reliability and availability and improved quality of supply to critical end-users such as industries or hospitals. The HVDC technologies are used to transfer electricity through DC from offshore wind and solar farms and converting it back to AC at the power areas onshore. This brings about reduced losses and improved controllability [].

D. Renewable Energy and Distributed Generation

This distributed generation can be in the transmission level or the distribution level and residential homes. Such devices/agents include photovoltaic and solar panels. These types of devices are becoming more available to the public depending on the operating environment and this reduces the carbon footprint in the network. The increase in purchase of this type of technology will increase the chaotic behavior of the grid which will have more data to process and implement to be able to determine the power flows in the system].

E. Grid Monitoring/Management

Power outages are very expensive and should be in every way avoided with proactive actions taken to isolate the problem or divert it to a redundant asset. Installation of sensors such as Remote Terminal Unit (RTU) should be used to monitor and control the grid in real-time or close to it. These monitoring and control systems are being extended from the point of transmission down to the distribution grid. This type of smart grid integrated into the system is the Supervisory Control and Data Acquisition (SCADA) system which provide real-time visual monitoring and high controllability of the grid .

V. STAGE IMPLEMENTATIONS AND CHALLENGES

As seen in Table II below, improving the existing grid requires the input or integration of new technologies known as Smart Agents which derives the network from unidirectional flow to a more bidirectional flow where all stakeholders will be usefully engaged in decision affecting the flow of electricity in the grid. The Electricity Networks Strategy Groups (ENSG) proposed the steps to be taken to achieve the degree of grid to act smart. There are four stages to achieve the transition from Traditional Grid to Smart Grid:

- Stage 1: This is the current stage where the

successful implementation of the smart agents is tried and tested on the grid.

- Stage 2: These incudes further trials and pilot tests to be carried out.
- Stage 3: Expanded investment to meet stage 2 requirements.
- Stage 4: Providing a platform for different power system alternatives.

TABLE II. INTEGRATION LEVELS OF SMART GRID

Stage 1	Stage 2	Stage 3	Stage 4
Existing Stage	Future Steps	Meeting future steps	Platform for more options in the power system
Superior Understanding	More pilot tests are to be carried out to verify its capability and durability into the grid	This is to respond to the needs and legacy	Increase of data information which will help intelligence and control in the power system
Exhibits a range of applications on the power system	Spot variety of ways to expand in application and functionality	To be able to increase the interaction with smart agents	Increase in development of Smart Grid technologies used to be able to integrate into the system
The implementation of such smart grid agents have been successful in the power system		The projects will be exhibited in larger size to show its application on extent and functional depth	Enhanced power flow and voltage control

Using the above stage integration process of Smart Grid, Table III will give us the opportunity to view some of the smart agents and their maturity level. Table III shows the research done on the general technology advancement and maturity level on the various smart agent/technologies. It also gives an overview of challenges each technology area would have gone through its advancement stage.

- Development stage will be indicated by red colored circle
- Matured stage will be represented by yellow colored circle
- Semi-matured stage will be represented by blue colored circle

Matured Stage will encompass an early stage of deployment with the advancement in technology of the technology areas and agents. Developing Stage will consist of the stage of advancement and the pilot tests still carried out on the different projects. The semi-matured stage will consist of some of the technologies been deployed to the public but still ongoing in the pilot projects.

TABLE III. MATURITY TABLE

Technology areas/smart agents	End-user Sphere	Smart Grid Sphere	Systems Sphere	Improvement Tendency
AMI				Fast
Distributed Generation (Wind and Solar)				Still Improving
PHEV				Still Improving (pilot stage test)
FACTS/HV DC	------			Fast (Implemented in project and still improving)

The integration of the smart agents mentioned in Table III above will help shift the focus from the generation to suit demand to running demand to suit the low-carbon generation. Increasing the smartness of the Grid will broadly transit to low carbon gains and strategies with an impact of higher degree of complexity with new patterns of the electricity usage and generation.

TABLE IV. CHALLENGES/IMPLICATIONS OF INTEGRATING STAGES OF SMART GRID

Challenges	Implications	Smart Grid Response
New power flows - Electrification and Distributed Generation	Increase in demand of electricity	Increased intelligence and control in system operation
	New power flows and system management	Enhanced end-to-end power integration
	Integration with a variety of domestic devices to enable active demand response	Deliver enhanced grid planning and improved utilization to defer and optimize capital spending
Higher levels of intermittent generation	Required low cost power system management in both distribution and centralized	Optimization of the power system through demand energy resources such as PHEV, wind etc.
Maximizing embedded storage capability	Energy storage devices by grid to vehicle and providing energy vehicle to grid to balance the system	Necessary intelligence to optimize usage to benefit the system
Data capturing and monitoring	Demand for more efficient and advanced smart meters	Increase end-user to operator communication, demand side management, peak shaving

VI. CONCLUSION

In this paper, the need for Smart Grid is captured by showing the comparisons between the traditional grid and the intelligent grid and an overview of the types of smart agents which are integrated into the different technology areas. The different stages are tabulated for simplification to show the process of achieving a full-blown Smart Grid which paves a way for sectionalizing the different Smart Grid agents into different maturity stages. The concept of putting the advancement in stages and the smart agents in maturity will help achieve the set goals of a Smart Grid project. This will match the proper stage of the Smart Grid capabilities which will help achieve the project in a cost-effective manner and in the right project time frame.

WHAT IS TRANSMISSION LINES RIGHT OF WAY (TROW)?

Transmission lines right of way (TLROW) is defined as land set in two paths of the centre of the transmission line. TLRWO is also called the transmission line corridor and this corridor could be maintained by either government or private authorities who do the maintenance work. Safety is one of the essential factors of the transmission ROW which provide necessary land scape arrangement.

There are several voltage level of the line maintained and the width for the transmission line corridor ROW changes due to the voltage levels, e.g. 132kV Transmission line ROW is 30m by width which means 15m either side from the centre of the line. For the higher voltage transmission line the width of transmission gets increased to maintain proper safety clearance.

Normally, trees which are higher than 3 meters are cut out to maintain the proper ROW under transmission line and trees or plants can grow below 3m. The condition and clearance height differs from country to country.

TLROW is one of the major considerations while creating transmission line. Traverse overhead most vegetation effect for transmission line corridor and social and environmental study is very necessary while designing transmission lines.

ESIA of transmission lines are much less compared to other major development but in some cases there are transmission line corridors with major impacts in environmental sensitive areas. Following are most commonly used TLROW.

TLROW for 132kV transmission line = 30m by width

TLROW for 330kV transmission line = 50m by width

However, the maintenance of proper ROW in electrical power transmission lines is a very important factor in transmission lines when considering maintenance and safety factor.

Towers and other overhead power lines are often considered to be a form of visual pollution in the TLROW;

Safety: Electricity can be deadly, so that's why it's normally contracted out to qualified line clearance arborists to perform the work.

Land owners should never attempt to trim or remove tree limits near or adjacent to any power line. If you are concerned about a tree that

ROW is an indispensable aspect in laying of transmission line for the project to be completed on time but some time ROW issue becomes a delaying factor as such proper survey must be done so that ROW is cleared and doesn't hamper the transmission projects.

Frequently asked questions on TLROW:

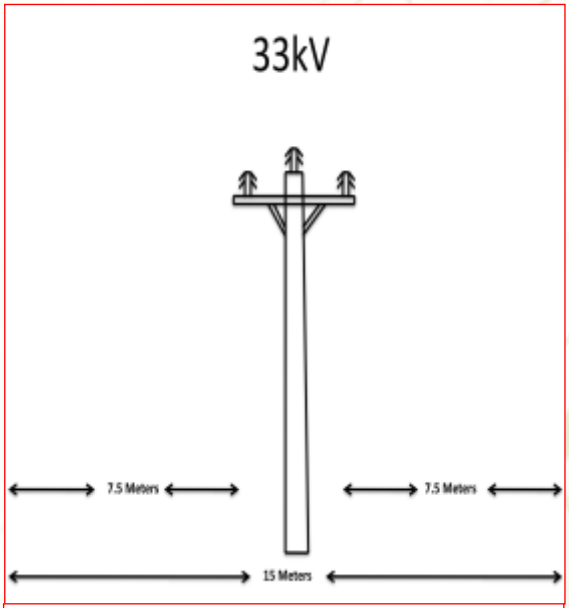
Can I plant and grow trees on the transmission line ROW?

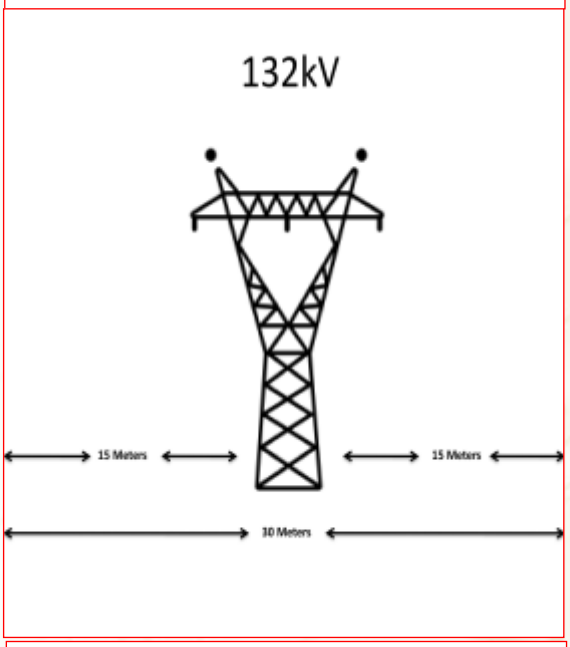
When evaluating the current vegetation and before planting everything in a TLROW consult the list of suggested low-growing trees and shrubs that may be compatible with certain areas of the ROW. Just remember that even if a particular tree shrub is on the list, it might still be a problem if it is planted in the wrong place. This is why it is a good idea to always consult the maintenance team.

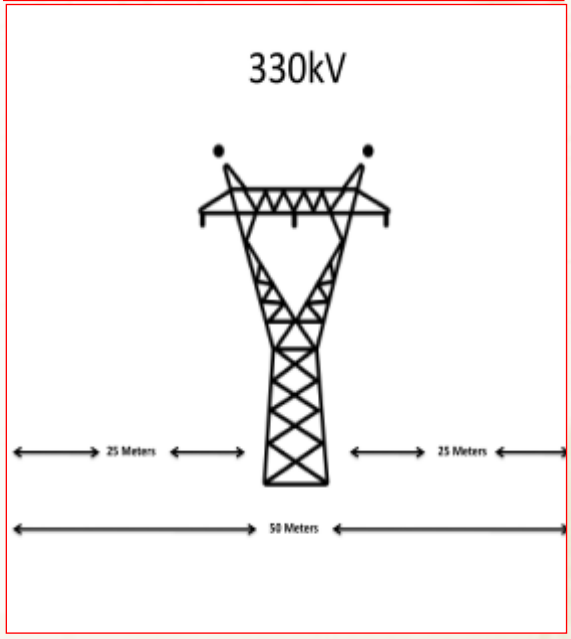
Crops/Agricultural Lands: This also needs to me cleared and according to the policies of the company/community compensation is provided.
But it should be noted that if it is not possible to get the area cleared, then the trees are to be erected leaving that buildings:

How is TLROW Calculated?

TLROW calculation depends on various parameters. You need to know the voltage level and ground clearance then you calculate the max. Swing is due to wind in that area, Sag is also required.







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Watch out for more Tips on TLROW!!!!

FEEDBACK PAGE

Durowade Najeem @Najmdeen · Jun 9

Replying to @TCN_NIGERIA

Truly there's an urgent need to bridge the infrastructural gap in the industry. We don't get enough power supply, yet power transmitted to all the discos are underutilised.

2

Michael Akanji @mickiebrownkie · Jun 13

The Transmission Rehabilitation Expansion Program, TREP is strengthening the weakest 330kV transmission line corridors through new lines and reconstruction.

Meanwhile, some 330kV/132kV lines will be re-conductored using modern higher carrying capacity conductors.
#TCNPowerUpdate

1 4 3

Norbert Edomah @n_edomah · Jun 7

Replying to @TCN_NIGERIA

Well done @TCN_NIGERIA . Let us all contribute our small quota in building our country. God bless #Nigeria

Alfred Lisiyas @AlfredLisiyas · Jun 17

Replying to @TCN_NIGERIA

Great! I was there January/February. Batch 2.. it was such an impactful training! Wishing all participants best of training.

Habeeb Tunde @habeebtunde2 · Jun 22

Replying to @mickiebrownkie @TCN_NIGERIA and 8 others

Very good.

Only if previous govts had given Power the attention it deserves.

Quick Q: Has the Mambilla power project began? We hardly hear anything about it.
@TCN_NIGERIA

Thank you @MBuhari @ProfOsinbajo @OfficialAPCNg @NGRPresident

1

We appreciate your comments, please keep them coming!

CONTACT US

REGION	SUB-REGION (S/R) / WORK CENTER (W/C)	TITLE OF THE OFFICER	NAME OF THE OFFICER (AGM(T) / PM(T))	PHONE NUMBERS	OFFICE ADDRESS
BAUCHI		GM(T)	Ali Sharifai	08033149427	Railway, Steyr Road Bauchi State. PMB, 0250, Bauchi.
	Gombe S/R	AGM(T)	Jibrin Nasiru	08035888373	Duku Road Gombe State, PMB, 67
	Jos S/R	PM(T)	Mohammed Ahmed	08065907063	Mile 7, Zarial Road Jos, PMB 2011
	Yola S/R	AGM(T)	Badamasi Kofar Naisa	08060493192	Numan Road, 330/132 KV Substation Yola.
	Maiduguri W/C	AGM(T)	Adamu Gaya	08027766939	Along Gombe/ Numan Road Yola, Adamawa State
BENIN		GM(T)	Olujimi Adetola	08060082299	Sapele Road, Benin City, PMB 133
	Benin S/R	AGM(T)	Isaac Okpe	08033587934	Sapele Road, Benin City, PMB 133
	Sapele W/C	PM(T)	Wilfred Asomwoniriri	08037921342	Sapele Work Center, Ogorode Sapele, PMB 4028, Sapele
	Delta S/R	AGM(T)	Jimoh Olanrewaju	08060223541	Ughelli, Delta State. PMB 96
	Omotosho S/R	AGM(T)	Kazeem Bakare	08033096385	Industrial Estate, Lagos/ Sagamu Expressway
ENUGU		GM(T)	Jack Emuchay	08037608407	New Haven, Enugu. PMB 1730
	Enugu S/R	AGM(T)	Cyprian Obianjunwa	08059188196	
	Onitsha S/R	AGM(T)	Micheal Oyigbo	08064960739	Awada (Obosi), PMB 1614, Onitsha, Anambra State.
	Apir S/R	AGM(T)	Emmanuel A Akpa	08054988829	330/132/33 KV T/S, Kilometer 15 Markurdi, Aliade Road, Apir Markurdi, Benue State.
KADUNA		GM(T)	Aminu Haruna	08059401383	Airport Road ,Mando, PMB 2185
	Kaduna S/R	AGM(T)	Mohammed Nuhu	08038744741	Airport Road ,Mando, PMB 2185
	Kano S/R	AGM(T)	Aminu Ismaila	08059401383	
	Dutse W/C	PM(T)	Mohammed Bello	08035884281	
	Gusau W/C	PM(T)	Tanko Dami	08144527277	132/33KV Station, PMB 1004, opposite NTA, Samaru Gusau, Zamfara State.
LAGOS		GM(T)	Lamina Adebola	08023286263	Ijora PMB 1020, Ebutte-Metta, Lagos
	Akangba S/R	AGM(T)	Charles Iwuamadi	08034545543	
	Ikeja West S/R	AGM(T)	Mojeed Akintola	08023199925	Ayobo Ipaja Road, PMB 21632 Ikeja Post-Office, Ikeja Lagos
	Papalanto S/R	PM(T)	Emma Adesina	08033102877	Papalanto Sub-Region, Olorunshogo, PMB 1001, Otta, Ogun State.
	Egbin S/R	AGM(T)	Ajiboye	08033513078	
	Aja S/R	AGM(T)	Hassan Mustapha	08065525647	Kilometer 42, Lekki Epe Expressway, PMB 80037,Victoria Island, Lagos
OSOGBO		GM(T)	Niyi Oladele	08033056205	Osogbo Ikiru Road, Power line
	Osogbo S/R	PM(T)	Adetutu Odukale	08039368668	
	Ayede S/R	AGM(T)	F. A. Akinro	07016782942	Akinyemi Way, off Ring Road, PMB 5494, Ibadan.
	Ganmo W/C	PM(T)	Kolade Adelakun	08034783187	
PH		GM(T)	Solomon Uyouko	08059820080	Trans-Amadi Way, Rumuoabiakani, Port-Harcourt
	Port Harcourt S/R	AGM(T)	Bernard Johnson	08036560702	
	Afam S/R	AGM(T)	J. Onyekwere	08033409656	Aja Sub-Region, Kilometer 42, Lekki Epe Expressway, PMB 80037, Victoria Island, Lagos.
	Aba S/R	AGM(T)	Humphrey Ubaekwena	07065942733	Aba Sub-Region, Alaoji along Enugu/ Port-Harcourt Road, PMB 7265 (Beside Aba flyover)
	Owerri W/C	PM(T)	Kadri Ogbori	08172930202	Egbu Road, Opposite Mayfair Hotel after Total Filling Station, Owerri.
	Calabar S/R	AGM(T)	Nasir Bello	08038313752	Off floor mill junction, Calabar Highway, Calabar, Cross-River State
SHIRORO		GM(T)	S. Abdulaziz	08033145058	By Shiroro Power Station, Shiroro, Niger State
	Shiroro S/R	AGM(T)	Salau Bisiriyu	08037870776	
	Jebba S/R	AGM(T)	Jiro Ahmed	07066027608	Jebba Power Station, Jebba, Niger State
	Kainji W/C	PM(T)	Nasir SarkinFada	08096347834	KM 15, Mokwa-New Bussa Road, Kainji, Niger State
	Birnin Kebbi S/R	AGM(T)	Garba Ali	08059713664	Jega Power Station, Jebba, Niger State
ABUJA		GM(T)	Tonack Ayuba	08055027497	Nile Street, off Alvan Ikoku Street, Maitama abuja
		AGM(T)	Baraya Mcshow	08139905176	
	Abuja S/R	AGM(T)	Suleiman Mahmud	08037871728	
	Ajaokuta S/R	AGM(T)	Bashir Gote	08032013784	Ajaokuta-Anyingba Road, Kogi State

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EDITORIAL TEAM

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U. G. Mohammed

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