1. EXECUTIVE SUMMARY

The development of any nation is primarily anchored on effective generation and efficient distribution of electricity supply. For Nigeria as a developing nation, ambitious to transform into one of the top 20 economies in the world by 2020, sustainable power supply to drive all the critical sectors of the economy becomes imperative and requires the cooperation and involvement of all stakeholders. The Power Sector, undoubtedly, has witnessed long history of neglect in terms of private sector involvement and investment. It has become an open secret that government alone cannot bear the huge cost of salvaging the sector, which will require over Billions annually. However, over the past years, there was significant progress in attracting private sector investment in the sector and positive indication of more in the coming years, a development that is consistent with the present Administration's commitment to the implementation of its Transformation Agenda.

Energy is one commodity on which the provision of goods and services depend. Its availability and consumption rate is an economic index to measure the development of any community. In Nigeria, there is a limitation to power supply from the National grid which has adverse toll on the populace's economic and social development. This necessitates the need for other sources of viable alternative to which small hydro power schemes readily fits in. major rivers and dam development provide an enviable energy potential for the exploitation of hydro energy in Nigeria.

Hydropower is a renewable source of power. The exploitable hydropower potential in Nigeria is conservatively estimated to be about 10,000MW (Francis, 2004). Only about 19% is currently been tapped or developed. The hydropower potential in Nigeria accounts for about 29% of the total electrical supply (Sambo, 2005). The energy sector distribution in Nigeria is shown

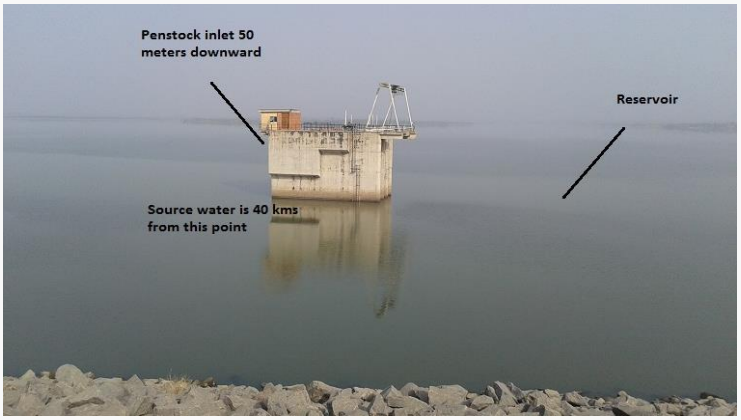
Energy Sector Distribution in Nigeria

Petroleum	60%
Natural gas	9%
Hydropower	29%
Coal	2%
Total	100%

Ikere Gorge Dam is one of the two large dams constructed by the authority , as part of the master plan for the comprehensive development of water resources potentials of the basins of OGUN RIVER. It is located 33 kms north –east of ISEYIN , in ISEYIN local government area of OYO STATE.

There are four rivers , which are feeding water to the reservoir and the major share has been contributed by the OGUN RIVER (85%).

Gross Reservoir capacity is about 565 million m^3 .



The dam was planned to generate 3750 units per hour (@ 62.5%-PLF against installed capacity) of electricity through turbines and benefiting people of

- Iseyin and Ikere
- Supply drinking water to Iseyin, Okeho, Saki and environs

- Irrigate over 12,000 hectares of land during dry season
- Provide water for fishing
- Supply over 82 million cubic metres of water to Iju Water Works in Lagos during the dry season and provide transportation services for people living around the dam.

TECHNICAL PARAMETERS :-

The multi-purpose dam has following technical parameters :-

1.	Static Head	-	40 meters
2.	Design flow	-	
3.	Installed capacity	-	6 MW
4.	Estimated Annual Energy Generation	-	34,891,000 kwh
5.	Approx. Length of 33 KV overhead T/ line	-	30 kms
6.	Estimated direct construction,		
	Supply of E&M and T/line cost	-	
7.	Type	-	Earth Embankment
8.	Length of Axis	-	660 meters
9.	Height at centre	-	47.5 meters
10.	Crest Elevation	-	277.5 meters
11.	Volume of earth fill	-	1.4 mcm
12.	Reservoir capacity	-	565 mcm
13.	Maximum water level	-	273.5 meters
14.	Normal water level	-	266 meters
15.	Auxiliary spillway	-	272 meters long

16. Intake tower	-	49 m high
17. Diversion conduit	-	6.5 m , 272 m long
18. Penstock	-	3.0 m Dia.Length-330m
19. Raw water main	-	1.5 m Dia.
20. Turbine Level	-	230.40 m (Centre Line)
21. Tail race water level (Max.)	-	236 m
22. Tail race water level (Min.)	-	228 m
23. No. of turbines	-	2
24. No. of	-	2
25. Turbine type	-	Vertical -
		Francis turbine
26. Turbine RPM	-	375
27. Turbine maximum head	-	40 m
28. Alternator output power	-	3750 KVA
29. Alternator output voltage	-	11 KV
30. Alternator output current	-	196.8 A
31. Alternator power factor	-	0.8
32. Alternator frequency	-	50 HZ

2. INTRODUCTION & BACKGROUND

Historical Information

In the Yoruba religion, Yemoja is the divinity of the Ogun River. The catechist Charles Phillips, father of the Charles Phillips who later became Bishop of Ondo, wrote in 1857 that the Ogun River was generally worshipped by the people who live along its banks from its rise until where it empties into the lagoon. The river ran through the heart of the old Oyo Empire. Metropolitan Oyo was divided into six provinces with three on the west side of the Ogun River and three to the river's east. At one time, the river formed an important route for traders carrying goods by canoe between Abeokuta and the Lagos Colony.

The dam was initiated by the military regime of General Olusegun Obasanjo and started in 1983 by the administration of Shehu Shagari. The dam was built in 1982/1983, but the work on the dam was abandoned by the subsequent military governments.

The Federal Government imported a complete set of dam turbines for Ikere Gorge Dam, through the Ogun-Osun River Basin Development Authority, to generate electricity, the plant is yet to be utilised for that purpose. The equipment brought in by the Shagari-led government to the dam were never installed. According to the knowledgeable sources, they had become obsolete and shall not be guaranteed so far .So redesigning of all the equipments is required as per the existing infrastructure and technical parameters.

The civil works contract was signed in November, 1980 for #35,861 million and executed by Roads Nigeria Limited while both the mechanical and electrical works were handled by Messers Noell (W.A) limited.

Like many other major projects across the country, the Ikere Gorge Dam was meant to provide relief in the power sector by generating electricity at least @ minimum 60% PLF against installed capacity.

The journey to Iseyin in Oyo State, from Lagos through Ibadan, is smooth until one gets to Isalu, a community within the ancient town. Then it turns to a nightmare. The reason is that between the community and the famous Ikere Gorge Dam lies a 33 kms stretch of bumpy and untarred road .The road leading to the dam is in a deplorable state from ISEYIN to IKERE GORGE DAM . The complex has the look of a small town tucked within the belly of a jungle. Although the road is bordered by shade trees, mostly cashew trees planted for commercial purposes by an agency of the Oyo State Government, the entire stretch is rough and riddled with potholes.

As the journey progresses, though tortuously, a vast and beautiful landscape marked by rolling hills and lush farmlands gradually unfolds. The atmosphere is calm and serene, yet it contrasts with the general mood of most of the people that are heading to their farms in small groups. Investigation shows that the road, which the residents describe as a Federal Government project, was originally built over 60 years ago by the people in order to transport their farm products. Today, it is one of the reasons why there appears to be intense anxiety among the residents of Iseyin and other communities surrounding the dam.

About 60 years ago, the Western Nigeria Development Corporation – perhaps with the assistance of the Federal Government – acquired the huge expanse of land surrounding the dam. The land amounted to thousands of hectares. The original owners of the land were forced to leave the area. The encroachment affected the communal life there and everything else, including the education of the people. In spite of this, they were not compensated in any way. As a result, the members of Isalu community in Iseyin, who were using the land for farming before government acquired it, are still unhappy."

The greater part of the people's complaints about the Ikere Gorge Dam appears to focus on the revival of the hydro power component of the dam's operations. Everybody knows that power generation is the engine room of any economy. If we had regular supply of electricity, investors would like to set up businesses here. This will in turn lead to the provision of jobs for thousands of unemployed youth .

3. PROJECT DESCRIPTION

GEOGRAPHY

Oyo state, which has as its capital Ibadan, the second largest indigenous city in Africa, is blessed with a lot of breath taking attractions centres that can catch the fancy of tourist. The dam is located in Iseyin Local Government, Oke Ogun region and has Owu reserve in its north-western part . Oyo State is located in the south West Region of Nigeria. Latitude 7 degree North and longitude 4 degree East bisect the state into four nearly equal parts. The State covers a total of 27,249 sq. km of landmass and is made up of 33 local governments. The topography of the state is one of gentle rolling lowland in the south, rising to a plateau 40 m and above in the north. The state is well drained with rivers flowing from the upland in the North/South direction. The major rivers are Ofiki, Ogun, Shasha, Oba, Opeki and Ogunpa flowing through Ibadan .

GEOLOGY

The geology of the study area can be described as a rock sequence that starts with the Precambrian Basement (Jones and Hockey, 1964); which consists of quartzites and biotitic schist, hornblende-biotite, granite and gneisses. The foliation and joints on these rocks control the course of the rivers, making them to form a trellis drainage pattern, particularly to the north of the study area. The sedimentary rock sequences are from Cretaceous to Recent; the oldest of them, the Abeokuta formation, consists of grey sand intercalated with brown to dark-grey clay. It is overlain by Ewekoro formation, which typically contains thick limestone layers at its base. About 9km upstream of Abeokuta town, there is a sharp change in land gradient thereby changing the river morphology from fast flowing to slow moving thereby leading to the formation of alluvial deposits overlying the sedimentary formation of Ewekoro, Ilaro and Coastal plain sands in sequence towards the Lagos Lagoon.

CLIMATE

The climate in Oyo state is equatorial notably with dry and wet seasons with relatively high humidity. The state landscape consist of old hard rocks and dome shaped hills which raise gently from about 500 m in the southern part and reaching a height of about 1,219 m above sea level in the northern parts.

VEGETATION

The vegetation is mostly evergreen forest where lumbering plantation farming of oil palm, cocoa etc. is encouraged.

TOURISM

The presence of tourist places with natural features in addition to traditional, cultural and geographical monument makes Oyo state irresistible to tourists. Examples of such attractions are the Ado-Awaye hills and suspended lakes, Iyanla hills, Asabiri hills, Iyamapo hill, old Oyo national park, Captain Bower's tower and Ikere gorge dam among others. Other interesting places are the mysterious Ajagbon tree in Ogbomoso town, which is reputed to be older than the town itself, Sogidi River a sacred river situated in Aawe, Agodi gardens, Trans amusement park and the zoological garden amongst others. The last three tourist centres mentioned above, namely the Agodi gardens, Trans amusement park and zoological garden all situated in Ibadan serve as recreational centers, play grounds and other sporting activities. Oyo state is also endowed with traditional industries that engage in black soap making, calabash carving at Akinyele local government area and cloth weaving at Iseyin and Ogbomoso towns.

PROJECT- OVERVIEW

The Ikere Dam with a very large volume of water has almost been wasting away for more than two decades. This regional development project which otherwise should facilitate the transformation of Oke Ogun region is not fully in operation. These helped in knowing the gap to be filled by this paper. The primary data were collected through reconnaissance survey and the administration of 250 questionnaires which

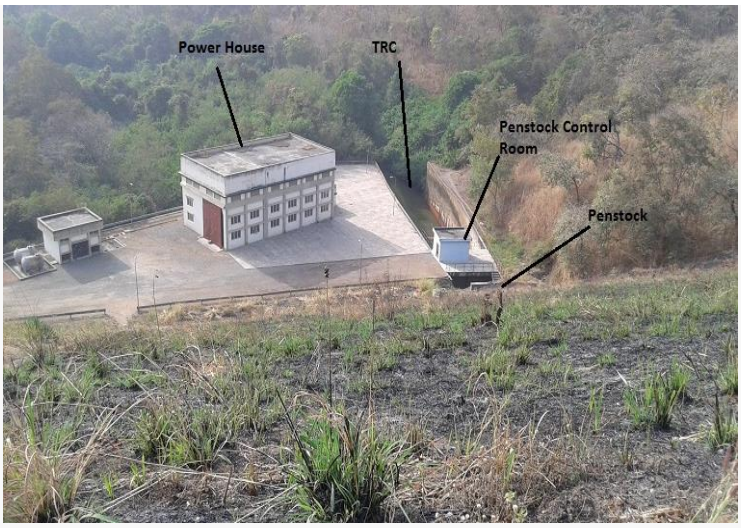
cover 50% of household population in the selected settlements. The methods of sampling were cluster and systematic samplings. Analysis and synthesis of data were carried out using descriptive and pictorial methods. The outcome of the various findings shows that crude method of fishing is being employed which affects production. Irrigation farming is largely inadequate.

The hydro electricity generation potential has not been tapped as there is no electricity power supply at Ikere and electricity power failure is common in the region as a whole. The hydro electricity generating potential should be tapped. It was concluded that fishing, tourism, irrigated farming and industrial potentials of Ikere Dam that could transform Oke Ogun region have not been fully explored. A lot of researches have been carried out by many scholars all over the world on the functions of Dams. New Energy Foundation, Japan (2006) stated the functions of Dams as supplying protein food, irrigation and demotic water supply, tourist attraction and health resorts, as well as generation of hydro of electric power.

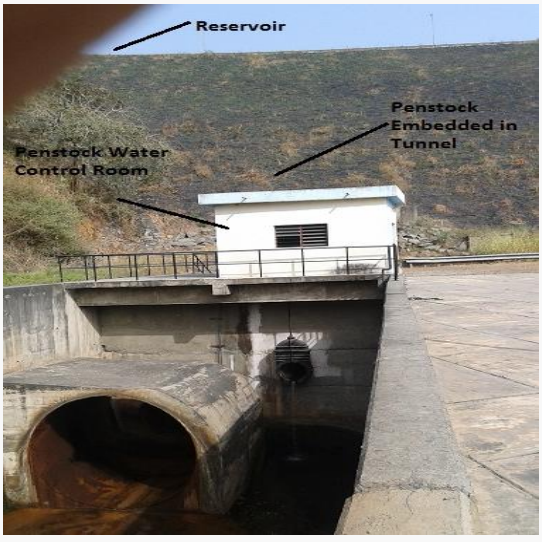
According to the Ogun River Basin Development Authority's (OORBDA) publication of March 1998 (5th Edition, page 50), as of December 31, 1997, civil works on the dam were 90 % completed while construction works on mechanical and electrical components stood at 100 % of completion.

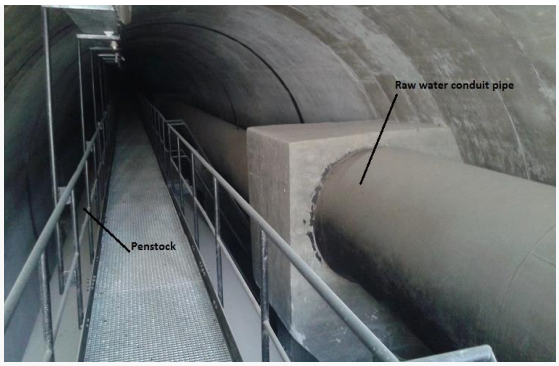
POWER HOUSE

The power house building has already constructed and E&M and HM equipments are required to be installed & commissioned. Existing power house infrastructure has provision of two numbers turbine sets of capacity 3 MW each . The power house building is very old and required to be clean .



PENSTOCK AND WATER CONTROL ROOM





TRANSMISSION LINE

Transmission line – Approx. length 30 kms , Single circuit on Concrete Poles as per TCN/NIPP specification

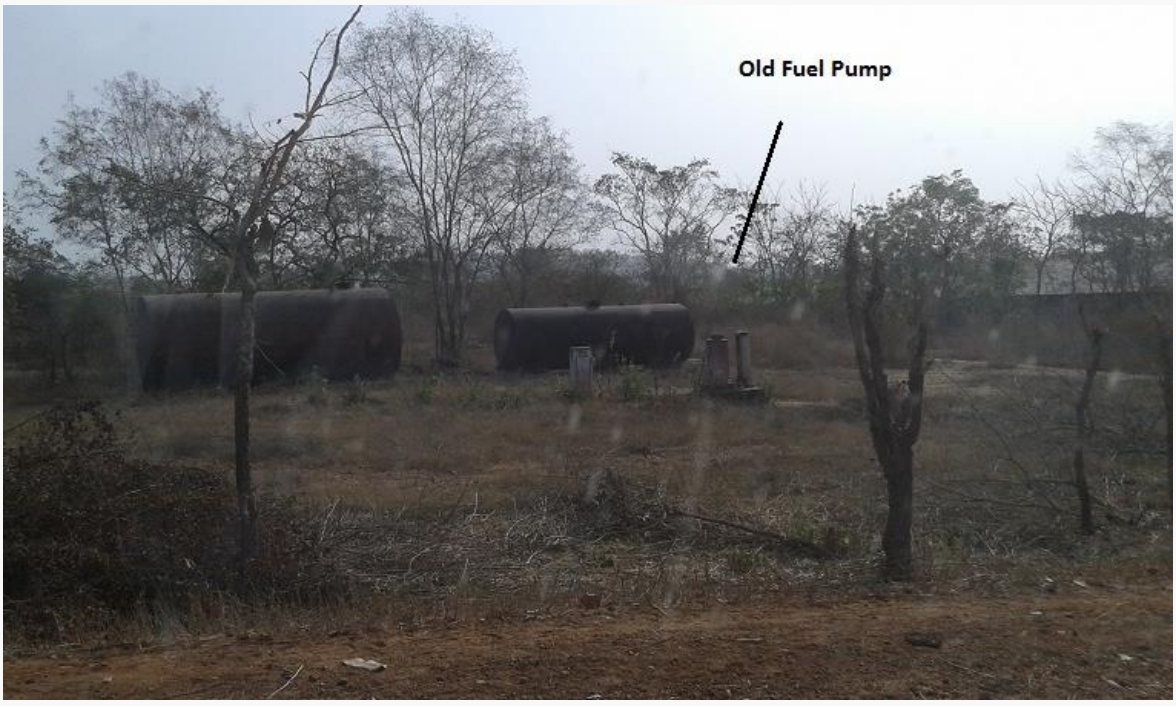
SPILLWAY

Spillway is located on the side of reservoir and when water level exceeds above 36 m, water has been pass out through spillway .

There are staff quarters as well as blocks of offices interspersed with farmlands but they are required to be reconstruct & furnish.

There is old workshop in project premises as well as old fuel pump but both are required to be reconstruct & furnish . The old work shop after rehabilitation may be

used for maintenance activities and fuel station can be again reconstruct / renovate and may be used for fuelling company vehicles inside the project premises.



OGUN RIVER

Ogun river basin can be divided into two parts; a high slope (average 15%) terrain marks the upper zone (section I) while the lower zone (section II) is of extremely low slope (< 1%) characterized by flooding with marshes and swamps. This study covers the lower part of Ogun river where the morphology of the river has entered the

mature state. The study was carried out on the site of Ajambata Floodplain irrigation project. The depths of rising floods were monitored throughout the year and the maximum depth (stage) was recorded. After recession, the depth of water in the river channel was monitored with the static depth of water in the tube-wells that were drilled on the site.

The upper section of the river continues to receive effluents from ground water thereby lowering the water levels in the vicinity, resulting in a loss of storage. This condition is maintained throughout the year, even during the dry season when there is no precipitation, the river discharge will be supported by discharges from the adjoining aquifer. The armoured riverbed is part of the impermeable layer . A survey was carried out on the river channel to locate, measure, and sample the pools that were formed during the dry season. This was done to assess and account for areas that can be classified as ecotone (habitats) and the hyporheic (river and groundwater ecosystems) zones. In the lower section where Ogun river channel flows through an alluvial plain that is the water table aquifer . This case is treated as a one-dimensional and transient groundwater flow problem (Polubarinova–Kochuna 1962), since the shape of the water table is a function of time. Darcy's equation of groundwater flow is applied with the earlier assumptions so as to take account of the water volumes moving into or discharged from the aquifers.

The flow nets analysis for upper and lower sections of Ogun river showed that there is considerable amount of groundwater flow. This study revealed an intricate groundwater flow pattern that is controlled by litho logical and structural factors that creates zone of surface and ground water interaction. These zones are often referred to as ecotone zones within the hypoheic ecosystems. Hence, the relations of aquifers in each zone along the river channel were identified based on pore space, fracture media and sediment materials deposited. Section I is characterized by groundwater discharge to the river from the adjoining aquifers while Section II is characterized by both the recharge into the aquifers and discharge from the aquifers at different period. The head in the aquifers relative to the elevation of the river surface determines whether the section of the river is gaining or losing water to groundwater at a particular time. The head of the water table in the aquifers must be

higher than the elevation of the river surface for groundwater to contribute to surface water. For surface water to enter into groundwater through the aquifers, the reverse must be the case. The effluent stream (gaining) condition is when the river receives groundwater discharge and the influent stream (losing) condition when the water table is lower that the river surface elevation. Isolated pools occur on the river beds during the dry season (December to April) and the ones located close to the river bank were observed to contain large quantities of aquatic flora and fauna. At this stage, Ogun river is in effluent condition so the flow is maintained by groundwater discharge. At a stage the influent condition is reached at the peak of the dry season when the pools even lose water into the ground. These pools have an average surface area of 52m2 and there are 11.3 pools per kilometre length of the river channel. Results from calculation revealed that about 11.5m3 of water is discharged per meter length from the aquifer into Ogun river channel.

As per OORBDA ,

Presently OGUN-OSHUN RIVER BASIN DEVELOPMENT AUTHORITY (OORBDA) is not under any legal commitment to the contractors as the contractor has completely demobilized from the site more than 20 years ago. No financial indebtedness to the contractors to date .

Components of hydro power project

a.Reservoir:

The function or purpose of reservoir is to store the water during rainy season and supply the same during dry season. This is in simple, water storage area.

b.Dam:

The function of dam is to increase the height of the water level (increase in the potential energy) behind it which ultimately increases the reservoir capacity. The dam also helps in increasing the working head of the power plant. Dams are generally built to provide necessary head to the power plant.

c.Trash Rack:

The water intake from the dam or from the forebay are provided with trash rack. The main function of trash rack is to prevent the entry of any debris which may damage the wicket gates and turbine runners or choke-up the nozzles of impulse turbine.

d.Forebay:

The function of forebay is to act as regulating reservoir temporarily storing water when the load on the plant is reduced and to provide water for initial increment of an increasing load while water in the canal is being accelerated. In many cases, the canal itself is large enough to absorb the flow variations. In short, forebay is naturally provided for storage of water to absorb any flow variations if exist. This can be considered as naturally provided surge tank as it does the function of the surge tank.

e.Spillway :-

The function of spillway is to provide safety of the dam and discharging surplus water and maintain the level as per requirement .

f.Surge Shaft or Surge tank :-

The main function of surge tank is to reduce the water hammering effect. When there is a sudden increase of pressure in the penstock which can be due to sudden decrease in the load or load loss conditions . This sudden decrease in load or load loss causes turbine blades to close immediately resulting sudden rise of water in the penstock . In order to protect the penstock from these water hammering effects, surge tank is used in hydroelectric power station.

g.Disilting chamber :-

It is installed in the system for the purpose of removing objectionable solid material and to prevent silt to prevent deposits in the channel and thus stopped them to reach at turbine . The speed of water is slow in order to prevent damaged to concrete .

h.Penstock :-

It is enclosed pipe system that delivered water to hydro turbines. The water in penstock possess K.E due to its motion and P.E due to its height . The total amount

of energy or power generated depends upon the water flowing in the penstock which is controlled by the control gates.

i. Draft tube:

The draft tube is a part of the reaction turbine. The draft tube is a diverging discharge passage connecting the running with tailrace. It is shaped to decelerate the flow with a minimum loss so that the remaining kinetic energy of the water coming out of the runner is efficiently regained by converting into suction head., thereby increasing the total pressure difference on the runner. This regain of kinetic energy of the water coming out from the reaction turbine is the primary function of the draft tube.

4. PROJECT OBJECTIVES

1. Generate 6MW of electricity for dam operation and rural electrification.
2. Supply 233 mcm (million cubic meter) irrigation water to the 12000 ha. Middle Ogun Irrigation project, out of which 3000 ha. (Phase-1) is currently being developed.
3. Supply 92 mcm of raw water to the water compacts of Oyo state for treatment and distribution to Iseyin , Okeho,Iganna and environs .
4. Supply raw 80 mcm water to Lagos state water corporation for treatment and consumption with in the lagos municipality.
5. Promote fish farming in the dam reservoir and
6. Promote tourism and recreational activities.

5. STRATEGIC NEEDS ANALYSIS WITH DETAIL BOQ & IMPLEMENTATION PLAN

The civil works contract was signed in November, 1980 for #35,861 million and executed by Roads Nigeria Limited while both the electrical & mechanical works were handled by Messers Noell (W.A) limited. Assessment of the works on the dam presently according to OORBDA (1998) shows that the civil works are 99.0% completed. However Mechanical & Electrical works are still pending except installation of Penstock and raw water conduit pipe .

1. **Redesigning** of the electro-mechanical equipments (Turbine, Generator, Transformer , Switchyard) as per existing infrastructure.
2. **Electrical works** – Not completed (supply of equipments , Installation ,Erection & Commissioning) is pending
3. **Transmission Line 33 KV**- Not completed feeding power to National Grid - Only installation of poles has done (approx. Line length – 30 kms), complete erection of 33 KV line equipments with sag of conductor is pending .
4. **Mechanical works** – Only installation of Penstock & raw water pipe has completed . But Complete supply of all mechanical equipments and there installation , erection and commissioning is still pending

COMPLETION REQUIREMENT

APPENDIX-1

Scope of TG Supply

Sl.no.	Particulars	unit	Qty.
1	**Turbine**		
A	Vertical Francis Turbine, diameter as per existing infrastructure , 500 rpm	Nos.	2
2	**Turbine Auxiliaries:**		
A	Oil Pumping System	Nos.	2
B	Cooling water system	Nos.	2
C	Drainage & Dewatering system	Set	1
3	**Main Inlet Valve**		
A	Inlet valve 1500 mm Butterfly Valve, 40 meter head	Nos.	2
4	**Generator Auxiliaries**		
A	Synchronous Generator 4000 KW , Brushless Excitation system	Nos.	2
B	Lubrication System	Nos.	2
5	**Protection & control panels.**		
A	PLC Based Governor cum Turbine with AVR Panel	Nos.	2

Scope Balance of Plant:

Sl.no.	Particulars	unit	Qty.
1	AC Distribution and MCC panel	No.	1
2	Indoor Power Panels		
a	Generator Neutral Cubicle (NGT Panel)	Nos.	2
b	Generator Leads Cubicle (CTVT Panel)	Nos.	2
c	Protection & Synchronizing	Nos.	2
3	Out Door equipment		
a	Main Transformer -4200 KVA ONAN, 11/33 KV, 50 Hz, Ynd11 Step up Transformer with Off Circuit tap Changer ± 2 x 2.5%	Nos.	2
c	Auxiliary Transformer - 100 KVA ONAN, 11/0.415 KV, 50 Hz, Ynd11 Step up Transformer with Off Circuit tap Changer ± 2 x 2.5%	No	1
4	**33 kV Indoor Metal enclosed switch gear comprising of the following:**		
a	33 kV Generator Transformer breaker panel with protection relays and Metering	Set	2
b	33 kV Incomer breaker panel with protection relays and Metering	Set	1
c	33 kV Isolator switch	Set	1
d	33 KV Metering cubicle	Set	1
10	**DC SYSTEM**		
a	110 Volts, 240 Ah VRLA Maintenance free Battery.	set	1
b	Battery Charger + DC Distribution board	set	1
11	**Cables**		

a	HT Copper Power Cable	Set	1
b	LT Power Cables		
c	Control Cables		
d	Instrumentation Cables		
e	Cable trays		

Appendix-2

Schedules of Spares

Sl No.	Item of Spare	Quantity
A	**TURBINE**	
1.	Guide vanes	1 Set (4 Nos.)
2.	Shaft seal packing	1 Set
3.	Shaft Sleeves	1 Set
4.	Piston Rings for servo motor cylinders	1 Set
5.	Packing and sealings, all type and sizes	1 Set
6.	Bushes / bearings for regulating mechanism	1 Set
B.	**Pressure oil system**	
a.	Oil pump for pressure oil supply	1 No.
b.	Seals/packings (all type)	1 Set
c.	Filters	1 No. Each
d.	Solenoids coils	2 Nos. of Each type
e.	Pressure switches	2 Nos.
g.	Valve	1 No. Of each type
C.	**PLC Based governor panel**	

Sl No.	Item of Spare	Quantity
a.	Digital input card	1 No
b.	Digital Out put card	1 No.
c.	Analogue input card	1 No.
d.	a. Contactors – 1 no of each type b. Fuses – 1 no of each type c. Auxiliary relay (Change over type)– 1 no of each	1 Set
e.	Guide vane position transducer	1 No
f.	Speed sensor probe	1 No
D.	**GENERATOR**	
a.	Brake liners	1 set (if applicable)
b.	RTDs	1 No. of each type
c.	Dial thermometers	2 Nos.
d.	Excitation Spares of following a. Contactors – 1 no of each type b. Fuses – 1 no of each type	1 Set
E.	**TRANSFROMER AND LINE, PROTECTION & METERING PANELS**	
a.	Bulbs / fuses	20% of Population
b.	Lockout Relay (Master trip relay)	1 No.
C.	TNC –Switch	1 No
F.	**COOLING WATER SYSTEM**	
a.	Flow meter	1 No
b.	Valve	1 No.
G.	**11 kV Breaker panel**	

Sl No.	Item of Spare	Quantity
a.	Closing and tripping coils	2 Nos each

Appendix-3

List of Mandatory Maintenance Tools and Plants:

Sl. No.	Description	Quantity
1	5000V range Digital megger	1 No.
2	Tong tester 0-1000 A clip on volt-meter and ammeter	1 No.
3	Digital Multi meter	1 No.
4	Hand held type phase sequence meter 50 to 500 V	1 No.
5	Blower	1 No.
6	Soldering iron	1 No.
7	Hand held speedometer	1 No.
8	Vernier callipers 300 mm	1 No.
9	Dial guage with magnetic base 0 .01 mm accuracy	3 Nos.
10	Micrometer	1 No.
11	Inside & Outside calipers	1 No. each
12	Ring spanners & Double end open jaw spanner 5 mm to 36 mm set 36 x 41, 46 x 51 & 50 x 55 m size	1 Set each
13	Single end open Jaw & Single end ring spanners 46, 50, 51 and 55 mm	1 No. each
14	Box spanners 10 to 32 mm with accessories	1 Set
15	Circlip opener (inside & outside) 6”	1 No. each

16	Hammers-Ball peen 1 Kg and Straight - 5 KG & 10 Kg	1 No. each
17	Pistol drilling machine	1 No.
18	Shim cutter 12" size	1 No.
19	Pipe wrench 18", 24"	1 No. each
20	Screw wrench 18", 24"	1 No. each
21	Allen keys 5 mm to 24mm	1 Set
22	Cutting pliers 6" & 8" size	1 No. each
23	Nose pliers 6" & 8" size	1 No. each
24	Hacksaw frame 12"	1 No.
25	Rough & smooth flat, round, half round and triangular file 12" size	1 No. each
26	Centre punch & letter punch	1 No. each
27	Chisels 4",6",8" and 12"	1 Set
28	Bench vice 12" size	1 No.
29	Screw drivers 6", 9", 16"	1 Set
30	Wire slings 5 and 10 ton capacity	4 Nos. each
31	"D" Shackles 5 and 10 ton capacity	4 Nos. each
32	Feeler gauge 0.05 mm to 1 mm size 6", 18"	1 Set each
33	Master level :-Accuracy 0.02 / meter ,Length Range 0-150 mm.	1 No.

Appendix-4

Description of Vertical Francis Turbine

Our scope of supply covers **Horizontal Shaft Francis turbines** to generate rated output as specified in the technical particulars. The Set of turbine comprises of the following.

ONE: Runner integrally cast/welded in stainless steel (13% Chromium, 4% Nickel CA6NM). The runner will be mounted on the Generator shaft. Adequate numbers of relief holes are provided for reducing the axial thrust

ONE : Sealing Box comprising of labyrinth type seal with white metal lining. Suitable arrangement for drainage of leakage water is provided.

ONE : Spiral Casing, The material used is mild steel, ASTM A36 Grade. It is of volute type complete with stay-ring and sufficient number of stay vanes. The stay-ring besides guiding the flow into guide vanes, gives structural rigidity to the spiral casing against the hydraulic forces.

ONE : Front Cover of welded plate/mild steel flanged to the spiral casing. Required number of bushes for support of the guide vane pivots will be provided.

ONE : Rear Cover of welded plate/mild steel flanged to the spiral casing. Required numbers of bearing housings with bushes for support of guide vane stems are provided. The guide vane stems on this rear cover side are assembled to the operating mechanism.

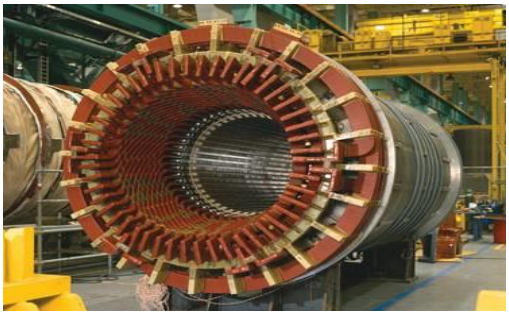
ONE : Guide Vane Operating Mechanism comprising of levers, links, servo lever connected to the hydraulic servomotor for the regulation of flow.

ONE : Draft Tube of diffuser type for pressure recovery and discharging water into the tail race. The material used is mild steel, ASTM A36 Grade.

Description of Generator and Auxiliaries

Horizontal Synchronous Generator, Brushless Excitation with Digital AVR each comprising of:

STATOR



Stator Frame

The stator frame is made of Welded Steel Construction and has adequate thickness to prevent distortion under operation. The frame size and construction features will be as per generator standard practice

Stator Core

The stator core is built-up of thin, high quality, low loss non-oriented grains, cold rolled Silicon steel Laminations. Each punching is carefully deburred and laminations are insulated on both sides with high quality insulating varnish to minimize eddy current losses.

Ventilation ducts are provided at intervals along the stator core, being formed by means of steel spacing bars securely welded to adjacent punching.

Stator Winding

The stator winding has class "F" insulation system. The stator winding is of multi-turn type, insulated throughout with epoxy resin, mica paper tape and glass tape insulation system.

Each coil is made up of number of strands of glass braided copper of electrolytic quality, and of rectangular cross section, to minimize eddy current loses. The coils are provided with class " F" epoxy resin, mica paper tape and glass tape insulation.

The whole stator is Vacuum Pressure Impregnated (VPI).

After the impregnation and curing process, the whole unit forms a rigidly supported fully consolidated, void free winding. The resin fills all the voids in the stator winding and results in better heat transfer from conductor to stator core.

Terminal Arrangement

The three main leads and three neutral leads of the generator windings are brought out of the stator frame, in two separate Terminal Boxes.

The Phase and Neutral end of the windings are brought out with suitable insulating enclosure where they pass through the generator housing.

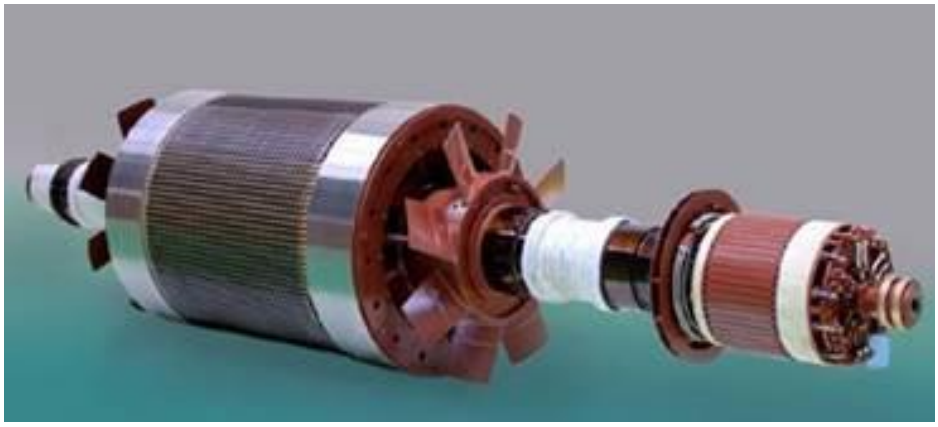
Cooling System

The generator is natural air cooled, rotor radial fan / axial fans is / are designed to give a smooth and quiet flow of air, Air is drawn from one / both End and Discharged at the other end / top of the machine, combined action of rotor poles and fans are sufficient to extract the heat generated in the generator

Temperature Detectors

Resistance type temperature detectors of simplex / duplex type are arranged symmetrically in the stator winding to indicate the temperature obtained during operation. An Auxiliary Terminal box having suitable terminal blocks are mounted on the generator frame to terminate the resistor element connections. The temperature detectors leads are kept flexible to facilitate disconnecting them without breakage.

Rotor Core



The Rotor Core is made up Rotor Stampings; skip notched to form cylindrical poles, directly stacked on to the rotor shaft.

The dynamic balancing of the complete rotor is carried out at plant to keep values of rotor vibrations within allowable limits.

Shaft

The generator shaft is made of a high quality medium carbon steel, properly heat treated and accurately machined all over and polished at the bearing surfaces and at all accessible points for alignment checks.

A complete set of test reports covering metallurgical strength, & ultrasonic tests performed on each shaft will be furnished.

Salient / Cylindrical Poles with Field Windings

The Salient / cylindrical poles are provided with adequate damper windings to improve stability under fault conditions, to reduce voltage distortions under conditions of single phase to ground fault.

Field Winding

The field winding is Multi-layer type, insulated with class "F" insulation and consists of copper strips formed into concentric winding.

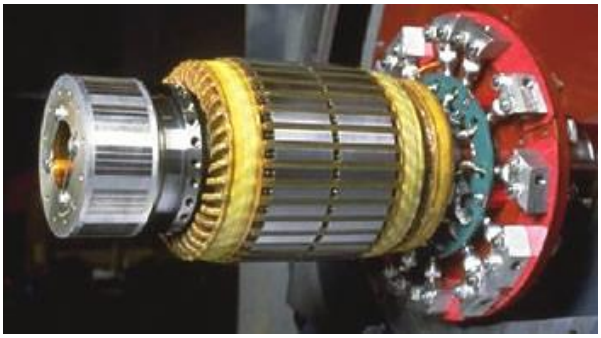
Balancing

All rotating parts of the generator unit shall be well balanced dynamically so as to run perfectly true, smoothly and within vibration limits specified and provision is made for readily and effectively compensating any out of balance that may occur upon erection at site or subsequently.

Bearing

Antifriction / sleeve bearing will be provided as per the manufacturer design either pedestal or end sleeve type.

Brushless Excitation System



Brushless excitation system for generators consists of an A.C. exciter, rotating high power silicon diodes.

The A.C. exciter is a 3-phase alternator. The A.C. generated on the rotor is fed to the rectifier system which is also mounted on the rotor itself. Thus, D.C. voltage is available which is directly fed to the generator field. For the purpose of making the assembly simpler and compact the A.C. exciter, the rectifier system and the protection system devices are mounted on the same shaft of the synchronous generator and it is placed on the overhang portion of the non-driving end bearing.

The DC voltage of exciter stator will be fed from excitation panel placed in control room. The following are the features of excitation panel (Automatic Voltage Regulator – AVR)

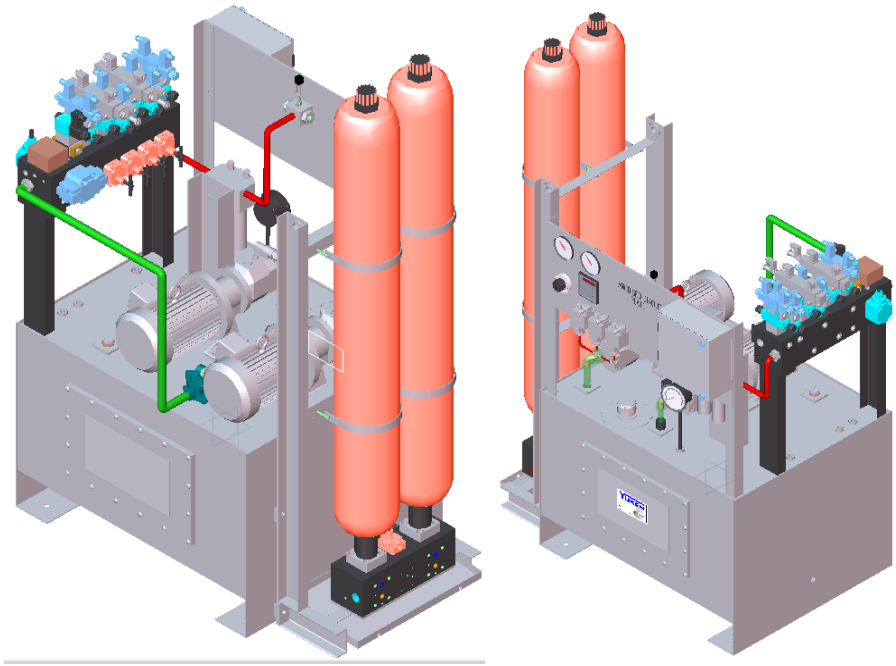
- Auto channel – 1 No.
- Manual channel – 1 No.
- Compounding for parallel operation.
- Follow up to match Auto and Manual channel out-put.
- Auto over fluxing feature.
- Under / over excitation protection.
- Under excited MVAR limiter.
- Power factor controller.

- Auto control on push-button.
- Manual control on push-button.
- Lamp test push-button.
- Auto voltage Raise / Lower push-button.
- Manual voltage Raise / Lower push-button.
- Excitation ON push-button.
- Excitation OFF push-button.
- Auto / Manual OFF push-button.
- Excitation ON / OFF Mode (Auto / Manual) Selector switch.

Description of Turbine Auxiliaries

Our scope of supply covers one set of turbine auxiliaries comprises of the following:

a. PRESSURE OIL SYSTEM – One Per Unit



Informative Image

The pressure oil system will be used for opening/closing of guide vane, butterfly valve application.

The hydraulic control system consists of: -

a) Hydraulic oil supply system including oil tank.

b) One normal running pumping unit with AC motor and starter.

c) One standby pumping unit with AC motor and starter.

d) Nitrogen Cylinder Pressure Accumulator.

e) One set of hydraulic control elements including pressure sensors, pressure gauges, relief valve, level valve, filters & control valves/emergency valves.

f) One set of direction control valves operated by solenoid coils for Guide Vanes, TIV through local control panel with a provision of local control

g) One set of control Valves for Guide Vane operation.

h) All inter-connecting piping between the hydraulic oil system and servo motor of Guide vane and TIV by seamless pipes.
Set of supports and clamps for the piping.

b. COOLING WATER SYSTEM. If applicable (Water cooled or Air cooled)

Cooling water system is been envisage for generator bearing oil coolers as applicable.

The tapping of the cooling water will be from draft tube/tail race pond/ penstock.

Water cooling system shall comprise of the following:

a) Design of the cooling water system shall be such that one pump can meet the requirements of cooling water for the unit.

b) Two Nos. of pumps complete with motors, base plates and starters will be provided.

c) Required numbers of flow meter for critical flow circuits will be provided.

d) Required number of strainers will be provided

e) Required no. of valves ,gauges etc will be provided

f) ERW-MS pipes, flanges, gaskets, seals for interconnection of equipments- will be provided

g) Support structures along with clamps for cooling water pipe line will be provided

Air cooling system shall comprise of the following:

A) Radiator and fans in the Lub Oil System

b) Blower Fan inlet and outlet

c) Radiator Fan motor.

Description of Main Inlet Valve

Our Scope of supply covers Butterfly valve of suitable diameter which is opened by oil pressure and closed by dead weight.

The Butterfly Valve comprises of :

ONE: Flanged body fabricated in steel plate. Upstream flange is bolted to penstock and downstream flange is bolted to spiral casing of turbine.

ONE: Fabricated / Cast disc, streamlined for minimum head loss . Disc proportions are designed for optimum deflection which assists in sealing.

TWO: Shafts of forged carbon steel keyed to the disc through suitable pins and generously designed for transmitting maximum operating output torque.

ONE: set of 'O-rings on shaft function as seals.

ONE: Resilient rubber seal in conjunction with stainless steel seat ring . Seat ring is accurately machined integral with body to ensure long operating seal life.

ONE: Clamping ring in segments to clamp rubber seal to disc for uniform seal setting.

ONE: Oil operated servomotor to open the disc.

ONE: Dead weight with lever to close BFV in a fool proof manner under all conditions of operation

ONE: Set of self-lubricated bearings with thrust pad on non-drive end shaft to take the loads on disc

ONE: Set of bypass arrangement with one electrically operated gate valve, one manually operated guard valve, elbows and related hard wares

Note: We have considered upstream matching piece of 200 mm length pipe.

GENERATOR BEARING LUBRICATION SYSTEM – 1 set/ unit. (if applicable)

Lubrication oil supply system will be for generator bearing. The system comprise of following equipment's.

a. One normal running pumping unit with AC motor with starter located in control room.
b. One standby pumping unit with AC motor and starter located in

control room.

c. One emergency standby pump with DC motor and starter located in control room
d. One set of control elements including Flow indicator, pressure gauges, relief valve, filters & control valves.
e. One set of heat exchanger.
f. All inter-connecting piping by MS pipes between the bearing and Lubrication oil system
g. Set of supports and clamps for the piping.

d) WATER LEVEL MONITORING SYSTEM – 1 set / Project

The water level measuring equipment's will be installed at intake (Fore bay).

The output signal will be connected to PLC for level measurement. Interconnection cables with amplifiers shall be provided by customer.

Description of Power Transformer

Our scope of supply includes Step-up transformer. oil immersed (ONAN), Natural Oil cooled/Natural air cooled, core type transformers, double wound and arranged for star / delta connection as per vector group reference Ynd11.

The transformers will be contained in mild steel tank with cooling radiators, confirming to IEC 60076

Off Load Tap changer with will be provided on HV side of the Transformers.

Transformers will be supplied with the first fill of transformer oil:

01.	Conservator drain Valve	1 No.
02.	Dehydrating breather	1 No.
03.	Buchholz relay	1 No.
04.	Standard marshalling box with Oil Temperature Indicator + Winding temperature Indicator contacts	1 No.
05.	Winding temperature Indicator with Alarm + Trip	1 No.
06.	Oil Temperature Indicator with Alarm & Trip	1 No.
07.	Off Load Tap changer	1 No.
08.	Plain Oil Level gauge (POG)	1 No.
09.	Rating and diagram plate	1 No.
10.	Drain Valve	1 No.
11.	Double diaphragm explosion vent with sight glass	1 No.
12.	Bi-directional flat rollers	4 Nos.
13.	Detachable radiators	1 Set
14.	Radiator butterfly valve	8 Nos.
15.	Epoxy paint on transformer	--
16.	Top & Bottom filter Valve	
17.	Lifting lugs	
18.	Shut off valve for Buchholz relay	
19.	Magnetic oil level gauge	
20. a)	HV Terminals : 3 Nos., 34.5 kV Bushings suitable for cable connection	
20 b)	LV Terminals :6.3 kV Bushings suitable for cable connection	

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Description of AC STATION SERVICE BOARD (LTAC PANEL)

One set AC Station service Main Board (LTAC Panel) and one set Auxiliary Distribution board

INCOMING FEEDERS: -

1 No. Incoming feeders for Aux. transformers Three Poles, each comprising of:

- 1 No. Electrically operated MCCB
- 1 Set. Indicating lamps
- 3 Nos. Current Transformer
  - Core – 1: Metering
  - Core – 2: Protection
- 1 No. Integrated indicating digital multifunction meter to indicate voltage, current, kW & kWh
- 1 No. Over Current & Earth Fault Relay (51/51N)

1 No. Incoming feeder for DG Set incomer, three poles, comprising of:

- 1 No. Electrically operated MCCB
- 2 Set. Indicating lamps
- 3 Nos. Current Transformer
  - Core – 1: Metering
  - Core – 2: Protection
- 1 No. Integrated indicating digital multifunction meter to indicate voltage, current, kW & kWh
- 1 No. Over Current & Earth Fault Relay (51/51N)

OUTGOING FEEDERS: -

a) 1 Set MPCB for motor control and station auxiliary control for BFL supplied equipment's is considered.
b) The distribution feeders and MCC will be of fixed type for Panels and BFL supplied equipment's

Description of DC POWER SUPPLY SYSTEM

Battery:

One Set sealed battery bank unit of 55 cells closed top cells of specified capacity.

- Stand insulators.
- Other miscellaneous items & accessories.

Battery Charger (Rectifier Unit)

One number Float cum boost charger operating on Three/Single Phase, AC, 50 Hz, AC supply of solid state design to charge the battery. The operation of the charger shall be auto. Normally, float charger will be feeding the load and charging battery. In case battery requires boost charging the same shall be done by auto change over.

The rectifier will have following.

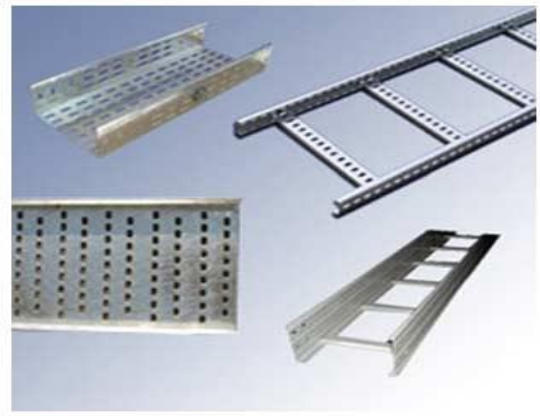
1 No. A.C Volt meter.
2 Nos.D.C. Ammeter
2 Nos.D.C Volt mètre.
1 No. Centre zero DC Ammeter for battery.
1 No. AC Main supply failure relay
1 No. AC Main supply Under/over voltage relay
1 No. SCR Fuse failure relay
1 No. Rectifier fuse failure relay
1 No. Charger failure relay
1 No. Battery earth fault relay
1 No. Over load Relay
1 No. Auxiliary Relay
1 No. FCBC Fail
1 Set Indicator
1 Set miscellaneous accessories

DC Distribution:

1 No. : 32 Amps, 3 kA/1sec.DC distribution board (with Aluminium busbars) as an integral part of charger comprising of:

1 No.: Incomer
10 Nos: outgoing Miniature Circuit Breakers (MCB's) feeders.
1 No: Emergency lighting MCB

Description of Power, Control Cable and cable accessories



Our scope includes power cables, control cables, cable trays and cable accessories.

The cables supplied will be provided to meet system requirement. The cables used will have appropriate class of insulation and material will be as per latest industrial standards. The Cables will be laid on fabricated trays in power house/switchyard.

The detailed description and scope of supply shall be as follows:

HT Power Cables

1) 6.3 kV (UE) grade and 34.5 kV (E), XLPE armoured, Copper conductor for inter connection between BFL supplied panels

LT Power Cables

1) 600V grade, 3 ½ core, PVC insulated, Copper conductor for connecting secondary of Auxiliary Transformers LTAC Distribution Panel in Power House.
2) 600V grade, 3 ½ core, PVC insulated, Copper conductor for connecting DG Set to LTAC Distribution Panel in Power House.

Control Cables

Various control cables used shall be copper conductor, PVC insulated, 0.6 kV, armoured cables of suitable sizes and length. The wiring cable size is CT & PT circuit 2.5 sq mm and 1.5 sq mm for control circuit.

Instrumentation Cables

4C x 1 mm^2 copper, screened cables for Governor circuiting shall be provided of suitable lengths. 0.5 sq mm for PLC digital inputs

Cable Terminations Kits and Other Accessories

All the power cables will be terminated with heat shrink type termination kits.

All the Power cables and control cables will be provided with suitable size glands and suitable sized lugs. Cable ties, clamps and ferrules will be supplied as required.

PLC based Electronic Governor

Power house will be provided with the PLC based Governor. The Governor is suitable for Horizontal Francis turbine with all necessary electrical and electronic feedback is provided for proper operation of the Governor.

The provided governor is capable of operating in the following control modes

a. Speed control mode
b. Load control mode.
c. Water level control Mode.

6. PPP OPTIONS & ANALYSIS

PPP includes a wide range of contractual arrangements between the public and private sectors.

In general, there are three features:

• PPP combines the design, construction (or rehabilitation) of public infrastructure with its maintenance—and sometimes with the delivery of the service directly to the user. The transfer of responsibility for design, construction, and maintenance to the private contractor provides an incentive to minimise the whole life costs of the infrastructure service;

• The contract requirements are defined as outputs and service standards to be met, rather than inputs (such as exactly how the infrastructure should be designed and built). So, for example, a road contract might specify the quality of the road surface, its traffic capacity,

safety standards, other environmental standards, and so on. It does not need to specify exactly how the road is to be constructed. Contractors will be able to propose their own designs and construction methods—although the roads procuring authority will need to be satisfied that the proposals are consistent with its own standards. This means that the private contractor can be innovative in its approach. But the contractor will also need to take into account the need to provide maintenance to ensure that the infrastructure continues to perform as required over the entire period of the contract;

•Payments to the contractor (or revenues from user charges in the case of a concession) are linked to meeting the specified standards of performance. If the quality of service falls below the required level, payment will be reduced accordingly. This gives the public authority the ability to enforce the contract effectively and the private contractor a strong incentive to perform. It also means that payments do not commence until the service is provided, and that design and construction is financed by the contractor. The cost of this financing is recovered from service charges (and/or user charges) over the remainder of the contract period. This method of payment provides a strong incentive to the contractor to complete the construction phase and provide the service as quickly as possible so that payments can commence. It also means that the contractor needs to continue to provide

the service throughout the contract term in order to recover all of the financing costs. In effect, the public authority leases the asset (or grants the right to exploit it in the case of a concession), and transfers the responsibilities and risks of ownership to the private contractor.

Value for Money

Achieving the best value for money outcome in public services is the key consideration at all stages of a project's development and procurement. The project appraisal will take account not only of cost but also risks and service quality. The Government will test value for money by comparing the costs at net present value of PPP proposals against a value for money benchmark wherever possible (see the Supplementary Note on value for money). The benchmark will usually be an estimate of the costs of providing an equivalent service through public finance. Bids will only be invited when it is clear that there is scope for a private proponent to deliver value for money and the cost of the service payments are affordable to both government and

Public interest

Consideration of the public interest requires that:

- Public authorities should ensure adequate consultation with end-users and other stakeholders prior to the initiation of an infrastructure project;
- private sector participants in a PPP project will contribute to strategies for Communicating and consulting with the general public, customers, affected communities, and corporate stakeholders, with a view to developing mutual acceptance and understanding of the

Objectives of the public and private parties

- Private sector contractors in the provision of vital services to communities need to Be mindful of the consequences of their actions for those communities and work, Together with the public authorities, to avoid or mitigate socially unacceptable outcomes.

Risk Allocation

The principle that the Government will follow in allocating risks will be to optimise, rather than maximise, the transfer of project risks to the private contractor. This means that, in practice, risks will be allocated to the party best able to manage them. The allocation of risk will therefore determine the chosen method of private sector involvement and allocation of responsibilities, which will in turn be based on an assessment of the public interest.

Output Requirements

The formal agreement between the public authority and the private contractor will be specified in terms of verifiable service standards to be provided on the basis of output or performance based specifications. It will contain provisions regarding responsibilities and allocations of risk in the case of unforeseen events.

Transparency

Transparency and openness are requirements of all government procurement, including PPP projects:

• Fiscal discipline and transparency must be safeguarded and the potential public finance implications of sharing responsibilities for infrastructure with the private sector fully understood;

• a sound enabling environment for infrastructure investment—which implies high standards of public and corporate governance, transparency and the rule of law, including protection of property and contractual rights—will be put in place to encourage the participation of the private sector;

• public authorities will take effective measures to ensure public and private sector integrity and accountability and establish appropriate procedures to deter, detect, and penalise corruption;

• the awarding of infrastructure contracts or concessions will be designed to guarantee procedural fairness, non-discrimination, and transparency;

• private sector participants, their sub-contractors and representatives will not resort to bribery and other irregular practices, gain control over assets to gain an unfair advantage, or attempt to win favours. Nor should they be party to these practices in the course of their infrastructure operations. They will observe commonly agreed

principles and standards of responsible business conduct. They will participate in infrastructure projects in good faith and fulfil their contracted commitments.

Private Sector Participants in PPP

Most PPP projects require a range of skills, expertise, or resources not normally found in a single company. A number of different specialist firms will therefore collaborate to bid for the projects (without necessarily forming a formal joint venture at this stage). They will often include contractors and other construction specialists, but may include designers, or firms specialised in providing operations or services in the sector. If they are successful in winning the bid they may form a joint venture company if the project is to be contractor financed, or a Special Purpose Vehicle (SPV) if project finance is to be used. The SPV is created solely for the purposes of the project, with the members of the consortium providing equity finance and holding shares in the company. The major part of the finance will be provided by third party investors such as banks, and the financing agreements will allow these investors first call over the project revenues for the repayment of the financing, including interest charges. Although these third party investors are not shareholders, they have a strong interest in the success of the project, because if it were to fail they could lose a substantial part of their investment. Another participant in the process of bidding for PPP projects may be equity funds. These are groups of investors who have pooled their capital under a fund manager and who specialise in providing additional equity to these types of projects and assisting in the preparation of bids and managing the SPV and its contractual relationships. They have a high appetite for risk and will normally look to sell off their interest in the project once the facilities created under the contract are operational. They can provide a useful role in providing risk capital, since senior lenders will only provide typically 80%3 of the capital requirement. Even large construction companies will have limited amounts of equity to invest in any one project vehicle. Equity funds may also bring expertise from other projects or countries. A number of funds have already been established with an interest in the Nigerian infrastructure market. Multilateral agencies, such as the World Bank, can have an important role to play in these types of projects

because they provide access to relatively low cost finance and possibly other financial instruments such as partial risk guarantees. These provide insurance against default by the government, thus reducing the cost of third party finance. The involvement of multilateral agencies in the project financing can also provide reassurance to other investors that the project will not be subject to arbitrary political interference. Projects may be partially financed by donor grants or other aid. However such aid should be channelled directly to the procuring authority to offset some of the costs of the contract, including any user subsidies, and not used to finance the contractor. Aid to government that is tied to a particular national supplier providing some or all of the services under the contract, or offset against other agreements in favour of the donor, cannot be part of this procurement since it would not create a level playing field for other bidders4. Participants in the bidding process must be commercial companies or partnerships operating under the relevant laws of their country of registration and with a good technical and financial track record. A bidding consortium may appoint independent legal and financial advisers who will prepare the necessary bid documentation, such as a financial model, and advise on contractual negotiations with the Authority as well as drafting of agreements between the consortium members, sub contractors, and lenders. The financial advisers will also advise on the lowest cost financing structure and the likely terms of that financing. During the later stages of the procurement, the consortium may appoint an insurance adviser and an arranger for the finance. The lenders will arrange independent technical and legal advisers to carry out due diligence on the Preferred Bidder's financial and technical proposal and the agreed risk allocation between the contractor and the Authority, and between the SPV, its subcontractors, and insurers.

7. Benefits

The benefits derivable from this project are enormous and cannot be quantified in economic terms only. The comfort and social developments associated with regular and uninterrupted power supply makes it a laudable venture

8. Economic Impact / Analyses

The conceptual undertone of this paper is one economic development dualism concept. Economic development is a process that transforms a stagnant society with a low average real income into one in which income rises more or less continuously as technology embodied in accumulating capital (Harvery, 1993). It is a process of growth pertaining to the production, distribution, use of income, wealth and commodities and entails full employment of the resources of the region on the long run for the improvement of the standard of living of the people. It is important to note that economic development in any society is the manifestation of its economic growth. This could be measured according to Kayode (2002), in six ways; Increase in the flow of total economic output Rise in output per head or per worker Increase in personal welfare. Change in economic structure ϖ Increase in consumption per head. Hydro power dams have made significant contribution to the economy of Nigeria , particularly in the following areas

- Hydro Power Generation
- Agriculture production through Irrigation

Less than 20 million people out of approx. 130 million Nigerian have access to electricity supply. With the possibility of Ikere Gorge dam construction and power generation , it is expected to contribute in national economy.

A series of changes in the stages of structural configuration. Kayode concluded by saying development can be more than “growth” and could be defined as “growth plus” the detail of the plus must include element of equity, social justice and sustainability of growth. The situation where some parts or regions of the country are experiencing rapid economic development while others are lagging behind is

dualism. Among the notable factors influencing dualism are unevenness in endowment of national resources, Skegness in industrialization, unevenness in the infrastructural facilities distribution and political. This concept of economic development dualism is relevant because Oke Ogun region is lagging behind other regions in Oyo State such as Ibadan region and Oyo/Ogbomoso regions. This concept has prompted the Federal Government to locate Ikere Gorge Dam in the region to transform the stagnant economy of the region to a better one.

Regional transformation planning Quite an enormous amount of work has been done in the various aspects of regional transformation planning both within and outside the country. A number of such past works that are relevant to this paper are reviewed. Wikipedia, an outline dictionary defines transformation as a marked change, as in appearance or character, usually for the better. Some synonymous words and phrases like Betterment, improvement or advance –a change for the better; progress in development were proffered by the dictionary. Olaseni (2004) defined transformation as accelerated socio-political change in a desired direction that may involve physical, socio-economic and cultural improvements in the condition of the people. Egunjobi (2004) recommended regional planning as the only solution for the transformation both urban and rural areas. Regional transformation plan is meant to maintain and enhance quality of life while ensuring a strong economy and a healthy and sustainable environment. It aims to grow a healthy and sustainable region by building upon the vibrancy of a region, richness of its cultural heritage, strength of its varied economy, beauty of its wilderness and ocean areas, desire for social inclusiveness, and character of its communities (Halifax Regional Municipal Planning Strategy, 2006). It is a framework to ensure that current and future residents continue to enjoy the present quality of life and outline how to preserve their environment while at the same time maintaining a strong, vibrant economy. Sankaran (2003) tried to define regional transformation planning by saying “the source of the greatest social welfare is the ushering in of new and better ideas whether through the introduction of new methods of production, forms of organization, sources of supply, emerging markets or products. The dislocation caused by these changes leads to new and lasting sources of prosperity”. Agbola (2005) mentioned some basic push and pull factors called urban transformation

forces that should be taken care of in dealing with urbanization problems. This serves as eyes opener that there are some regional transformation forces or factors that have to be considered while planning for any region"s transformation. These may include among others; economy, environment, and industry.

Concisely, before planning for regional transformation the people of such region should be dissatisfied with their present condition. In this sense, Brenner (1983) recommended an envy factor that shapes the region"s future along the lines of a more successful region, perhaps even leapfrogging the model region. In this specific context, a regional transformation project has to be sited to any region that needs a change .This has made the Federal Government of Nigeria to locate Ikere gorge dam in Oke Ogun region for the upliftment of this under-developed region.

9. Brief Overview of Project Financial Planning / Viability report

On the basis of preliminary inspection , we have been able to establish that the tidal movement in the Ikere Gorge Dam supports the construction and hydro project development for generation of 6 MW electricity.

The size of reservoir is very big (seen at site and also through google images)

The multiple purpose Reservoir has 565 mcm capacity of water feeding by four rivers and major share has been contributed by the OGUN RIVER (85%).

The dam was planned to generate 3750 units (62.5%-PLF against installed capacity) of electricity through turbines. However it is expected to achieve minimum PLF@60% against capacity. However it can be more depending upon discharge and annual rainfall.

The information related to actual discharge of Ogun river of last 10 years and corresponding head of hydro power plant has not available with OGUN-OSHUN RIVER BASIN DEVELOPMENT AUTHORITY (OORBDA).

So the basis of PLF assumption , Annual generation as per installed capacity is – 52560000 units and project is viable only if we achieve minimum 60% PLF w.r.t installed capacity i.e., – approx. **31536000** units annually.

So on the basis of PLF assumption , previous rainfall data and large catchment area of Reservoir ,it can be assumed that hydro power project may be viable.

However more PLF may be achieved depending upon the water availability and annual rainfall .

As per the report (means of Agro meteorological observations) from Ogun-Oshun river basin development authority , a dry season from November to March and a wet season between April and October. Mean annual rainfall ranges from 900mm in the north to 2000mm towards the south. The estimates of total annual potential evapotranspiration have been put between 1600 and 1900mm.

As the civil works of the project is almost completed , so there is no liability for clearance from various departments and only things are required to complete is mentioned as under :-

- Redesigning of electro-mechanical equipments as per existing infrastructure
- Electrical works-Supply , Installation, Erection & Commissioning
- Automation of plant
- Mechanical works - Supply , Installation, Erection & Commissioning
- 33 KV Transmission line – Supply , installation , erection and commissioning of 33 KV line – Pending
- Civil works – Construction of approach road, staff quarters, offices, security posts, Painting of power house building etc.

As per OGUN-OSHUN RIVER BASIN DEVELOPMENT AUTHORITY (OORBDA) report, they are not under any legal commitment to the contractors as the contractor has completely demobilized from the site more than 20 years ago. No financial indebtedness to the contractors to date .

1. Plant Capacity

The table below shows the details of the plant expected output factoring estimated capacity factors for different months. Capacity factor for each month is a function of seasonal rain water level.

Base Year	Months	No. of days per month	No. of Hours per month	Capacity Factor as per months	Plant Installed Capacity @ (100%)	Plant Capacity @ 100% Capacity Factor Output	Sum of Out puts for First and second half Years
				%	6 MWhrs	MWhrs	
2015	January	31	744	40%	4,464	1,786	
	February	28	672	40%	4,032	1,613	
	March	31	744	40%	4,464	1,786	
	April	30	720	65%	4,320	2,808	
	May	31	744	85%	4,464	3,794	
	June	30	720	90%	4,320	3,888	15,674
	July	31	744	90%	4,464	4,018	
	August	31	744	90%	4,464	4,018	
	September	30	720	80%	4,320	3,456	
	October	31	744	65%	4,464	2,902	
	November	30	720	60%	4,320	2,592	
	December	31	744	50%	4,464	2,232	**19,217
	Total	***365***	***8760***	***7.95***	***52,560***	***34,891***	
	Average	***30***	***730***	***0.6625***	***4,380***	***2,908***	

MYTO WACC CALCULATION BASIS	
Debt	70.00%
Equity	30.00%
Risk Free Rate	18%
**Nominal Return on Equity	29%
Nominal Cost of Debt	25%
Corporate Tax	32%
After Tax Return on Debt	0.17
Return on Equity	0.33
WACC (after Tax)	**0.218**

Projected Performance and Viability

Investment Evaluation Summary for the Project (Both Debt and Equity Stakeholders)

	Value Measure	%
WACC	%	21.80%
IRR	%	29.762
NPV @ 20 YEARS	***N'Million***	896
NPV @ 25YEARS	***N'Million***	1,074
Simple Pay Back Period		Year 5
Discounted Pay Back Period		Year 10

10. TECHNICAL DUE DILIGENCE OF HYDROPOWER PROJECT

- **Energy Market & Hydro Power in Nigeria**

Current Satus

Access to clean modern energy services is an enormous challenge facing the African continent because energy is fundamental for socioeconomic development and poverty eradication. Today, 60% to 70% of the Nigerian population does not have access to electricity. There is no doubt that the present power crisis afflicting Nigeria will persist unless the government diversifies the energy sources in domestic, commercial, and industrial sectors and adopts new available technologies to reduce energy wastages and to save cost. This review examines a set of energy policy interventions, which can make a major contribution to the sustainable economic, environmental, and social development of Africa's most populated country, Nigeria. Energy efficiency leads to important social benefits, such as reducing the energy bills for poor households. From an economic point of view, implementing the country's renewable energy target will have significant costs, but these can partly be offset by selling carbon credits according to the rules of the 'Clean Development Mechanism' agreed some 10 years ago, which will result in indirect health benefits.

Nigeria could benefit from the targeted interventions that would reduce the local air pollution and help the country to tackle greenhouse gas emissions. Many factors that need to be considered and appropriately addressed in the shift to its sustainable energy future are examined in this article. These include a full exploitation and promotion of renewable energy resources, energy efficiency practices, as well as the application of energy conservation measures in various sectors such as in the construction of industrial, residential, and office buildings, in transportation, etc.

Current electricity situation in Nigeria

The electricity system in Nigeria centres on PHCN, which accounts for about 98% of the total electricity generation . Power generation by other agencies such as the Nigerian Electricity Supply Company relies on thermal power for electricity generation unlike PHCN, which relies on both hydro- and thermal power. However, electricity is also a consumer of fuel and energy such as fuel oil, natural gas, and

diesel oil. The importance of these sources of energy and fuel for generating electricity has been decreasing in recent years. However, hydropower that is relatively cheaper than these sources has grown to be more important than other sources . However, more recently, the Power Authority has generated electricity through a mix of both thermal and hydro systems. All the power, distribution, and substations are specially interlinked by a transmission network popularly known as the national grid. The entire electricity generated nationwide is pooled into the National Control Centre, Osogbo, from where electricity is distributed to all parts of Nigeria.

The national electricity grid presently consists of 14 generating stations (3 hydro and 11 thermal) with a total installed capacity of about 8,039 MW as shown in Table 2. The transmission network is made up of 5,000 km of 330-kV lines, 6,000 km of 132-kV lines, 23 of 330/132-kV substations, with a combined capacity of 6,000 or 4,600 MVA at a utilization factor of 80%. In turn, the 91 of 132/33-kV substations have a combined capacity of 7,800 or 5,800 MVA at a utilization factor of 75%. The distribution sector is comprised of 23,753 km of 33-kV lines, 19,226 km of 11-kV lines, and 679 of 33/11-kV substations. There are also 1,790 distribution transformers and 680 injection substations . Table 2 shows a summary of the generation capabilities of PHCN power stations as operated in the year 2008 (January to December) .

Country statistics of electricity generation and *per capita* consumption

In spite of the contribution of electricity to the total gross domestic product, it is evident that Nigeria is facing several problems. The incapacity of the electricity subsector to efficiently meet the demand for electricity in the country has been caused by a number of problems, which have been detrimental to economic growth. The Central Bank of Nigeria has identified nine problems associated with the National Electric Power Authority (NEPA) (now PHCN):

1. Lack of preventive and routine maintenance of NEPA's facilities, resulting in huge energy losses.

2. Frequent major breakdowns, arising from the use of outdated and heavily overloaded equipment.

3. Lack of coordination between town planning authorities and PHCN, resulting in poor overall power system planning and overloading of PHCN equipment.

4. Inadequate generation due to operational/technical problems arising from machine breakdown, low gas pressure, and low water levels.

5. Poor funding of the organization.

6. Inadequate budgetary provision and undue delay in release of funds to PHCN.

7. PHCN's inefficient billing and collection system.

8. High indebtedness to PHCN by both public and private consumers who are reluctant to pay for electricity consumed when due.

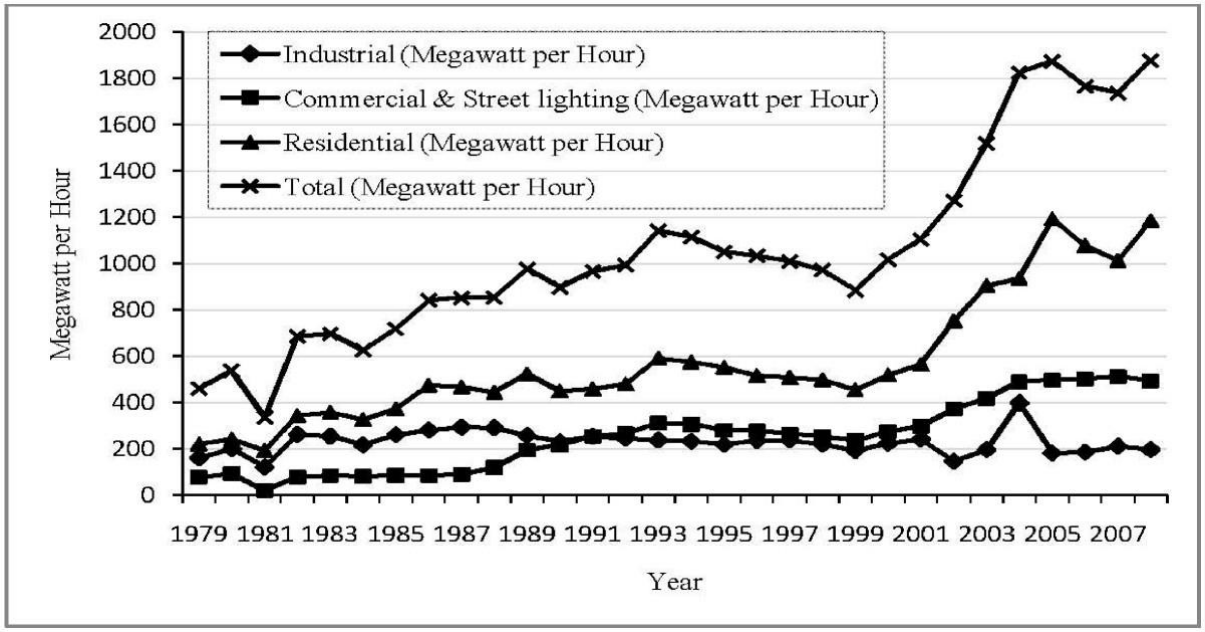
9. Vandalizing and pilfering of PHCN equipment.

In addition to these, most of the existing electricity plants in Nigeria are underutilized or not functioning at all. Numerous reasons could be sighted as responsible for the underutilization of these plants. Some of which are (1) scarcity of relevant manpower for adequate maintenance and general consumer indiscipline; (2) lack of essential spare parts for maintenance of the plants; (3) absence of local manufacturing capabilities;(4) lack of systematic studies of distribution networks to reduce the extraordinary losses that usually accompany haphazard system expansion; and (5) inability to convert gas flares to a source of electricity .

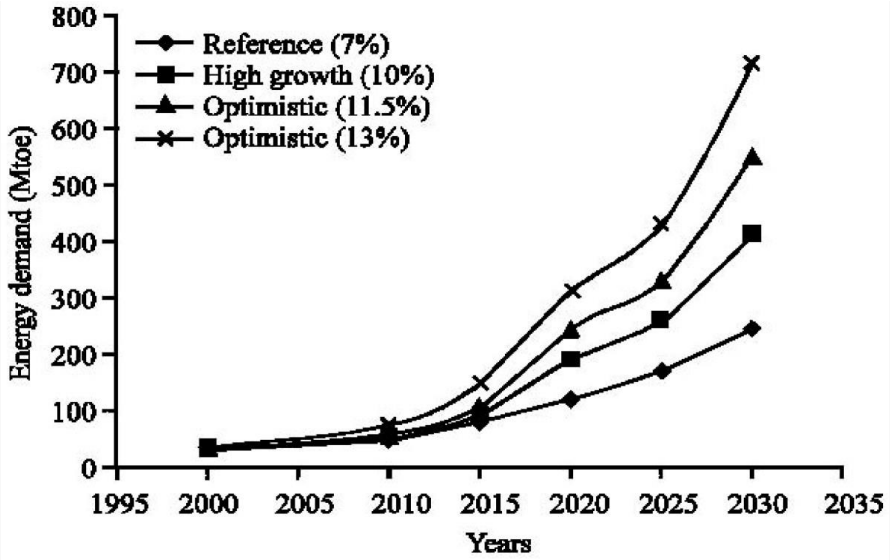
The inefficiency as well as the inadequate facilities to boost electricity supply also have been major causes of the increasing gap between the demand and the supply of electricity. This could be due to the fact that there are only 14 generating stations in Nigeria (3 hydro and 11 thermal stations). Out of the approximated 8,039 MW of installed capacity in Nigeria, not more than 4,500 MW is ever produced. This is due to poor maintenance, fluctuation in water levels powering the hydro plants, and the loss of electricity in transmission. It could also be due to the 80-MW export of

electricity each to the republic of Niger and Benin. 'Apart from serving as a pillar of wealth creation in Nigeria, electricity is also the nucleus of operations and subsequently the engine of growth for all sectors of the economy'. It has been indirectly re-echoed that electricity consumption is positively related to economic growth and that the former is a causal factor of the latter. This means that electricity consumption has diverse impacts on a range of socioeconomic activities and consequentially the living standards of Nigerians.

Notwithstanding the above pitfalls that had rendered public electricity supply in Nigeria unreliable and inefficient, the trend of its utilization has grown significantly over the past years. Figure 1 shows the total electricity consumption in megawatts per hour and the various sectorial decompositions. Electricity utilization by the industrial sector has been fairly static because of the unreliable nature of the public electricity supply system in the country. Thus, many companies have resolved to provide their own power-generating sets as sources of electricity, leading to huge transfer costs on their products and services.



Graph showing the projected electricity demand between 2000 and 2030



- **Hydro Power Potential of Nigeria**

Development Targets

Targets small hydropower plants

Nigeria is endowed with hydropower potential of about 15,000mega watts(mw) unit of which 23 per cent is small Hydropower.

- **DUE DILIGENCE – BASICS**

Definition

Used for a number of concepts including a careful analysis

Of a business prior to signing a contrac, and / or

Of an act with a certain duty of care

Main Goals

Information acquisition about the asset

Analysis of the information received

Proper documentation of the whole process of an investment

Minimizing the risk of an investment in assets which are

Already existing or

Developed completely new

- **VARIOUS (SUB) TYPES ARE APPLIES DEPENDING ON THE DIFFERENT PURPOSES**

Financial due diligence to evaluate the capital, profit, liquidity, liabilities, customer records and other benchmarks

Tax due diligence to analyze the fiscal and tax related aspects

Legal due diligence to analyze the legal relations, obligations and risks

Technical due diligence to evaluate the assets in the view of availability, operation, maintenance, necessary rehabilitation and investments etc.

Environmental due diligence to evaluate the sustainability and compliance of all relevant standards

- Players
  - Investors and/or Lenders as interested party
  - Vendor and/or Borrower as current owner
  - Consultant for objective and independent services