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MANAGING POWER GENERATION PROJECTS

Introduction

A **power station** is an industrial facility for the generation of electric power. At the center of nearly all power stations is a generator, a rotating machine that converts mechanical power into electrical power by creating relative motion between a magnetic field and a conductor. The energy source harnessed to turn the generator varies widely. Under NIPP Phase1, Nigeria is applying her enormous natural gas endowment to produce electricity.

Need for Additional Power in the National Grid.

In the effort to improve on the quantum of power for the nation so that Nigerians can enjoy uninterrupted power supply, the Federal government of Nigeria commenced the building on fast track basis, Seven (7) new power stations in the Niger Delta area of the country. As at that time the available capacity of the units in the national grid was about 2,500MW. The effect of the 7 No. power stations was to double the available capacity.

To achieve this additional capacity, Gas Turbine Generators (GTGs) were selected. This resulted in the purchase and delivery of initial eighteen (18No) gas turbines for installation at Calabar, Egbema, Gbarain and Sapele. Later additional capacities were added, with projects located at Omoku, Alaoji, Olorunsogo, Omotosho and Geregu as shown below.

Stage 1 Power Plants:

- I. Calabar Power Station Lot 1, Capacity-562.5MW
- II. Egbema Power Station Lot 2, Capacity-337.5MW
- III. Ihovbor Power Station Lot 3, Capacity-450MW
- IV. Gbarain Power Station Lot 4, Capacity-225MW
- V. Sapele Power Station Lot 6, Capacity-450MW

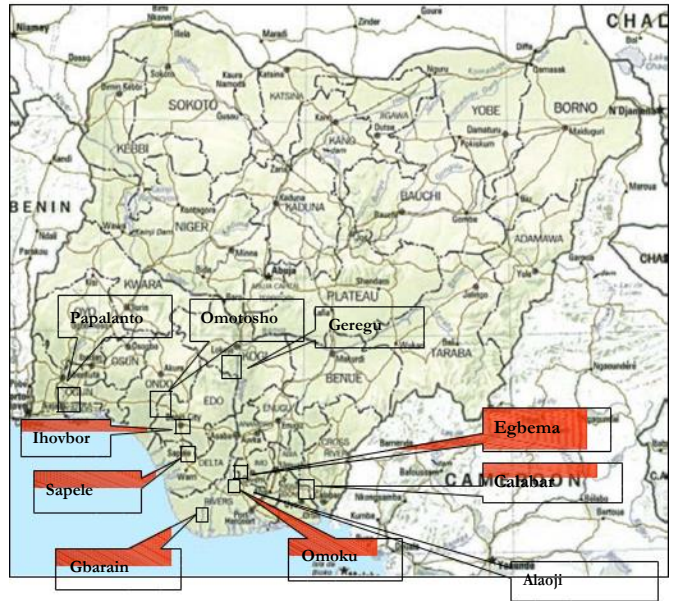
Total Capacity of stage 1 is -2,025MW

Stage 2 Power Plants:

- 1. Omoku Power Station Lot 7, Capacity-250MW
- II. Alaoji Power Station Lot 8, Capacity- 961MW
- III. Olorunsogo Power Station Lot 9, Capacity- 676MW
- IV. Omotosho Power Station Lot 10, Capacity- 451MW
- V. Geregu Power Station Lot 11, Capacity- 439.38

Over all capacity from these two stages of plants - 4802.38MW

NIPP Power Plants Locations



Services Rendered by Otis Engineering:

OTIS carries out specialized services geared towards ensuring that the NIPP power plants meet quality requirements, and that the project schedules are adhered to.

Some of the services for the implementation of the Power Station contracts :

- Basic Engineering, Analysis/Evaluation of Bid Proposals from Project Consultants and EPC Contractors
- Defining of the interfaces and the co-ordination of the respective limits of supply between the OEM and EPC Contracts.
- Designations of Responsibilities (DOR) between OEM, EPC and Project Consultant
- Monitoring, assessing and reporting of the overall work progress of all Sites and extended scope of work to the Client.
- Monitoring of interfaces during design audit and erection/commissioning phases.
- For the stage 2 Power Plants (Olorunsogo [Papalanto], Omotosho, Alaoji and Geregu), our services include status assessment, and an evaluation of the necessary procedures for taking over these additional project elements.
- Monitor project implementation process and supervise the technical and quality management performance.
- Provide advisory services to Client.
- Support and assist in workshop inspections, factory acceptance tests and performance acceptance tests.
- Monitor the conformity with general specifications, design fundamentals and local regulations.
- Verify and approve Contractors' design.
- Organise project meetings.
- Prepare regular progress reports



4 Unit Gas Turbines at Ihovbor



GTG Power Plant at Calabar LOT 1 - 562.5 MW

Equipment Overview

Gas Turbine (GT)

Equipment Manufacturer: General Electric
 Model : PG9171
 Fuel system : Natural gas only
 Starting Means: Electrical motor
 Air filtration: Self cleaning
 Exhaust System : Side right
 Emissions Control: Gas - Dry Low NOx
 Fire Protection: High pressure CO2
 Power Rating: 112.5 MW



GT 2 (112.5MW) at Egbema

Generators:

Equipment Manufacturer: General Electric.
 Model: BDAX 9-450 ERH
 Frequency: 50 Hz
 Rated power factor: 0.80 Lagging
 Power Factor Range: Capability to 0.95
 Leading Terminal Voltage : 15.0 kV
 Generator excitation: Brushless



GT Ancillary Equipment at Omoku

Transformers

Model: Three-phase, oil filled, ONAN/ONAF
 Frequency : 50 Hz
 Terminal Voltage (HV side) : 139 kV/ 343 kV (no-load)



Block 2 showing GT3 and GT4 at Sapele



GT 1 with transformers connections at Sapele

Control System

Equipment Manufacturer: General Electric
Generator: Control, excitation, regulation and protection panel
Operator interface: Local <HMI>



Air processing unit for GT 2 at Gbarain



Ihovbor Power Station - 450MW

Guarantee Monitoring - Defect Liability Period (DLP) Otis Engineering is involved in the co-ordination of DLP activities of the equipment, and the installation works of the EPC contractors. This is to ensure that defects from project implementation and/or other lapses are promptly attended to by those responsible before final take over of project by the Client.



Geregu II Power station 439.83MW



Front view:-GT 1 and GT 2, Sapele Power Station



Back View of GT3 and GT4, Sapele Power Station



Gas Turbine Hall in Calabar



Generator and GNAC at Egbema Power Station

Central Control Building (CCB)

The design of NIPP power plants gives premium consideration to safety. The operation of the plants are monitored from panels located in the Central Control Building, thereby reducing incidences of direct human machine interface, and hence reducing the risk of industrial accidents. The design also makes maintenance easier to manage, because any malfunction is detectable from the CCB, and specific maintenance requirements are displayed on the consoles. Each unit in the power plant is operated from Human - Machine Interface on the control desk in the control room. The control room houses the following:

- ✓ The Gas Turbine Generator (GTG) control panels
- ✓ The Medium Voltage (MV) Switch Gear control panels
- ✓ The Low Voltage (LV) Switch Gears

The operations and maintenance of the plants are managed through these remote panels



Central Control Building CCB at Calabar Power Station

Corporate Headquarters of O.T. otis Engineering



Commissioning of a Power Station

In commissioning a Power Station, OTIS deploys engineers to manage the following processes:

Cold Commissioning:

Cold Commissioning involves the following:

- Cold loop checks of all the cable terminations. This involves physical testing of all cable wirings.
- Smoke detector - to check for leakages
- CO2 test - to check for effectiveness
- Calibration of all instrument gauges

After cold loop checks, then the station receives back feed from the national grid to soak the Generator Start Up Transformer (GSUT) for 48hrs.

Hot commissioning

After 48hrs of soaking the GSUT, the MV and LV switchgears are energized to put supply on the MV and LV equipment.

- Calibration and testing of panel meters.
- Hot loop checks on all the wired circuits.
- Water washing of the compressor
- Powering of the cranking motor (6.6kv) to confirm the rotation of the motor.

Putting the Unit on Slow Roll.

After confirming the rotation of the starting or cranking motor, the unit is cranked to rolling speed (25rpm). The unit is left on rolling speed for about 24hrs.

First Fire

After 24hrs, the unit is started and left to run up to Full Speed No Load (FSNL). The unit is left at FSNL for 2hrs to stabilize. At FSNL, no-load excitation checks are carried-out. If all the parameters in terms of generator voltage, frequency and phase angle are confirmed, the unit is synchronized to the grid and loaded to base load (rated load)

Trip Tests

Trip tests are carried out on the unit at various loads, ranging from 25MW to base load. The unit is expected to remain at FSNL but if not, investigations will be carried out to rectify the problem.

Over Speed Test.

Finally, the unit is subjected to over speed test of 110% of rated speed (3000RPM). This is done by raising the speed from 3000rpm to 3300RPM.

Associated Consultant: Lahmeyer International (LI)

About Us



O. T. OTIS ENGINEERING

O.T. OTIS Engineering is an indigenous Nigerian company with its Head Office at N0 30/23, Olu Agabi Close, Cadastral Zone CO2, Gwarinpa 1, Abuja, and branch offices in Warri, Benin, Calabar, Omoku, Yenogoa, and Katsina. It is a multi-disciplinary Consultancy company primarily established to provide Engineering Services/Support in the industrial, energy and allied sectors of the Nigerian economy with particular emphasis on Consultancy Services and Project Management, Cost Engineering, Operation and Maintenance of Electro-Mechanical Equipment. **OTIS Engineering** has successfully completed projects in virtually all the facets of the Industrial sector in Nigeria from Machine Tools/Metal Working through Iron and Steel to Automotive Manufacture, Petroleum Refining and Petrochemicals, Electric Power to Pulp and Paper, in over 25 years of existence.