

THERMAL POWER PLANTS IN NIGERIA, LOCATION & CAPACITY, PERFORMANCE AND PRESENT STATUS (PART A)

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Abstract

This survey research paper, titled "Thermal Power Plants in Nigeria: Location, Capacity, Performance, and Present Status (Part A)" focuses on five major thermal power plants in Nigeria. Noticeably, electric power is a significant challenge for the industrial growth of a developing country. Rural areas often lack access to generated power. The major plants discussed include Egbin Thermal Power Plant (Lagos State), Alaoji Thermal Power Plant (Abia State), Afam Thermal Power Plant (Rivers State), Ughelli Delta Thermal Power Plant (Delta State), and Olorunsogo Power Plant (Ogun State), all located in the south-west part of Nigeria near gas pipelines. The article aims to extract data and information from various sources herein to provide insights into the generation capacity, location, and performance of these power plants. Ownership varies, with some power plants government-owned and others operating as public-private partnerships under NIPP, etc. The generation capacity may differ due to ongoing efforts to increase capacity as the case may be. Thus, the overview of these major thermal power plants in Nigeria is presented in tables, detailing installation year, commission, and current generation capacity. Subsequently, Part B will present other major thermal power plants in Nigeria, covering their status, ownership, and operational capacity.

Key Words - Available capacity, Installation capacity, Location sites, Present status, Thermal Power Plants

1. Introduction

Power is the foundation of any modern society and keeps a nation's economy strong. Increasingly, as the population grows and the industrial revolution continues, so does the demand for a stable, affordable, and adequate power supply increases. Along with other conventional systems, thermal power plants are a type of conventional power-producing system that generates energy. Fossil fuels are used in the combustion chamber to provide rotational torque that is further converted to electricity. These substances coal, natural gas, diesel, petrol, etc., are the fossil fuel burned to produce steam that drives the turbines (for steam turbine systems) or gas (for gas turbine systems). Through the connecting shaft, as it may be coupled, the rotational torque turns the rotating part of the electric generator. Depending on the source of fuel, we have a gas turbine power plant and a steam turbine power plant.

This research aims to ascertain at least the five major thermal power plants in Nigeria, their location and capacity, performance, and present status. Precisely, one may not ascertain in literature the total number of thermal plants connected to the Nigeria grid due to their owners and mode of operation, however, other existing thermal plants status will be researched and published in due time. Nigeria has numerous generation installations through different power providers; besides, the generated power does not meet the

demand as required. According to Wikipedia (2023, February 2), NERC (n.d), Nigeria is home to twenty-three (23) power plants that are connected to the national grid and have a total energy capacity of 11,165.4 megawatts (MW). These facilities are operated by generating corporations (GenCos), independent power providers, and the Niger Delta Holding Company. Before the reforms in the electricity sector, the three main independent power plants were the 480MW Agip-built Okpai plant, the 642MW Shell-owned Afam VI project, and the 270MW Ibom power NESCO and AES Barges facility. The third sector is the Nigerian National Integrated Power Project (NIPP), which was launched in 2004 to speed up the building of new power plants in Nigeria. Note that, the majority of the newly proposed plants are gas-powered [1],[2].

Babatunde et al. (2021) pointed out that poor functioning of a number of the current power plants prevents them from producing energy equal to their installed capacity, which poses a serious obstacle to satisfying the demand. Nonetheless, as part of their work, they evaluated a large Nigerian power plant's performance using exergy to find areas where thermodynamics may be improved. It is evident from their presentation that Nigeria, with a total installed capacity of around 12, 522 MW, could hardly claim an average of 4, 996 MW of electricity that was available. A few of the current plants operate inefficiently, performing much below their installed capacity, which contributes to the poor power availability. The ineffective functioning of

power plants in Nigeria, home to more than 197 million people, has several negative repercussions, including economic underproductivity, brownouts, excessive reliance on self-generated energy from captive diesel and petrol generators, and blackouts and brownouts [3].

Thermal power has led the world to produce electric power for a very long time. With a total recorded thermal capacity of 4,482GW as seen in Power Technology (2023, July 19), thermal capacity accounted for 55.1% of all power plant installations worldwide in 2021, according to Global Data. By the end of 2030, this is anticipated to account for 40% of the total installed capacity of 4,924 GW. 0.30 per cent of the world's thermal capacity is located in Nigeria. The Global Data power plants database in [4] lists the top five active thermal power plants in Nigeria in terms of capacity [4].

2. Overview of Five Thermal Plants Power Generation in Nigeria

2.1 Egbin Thermal Power Plant (Lagos State)

Egbin Thermal Power Plant is owned and operated by Egbin Power Plc. One of Nigeria's largest power generation companies is located in Lagos State. According to the sources (Egbin Thermal Power Station, 2023), (Gem. wiki/Egbin, 2023, October 8), the Egbin power plant had an initial total installed power capacity of 1,320 Megawatts (MW). The station contains six steam turbine units, with each unit delivering a power output of 220 MW. The plant is managed by the prominent African energy corporation, Sahara Power Group, as a subordinate entity. Table 1 shows the status of the Egbin thermal power generation station in Nigeria. The corporation supplies energy to millions of Nigerian households, companies, and industries, and hence plays a major role in the country's power industry. Presently, the organization is engaged in initiatives designed to augment this capability by employing novel technologies and substitute energy reservoirs [5], [6].

The largest energy-generating firm in Nigeria, Egbin Power Plc, has declared a record-breaking 1,000 megawatts (MW) of power output, according to Peter (2023). This achievement represents a new high in a two-year record. In a statement, the company's CEO, Mokhtar Bounour, said that the outcome was made possible by the assistance and collaboration of stakeholders, business partners, and staff members. Bounour also expressed gratitude to the staff for their dedication to putting in exceptional work, which has continuously allowed the business to make noteworthy contributions to the electricity industry. "Without the assistance of industry operators, this outstanding accomplishment that was documented on Sunday, June 25, 2023, would not have been possible," he stated. Bounour reaffirmed Genco's (generation company) dedication to the

objective of raising the plant's capacity and continuously promoting sustainability. Phase two investment expansion plan for Egbin Power was unveiled last year, to add 1,750MW to the national grid [7].

2.2 Alaoji Thermal Power Plants (Abia State)

Alaoji Thermal Power Station is located in Abia state, Nigeria with an installed capacity of 1,074MW. The project was developed by Niger Delta Power holding company and was commissioned in 2012. According to Power Technology's article published on July 19, 2023, the Alaoji Generation Company Nigeria owns the project [4]. Also, according to Global Energy Monitor Wiki (2023, October 8), Alaoji power station is an operating power station of at least 1068 megawatts (MW) in Ala-Oji, Alaoji, Aba, Nigeria with multiple units, some of which are not currently operational [6].

According to the article published by Power Engineering International (2015, March 25), the first phase of the Nigerian gas-fired power plant was inaugurated by then Nigeria's President Goodluck Ebele Jonathan with 540 MW first phase of the nation's 1074 MW combined cycle Alaoji gas-fired power plant. The plant, which features four 126.1 MW gas turbines, is located within the Ugwunabo Local Government Area of Abia state and was built by the Niger Delta Power Holding Company (NDPHC) under the government-sponsored National Integrated Power Projects (NIPP) programme. Table 2 displays the Alaoji thermal power station with an available active capacity of 496 MW. Along with three others recently inaugurated NIPP power plants; the then Power Minister, Professor Chinedu Nebo said the (NIPP) programme has contributed 2188 MW to Nigeria's installed power capacity, which currently stands at 5.5 GW [8].

2.3 Afam Thermal Power Plants (Rivers State)

2.3.1 Afam I-V Thermal Power Plants

The Afam I-V power station is a 987.20MW thermal (gas-fired power) project as seen in (Power Technology, July 19, 2023). Afam I-V thermal power stations are located in Afam, Oyiabo LGA of Rivers State, Nigeria. The projects were executed in phases. Afam I-III was owned and developed by Trans Afam Power Limited which was commissioned in 1962 [4]. Currently, Afam I-III is not active. From the references' point of view (Power Technology, November 14, 2023), (GlobalData Plc, 2023), (Infoguidenigeria.com, 2023), (First Independent Power Limited, 2019), and (Global Energy Monitor Wiki, November 19, 2023), it was discussed that Afam power plant has four Afam gas plants located in Rivers State. The government's Afam V power station (276 MW), Shell's Afam VI power plant (650 MW), FIPL's Afam power

station (360 MW) and currently there is ongoing construction for Fast power plant. The Afam V power station/ plant was put into service in 2002, whereas the Afam IV facility was opened in 1982.

With a combined generating capacity of 726 MW, Transcorp Power Limited owns both the Afam IV and Afam V power plants. Afam Power Plc and Afam III Fast Power Limited shares were to be sold and purchased by the Nigerian federal government and the Transcorp Power Consortium in 2020 as part of the nation's divestiture of power-producing assets. The bidding procedure was competitive, and Transcorp Power Consortium emerged as the preferred bidder with an offer of N105 billion [9],[10],[11],[12],[13]. The various extracts of Afam thermal power stations are presented in brief (see Tables) as contained in some works of literature. Table 3 shows the Afam I thermal power station established in 1962. Table 4 shows the Afam II status, Table 5 shows the Afam III status, Table 6 shows the Afam IV thermal power station status, Table 7 shows the Afam V thermal power station status whereas Table 8 shows the combined generation status (active) of the Afam IV-V thermal power station.

2.3.2 Shell's Afam VI Thermal Power Plant

According to the Global Energy Monitor Wiki dated November 23, 2023, the Afam VI facility, which is owned by Shell, was constructed in phases and commenced operations in 2008. The facility comprises three 150 MW gas turbines that produce both heat and power (i.e. combined cycle), in addition to a 200 MW steam turbine. It is presently in operation and has a combined installed capacity of 650 MW, as indicated in Table 4.9 of the aforementioned sources [14],[15].

One of the four main gas projects in Nigeria's Rivers State is the Afam VI power plant operated by Shell. Afam IV (450 MW), Afam V (276 MW), and the FIPL's Afam power plant (360 MW) owned by FIPL are the other three gas projects. It was estimated that the Afam VI power plant provided about 12% of Nigeria's grid electricity in 2016. The Nigerian Electricity Regulatory Authority renewed the Afam VI power plant's electricity generating license in November 2017. The plant provided the grid with more than 25.97 million Megawatt-hours (MWh) of electricity between 2008 and 2017.

In January 2018, the Power Services Division of General Electric, LAGOS, and Shell Petroleum Development Company (SPDC) sealed a Multi-Year Services Agreement (MYA) for the Afam VI power plant. The arrangement included GE MXL2 development, which raised the power plant's capacity to 30 MW. This led to a decrease in CO₂ emissions and a considerable reduction in fuel consumption because of the higher efficiency. An overview of Shell's Afam VI thermal power station's current state is presented in Table 9. During its highest

point in 2018, the facility produced enough energy to power three million homes in Nigeria. It was anticipated that the subsidy would enhance production and availability, decrease plant operating costs, and boost transmission reliability for 200,000 homes in Nigeria [14], [15].

2.3.3 Added State Government Power Projects (Rivers State)

Apart from the Afam power plants (the government's Afam I-IV power plants) mentioned earlier, there are a host of government power projects executed as follows:

a) Eleme Power Plant - (Rivers State)

First Independent Power Limited (FIPL) operates the Eleme Power facility, which is regarded as the first FIPL facility built in compliance with the company's criteria (First Independent Power Limited, 2019). The power plant was not in operation at first and was in a condition of deterioration. FIPL was tasked with renovating and activating Eleme's 20 MW GE LM2500 gas turbine in 2001. To boost the station's capacity, FIPL decided to replace the outdated 20 MW GE LM2500 with three 25 MW Frame 5 Nuovo Pignone Gas turbines due to operating difficulties. Although the new turbines have been installed several plant controls and accessories have not yet been installed and commissioned. Also, the station is not active yet [12].

b) Omoku Power Plant - (Rivers State)

Omoku thermal power plant is situated alongside the NAOC gas processing plant in Obrikom, Omoku, Ndoni, Rivers State. The operational natural gas for the turbines is obtained from the NAOC gas processing plant, Obrikom. The power station was commissioned in 2006 by President Olusegun Obasanjo when Dr Peter Odili was then governor of Rivers State. The station is **active**. The Omoku gas turbine power plant has six units of 25MW GE Nuovo Pignone heavy-duty gas turbines, making a total of **150MW** installed nameplate capacity. The plant generates power and transmits it to the national grid via its on-site 132kV switching facility through Rumuosi Transmission Substation [12]. According to Oskajo & Partners Ltd (2014), the Omoku power plant started in 2001 and was completed in 2002, a state government project under the Ministry of Power [16].

c) Omoku II Power Plant - (Rivers State)

The Omoku II thermal power plant is a two-unit 9E gas turbine each with 126MW, total installed capacity is 252 MW (ISO) gas-fired power project, under construction and expected post-completion construction in 2024. The project is owned and developed by Omoku Generation, and the Turbine is supplied by GE Power, EPC Contractor: Rockson Engineering Company Limited, and also Dongdian Second [17], [18]. This project is not active at the moment.

d) *Trans-Amadi Plant – (Rivers State)*

The Trans-Amadi plant, located in Rivers State, Nigeria, has a **136MW** installed capacity overall. The plants were commissioned in two phases. Three 12 MW solar Mars gas turbines for Phase I, which started operation in 2002, and four 25 MW Nuovo Pignone frame gas turbines for Phase II, which started operation in 2009.

Detailed facilities at power station: Three 12 MW GE solar Mars gas turbines, four 25 MW GE Nuovo Pignone gas turbines, control buildings, three 35 MVA (11 KV/33 KV) and three 75 MVA (33 KV/132 KV) transformers, and two black start generators for island mode restart are all part of the power plant. The natural gas used in the turbines is supplied by Shell Nigeria [12]. The station is **active**.

2.4 Ughelli Delta Thermal Power Plant (Delta State)

The Ughelli Delta Thermal Power Plant has a total capacity of 964.68MW, of which **892.68MW** is now active, according to an article published by Power Technology on January 4, 2024, in the GlobalData Power Intelligence Centre. The project was launched in 1966. Equity in the project is owned by Transcorp Power. The project is situated in Delta State, Nigeria [19]. Table 10 shows the Ughelli Delta Thermal Power Station status. Two gas turbines from Stal-Laval Turbin, each with a nameplate capacity of 36 MW, are installed at **Ughelli Delta Power Plant Phase I**. With six gas turbine units, each with a capacity of 23.78 MW, **Phase II** is outfitted with Mitsubishi Power H-25 gas turbines. **Phase III** is outfitted with six gas turbine units, each with a 23.78MW capacity, manufactured by Mitsubishi Power H-25 gas turbines, while **Phase IV** is constructed with six gas turbine units, each with a 100MW capacity, manufactured by GE Power Frame 9E gas turbines [19].

As mentioned by Global Energy Monitor Wiki on October 8, 2023, the Ughelli Power Station is located in Ughelli, Delta State, Nigeria. Transcorp Ughelli Power Station, as it is often called, is a functional power plant with a 600 megawatt (MW) minimum capacity [20].

2.4.1 Added Thermal Power Plants (Delta State)

a) *Sapele Thermal Power Station*

In addition to the Ughelli power plants, the Sapele power station and the Sapele II power station are up and running. The **Sapele thermal power station**, as seen in [21], is a multi-unit operating power plant in Sapele, Delta, Nigeria, with a minimum installed capacity of 1020 megawatts (MW) between 1980 and 1981. Among the 1020 MW installed capacity: two steam (from the 1980s) turbines and four gas

turbines (from the 1981s) have been put off. The facilities currently only have four steam turbines (**480 MW**) operating as of June 2022 (Global Energy Monitor Wiki, 2023, October 8). See Table 11 which depicts the Sapele I thermal power plants.

b) *Sapele II Thermal Power Plant*

The Sapele II Power Station is an operational power plant located in Sapele, Delta, Nigeria, with a minimum installed capacity of 905 megawatts (MW).

According to the Global Energy Monitor Wiki as of October 8, 2023, the plant consists of multiple units, some of which are currently not in use. The operational Unit 2 features 4 GE gas turbines, having a combined capacity of 451 MW and is also known as the privatised Sapele Power Station. Table 12 displays the Sapele II thermal power plants and their various combinational units.

2.5 Olorunsogo Power Plant (Ogun State)

The Olorunsogo power plants were developed in phases, Olorunsogo I thermal power plant was commissioned in 2007 with an installed capacity of 336MW thereafter, Olorunsogo II thermal power plant was conceived in 2015 – 2017

2.5.1 *Olorunsogo I Power Plant (Ogun State)*

The Olorunsogo I Power Plant is a gas-fired power project with a capacity of 336 megawatts. It is situated in Ogun, Nigeria [25]. The project comprises eight numbers of 42 MW single shaft heavy-duty models (PG6581B; Frame 6 type), a total installed capacity of 336 MW, gas turbine produced by Nanjin Turbine Company of China under licence from General Electric [26]. Table 13 shows the Olorunsogo I thermal power plant status.

2.5.2 *Olorunsogo II Power Plant (Ogun State)*

According to a Power Technology report from July 19, 2023, the Olorunsogo II Power Plant in Ogun State, Nigeria, with a capacity of 750 MW, has been in operation since 2015. It was constructed by SEPCOIII Electric Power Construction. Olorunsogo Generation Company Limited also owns stock in the project as seen in [4].

The open-cycle project of NDPHC-NIPP was first launched in March 2015 and the combined cycle project was put into service in 2017 [27]. These two projects both use gas turbines with mixed cycles. The Olorunsogo II thermal power plant status is depicted in Table 14.

3. Extraction Approach

A comprehensive survey was conducted to extract data and information from relevant sources in the global village, with

a specific emphasis on the status of thermal plants, particularly the five major thermal power plants in Nigeria. It should be acknowledged that the feasibility of retrieving a concise database encompassing all thermal power plants in Nigeria and their status simultaneously online is limited. Consequently, a random sampling approach was employed to present the significant findings derived from this survey.

4. Results of the Five Thermal Power Plants Under Consideration

Based on the facts drawn from the various sources cited in the references, the five main thermal power plants analysed in this study are presented in the tables below. While Nigeria has additional thermal facilities, this investigation concentrated on these five due to their importance to the national economy. See Table 1 to Table 14.

Also, Figure 1 presents the total installed capacity versus active capacity for the five thermal power plants; the total installed capacity is equal to 6964.88MW while the active capacity was 6518.68MW. Figure 2 shows the respective installed and active capacity of the five Thermal Power Plants under study.

Table 1 Egbin Thermal Power Plant (Lagos State) [Adapted from 5, 6, 7]

Commencement Period	Plant Location	Total Installed Capacity	Status	Owners	Corporate Ownership and Operator (Parent)	Developers	Contractors	Under-construction
In July 1985, the first unit was commissioned. In November 1986, the sixth unit was commissioned.	Egbin Town, Ikorodu, Ijede J, 104102, Lagos State Nigeria. Location Coordinates (WGS 84): 6.563772, 3.615132	1320MW (with six steam turbines each 220MW)	(Active) 1000 MW as of Sunday, June 25, 2023	Egbin Power Plc	KEPCO Energy Resources Ltd [70.00%]; Bureau of Public Enterprises (Nigeria) [24.00%]; Ministry of Finance Incorporated (Nigeria) [6.00%] in all the Units	Sahara Power Group	For the gas-fired power plant, Bouygues Construction, Marubeni, and Mitsubishi Power were chosen to provide engineering procurement construction services.	Unit B 1800MW, Target by 2025

Table 2 Alaoji Thermal Power Plant (Abia State) [Adapted from 4,6,8]

Commencement Period	Plant Location	Total Installed Capacity	Status	Owners	Corporate Ownership and Operator (Parent)	Developers	Contractors	Under-construction
Project Commissioned 2012 Units 1-4: commence in the year 2015 Units 5-6 under construction, expected completion year 2025	Ala-Oji, Alaoji, Aba, Nigeria, Coordinates (WGS 84) 5.06677, 7.32181	Four (4) Units 1 - 4 at 124MW each (Fuel type: Gas Turbine): 496MW (Active) Two additional units: Units 5-6 at 286MW each (Fuel Type: waste heat- steam turbine): 572MW Total Capacity: 1068MW	(Active) Available 496 MW	Alaoji Generation Company Ltd	Niger Delta Power Holding Company	Niger Delta Power Holding Company (NDPHC)	National Integrated Power Projects (NIPP) programme	Units 5-6 at 286MW each (Fuel Type: waste heat- steam turbine). The expected year of completion is 2025.

Table 3 Afam I Thermal Power Plant [Adapted from 9, 10, 12, 13]

Commencement Period	Plant Location	Total Installed Capacity	Status	Owners	Corporate Ownership and Operator (Parent)	Developers	Contractors	Under-construction
Project established 1962 Development in multiple phases	Afam, Oyigbo LGA, Rivers State Coordinates (WGS 84): 4.85176, 7.2535	(Unit GT 1-2, 2No. of GT 10.3MW each) (Unit GT 3-4, 2No. of GT 17.5MW each) 55.6MW	Not active now	Trans-Afam Power Ltd	Trans-Afam Power Ltd	Trans-Afam Power Ltd	-	-

Table 4 Afam II Thermal Power Plant [Adapted from, 9, 12, 13]

Commencement Period	Plant Location	Total Installed Capacity	Status	Owners	Corporate Ownership and Operator (Parent)	Developers	Contractors	Under-construction
Project established 1962 Development in multiple phases	Afam, Oyigbo LGA, Rivers State Coordinates (WGS 84): 4.85176, 7.2535	Unit GT 5-8, (4No. of GT 23.9MW each) 95.6MW	Not active now	Trans-Afam Power Ltd	Trans-Afam Power Ltd	Trans-Afam Power Ltd	-	-

Table 5
Afam III Thermal Power Plant [Adapted from 9,10,12,13]

Commencement Period	Plant Location	Total Installed Capacity	Status	Owners	Corporate Ownership and Operator (Parent)	Developers	Contractors	Under-construction
Project established 1962 Development in multiple phases	Afam, Oyigbo LGA, Rivers State Coordinates (WGS 84): 4.85176, 7.2535	Unit GT 9-12, (4No. of GT 27.5MW each) 110MW	Not active now	Trans-Afam Power Ltd	Trans-Afam Power Ltd	Trans-Afam Power Ltd	-	-

Table 6 Afam IV Thermal Power Plant [Adapted from 9,10,12,13,]

Commencement Period	Plant Location	Total Installed Capacity	Status	Owners	Corporate Ownership and Operator (Parent)	Developers	Contractors	Under-construction
Project established 1962 Development in multiple phases	Afam, Oyigbo LGA, Rivers State Coordinates (WGS 84): 4.85176, 7.2535	Unit GT 13-18, (6No. of GT 75MW each) 450MW	Active (450MW)	Transcorp Power Ltd	Transnational Corp of Nigeria PLC	Trans-Afam Power Ltd	-	-

Table 7 Afam V Thermal Power Plant [Adapted from 9,10,12,13]

Commencement Period	Plant Location	Total Installed Capacity	Status	Owners	Corporate Ownership and Operator (Parent)	Developers	Contractors	Equipment Manufacturer s/ Suppliers
Project established 2002 Development in multiple phases	Afam, Okoloma, Oyigbo LGA, Rivers State Coordinates (WGS 84): 4.85176, 7.2535	Unit GT 19-20, (2No. of GT 138MW each) 276MW	Active (276MW)	Transcorp Power Ltd	Transnational Corp of Nigeria PLC	Trans-Afam Power Ltd	-	Siemens supplied: Siemens SGT5-2000E gas turbine and Air Cooled two-pole TLRI 115/36 electric generator

Table 8 Afam IV-V Thermal Power Plants with Combined Generation [Adapted from 4, 9,10,13]

Commencement Period	Plant Location	Total Installed Capacity	Status	Owners	Corporate Ownership and Operator (Parent)	Developers	Contractors	Equipment Manufacturer s/ Suppliers
(Afam IV) - 1982 and (Afam V) - 2002	Afam, Okoloma, Oyigbo LGA, Rivers State Coordinates (WGS 84): 4.85176, 7.2535	Unit GT 13-18, (6No. of GT 75MW each) 450MW And Unit GT 19-20, (2No. of GT 138MW each) 276MW 987.2MW	Active (726 MW)	Transcorp Power Ltd	Transnational Corp of Nigeria PLC	Trans-Afam Power Ltd	-	Siemens supplied: Siemens SGT5-2000E gas turbine and Air Cooled two-pole TLRI 115/36 electric generator

Table 9 Shell's Afam VI Thermal Power Plant [Adapted from 14, 15]

Commencement Period	Plant Location	Total Installed Capacity	Status	Owners	Corporate Ownership and Operator (Parent)	Developers	Contractor/Equipment Suppliers
Project established 2008	Afam, Okoloma, Oyigbo LGA, Rivers State. Coordinates (WGS 84): 4.84953, 7.25693	(3No. GT13E2 Units of 150 MW each), and 1No. Steam Turbine (ST) 200MW 650MW	Active (650MW)	The Shell Petroleum Development Company of Nigeria Ltd	NNPC Ltd [55.00%]; Shell PLC [30.00%]; Total Energies SE [10.00%]; other [5.00%]	The Shell Petroleum Development Company of Nigeria Ltd	Daewoo Engineering & Construction, Dietsmann and GE Power

Table 10 Ughelli Delta Thermal Power Plant [Adapted from 19, 20]

Commencement Period	Plant Location	Total Installed Capacity	Status	Owners	Corporate Ownership and Operator (Parent)	Gas supplied by	Contractor/Equipment Suppliers
Project established 1966 and go on in phases	Ughelli, Delta State Nigeria. Coordinates (WGS 84): 5.54131, 5.91591	Phase I: Two Stal-Laval Turbin gas turbines each 36MW; Phase II: Six Mitsubishi Power H-25 gas turbines each 23.78MW; Phase III: Six Mitsubishi Power H-25 gas turbines each 23.78MW; Phase IV: Six GE Power Frame 9 gas turbines each 100MW. 964.68MW	Active 892.68MW	Transcorp Power with a stake of 100%.	transnational Corp of Nigeria PLC	The Shell Petroleum Development Company of Nigeria Ltd	The air-cooled, open-ventilated electric generator for the Ughelli Delta Power Plant Phase II was provided by Mitsubishi Power. Phase III of the Ughelli Delta Power Plant used a horizontal shaft electric generator from Siemens.

Table 11 Sapele Thermal Power Plant [Adapted from 21]

Commencement Period	Plant Location	Total Installed Capacity	Status	Owners	Corporate Ownership and Operator (Parent)	Gas supplied by	Contractor/Equipment Suppliers
<p>Phased commissioning of the project took place between September 1978 and August 1981. Project (Unit 1-GT 11-14)</p> <p>Project Unit 1-ST1-6) established in 1980</p>	<p>Sapele, Delta State Nigeria. Coordinates (WGS 84): 5.92614, 5.64498</p>	<p>Unit 1-GT (11-14) each 75 MW = 300MW</p> <p>Unit 1-ST (1 – 6) each 120 MW = 720MW</p>	<p>Not Active</p> <p>Active with (480MW)</p> <p>(Since Unit1-ST4 and 5) are not operational</p>	<p>Sapele Power PLC</p>	<p>G-Eurafric Power Ltd</p>	-	-

Table 12 Sapele II Thermal Power Plant [Adapted from 22, 23, 24]

Commencement Period	Plant Location	Total Installed Capacity	Status	Owners	Corporate Ownership and Operator (Parent)	Gas supplied by	Contractor/Equipment Suppliers
<p>The project was established between (2011 and 2012)</p> <p>Project Unit3 (1-3) expected to come online by 2028</p>	<p>Sapele, Delta State Nigeria. Coordinates (WGS 84): 5.92614, 5.64498</p>	<p>Unit 2: (1-4) Four Gas Turbines of (GE Frame 9E Gas Turbines) 113 MW each. 507.6 MW (ISO) and 451MW (Net)</p> <p>Unit3:(1-3) has 151 MW each</p>	<p>Active</p> <p>451MW</p> <p>453 MW</p> <p>Not Active at the moment</p>	<p>Ogorode Generation Company Limited</p>	<p>Project Coordinator : Oska-Jo and Partners Limited</p> <p>Niger Delta Power Holding Co</p>	-	<p>EPC Contractor: Marubeni Engineering West Africa Limited</p> <p>GE Power Ltd supplied the Gas Turbines, etc components</p>

Table 13 Olorunsogo I Thermal Power Plant [Adapted from 25, 26, 27]

Commencement Period	Plant Location	Total Installed Capacity	Status	Owners	Corporate Ownership and Operator (Parent)	Developers	Contractor/Equipment Suppliers
Project got commissioned 2007	Olorunsogo Coordinates (WGS 84): 6.882N, 3.314 E in Owode LGA, Ogun State	8No. 42 MW each, (PG6581B, Frame 6 type) 336 MW	Active 336MW	Olorunsogo Generation Company Limited	Olorunsogo Generation Company Limited	SEPCO III Electric Power Construction and Oska-Jo & Partners Ltd/Scott Wilson Plc.	For the gas-fired project, Nanjing Turbine & Electric Machinery (Group) was chosen as the turbine provider. Eight PG6581B gas turbines, each with a 42 MW nominal capacity, were supplied by the business.

Table 14 Olorunsogo II Thermal Power Plant (NIPP) [Adapted from 4, 26, 28]

Commencement Period	Plant Location	Total Installed Capacity	Status	Owners	Corporate Ownership and Operator (Parent)	Developer	Contractor/Equipment Suppliers
Project Commissioned in 2015 – 2017.	Coordinates (WGS 84): 6.88532 N, 3.31627E Ogun, Nigeria	Four No. 112.5MW each Gas Turbine (GE Frame 9E Gas Turbines), Two No. 112.5 MW each Steam Turbines 754MW (ISO) and 676MW (Net)	Active 750MW	Olorunsogo Generation Company Limited	Olorunsogo Generation Company Limited	SEPCOIII Electric Power Construction	Oska-Jo and Partners Limited SEPCOIII Electric Power Construction Corporation of China GE Power supplied the project with electric generators Steam boiler supplied by John Cockerill Group for the project.

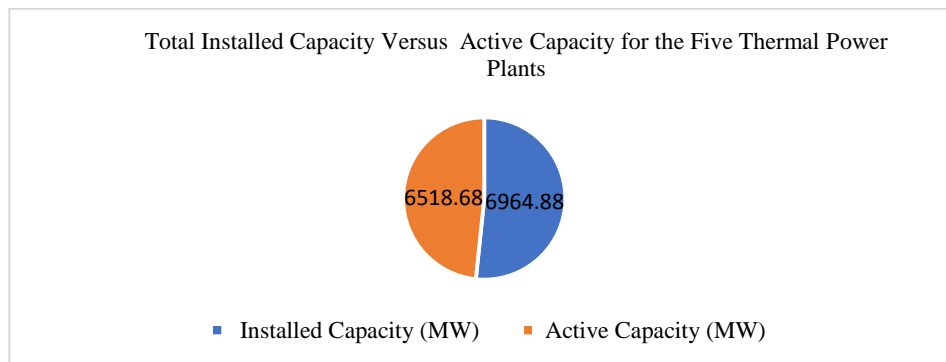


Figure 1 Total Installed Capacity Versus Active Capacity

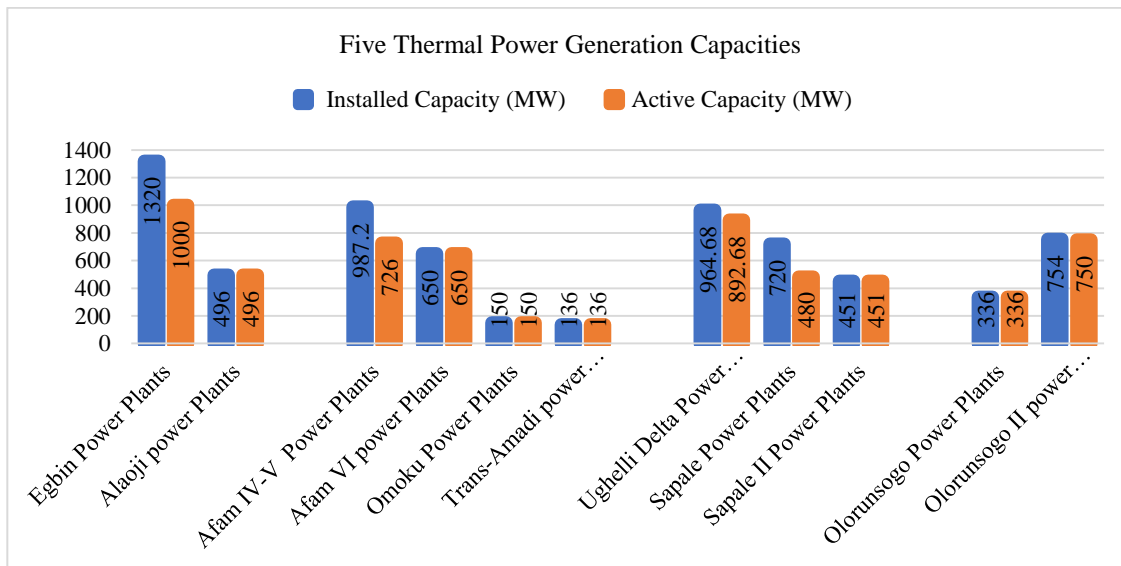


Figure 2 Five Thermal Power Plants under study

5. Conclusion

The thermal power plants under investigation are gas-fired in single or combined cycles; as a result, they are located near gas pipelines supplied by some gas plants, as evidenced by [1, 26]. These gas plants include the Escravos pipeline system, the Okoloma gas plant, the Norten option gas plants, the Agip (Obiafu-Obrikom) gas plant, and the Utorogu-Ughelli east gas plant. Aside from politics, a significant issue with thermal power generation is the supply of gas.

It appears that the five thermal power facilities under investigation produce 93.59% of their installed capabilities. When we combine the installed capacities, we obtain 6964.85 MW and the active capacity is 6518.68 MW, or almost 6.52 GW.

As long as gas is readily available and sufficiently supplied, with less political interference, the acquisition and installation of advanced gas turbines in the region producing natural gas, and an energy mix (using renewable energy sources), the power status will be conducive to the country's industrialization and economic expansion.

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