A

Technical Report

On

Student's Industrial Work Experience

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DEDICATION

This work is dedicated to the almighty God, for it is by his grace I have come this far in actualizing my dream of becoming a purpose driven person and also to my father, Builder Christian and mother, Mrs Theresa Ezeugwa for their unrelenting support to ensure that I become a qualified Engineer.

ACKNOWLEDGEMENT

First, to the family of Engineer Edozie and Nneka Ezeugwa for the painstaking efforts they made to ensure I secured an inch perfect SIWES placement I say thank you.

To the Manager NGC EOD, DM Tech- Engineer Uwakwe, Superintendent Operations- Mr Nwagu A.O, I am grateful for the rare opportunity you gave me.

I thank Mr Oruwari R.O, The process plant operator to which I was attached for the resounding knowledge he imparted in me.

I also thank Mr Abdullahi for his ever engaging academic presence, Mr Yusuf and Mr Oluji for their maximum support at work, and to the entire Staff and Management of NGC EOD, I say thank you for being part of my success story.

ABSTRACT

Nigerian Gas Company (NGC) receives pure natural gas from the SPDC (Shell) gas producing field at Alakiri through the Alakiri & Alakiri/Obigbo North-Onne Pipeline System which transports natural gas under pressure. The gas received is pure methane (CH4). We process the gas before distributing it to the final consumer. The final consumer in this case is NOTORE, a fertilizer producing plant.

My main functions were terminal facilities inspection, controlling, monitoring, logging process parameters, and gas metering. Sub-functions include exchange of inlet and sales-line pressure with NOTORE and sending out radio reports to the zonal office control room, which includes but not limited to the daily gas volume supplied to the consumer.

This report is about my work experience at the NGC.

TABLE OF CONTENTS

42

LIST OF FIGURES

LIST OF TABLES

CHAPTER ONE

1.0 INTRODUCTION

Natural gas, which was once an almost unwanted product or more correctly a co-product of crude oil production, now provides about one-fifth of all the world's primary energy requirements. This remarkable development has taken place in only a few years with the increased availability of the gas resources of the countries, and the construction of long-distance, large diameter steel pipelines which, have brought these ample supplies of gaseous fuel to domestic, commercial, and industrial users many miles away from the field themselves.(Ikoku, 1992)

Today, the Nigeria National Petroleum Cooperation (NNPC) through the Nigerian Gas Company plays a dominant role in the harnessing, transmitting and sales of natural gas in Nigeria.

1.1 HISTORY OF THE COMPANY

The Nigerian Gas Company Limited (NGC) was established in 1988 as one of the 11 subsidiaries of the Nigerian National Petroleum Corporation (NNPC). It is charged with the responsibility of developing an efficient gas industry to fully serve Nigeria's energy and industrial feedstock needs through an integrated gas pipeline network and also to export natural gas and its derivatives to the West African Sub-region.

NGC is committed to adding value to natural gas and making it an energy resource of first choice for the benefit of all stakeholders. The company was initially established to efficiently gather, treat, transmit and market Nigeria's natural gas and its by-products to major industrial and utility gas distribution companies in Nigeria and neighboring countries. In other to deliver efficient services to the numerous customers the business philosophy has been reviewed to focus on Transmission, Distribution and Marketing of Natural Gas.

1.1.0 Existing pipeline systems and customers;

NGC currently operates the following customer supply systems:

i. The Sapele gas supply system which supplies gas to NEPA Power Station at Ogorode-Sapele,

ii. The Aladja system which supplies to Delta Steel Company Aladja, and the Sapele-Oben-Ajaokuta steel Company and will form the back-bone of a future Northern pipeline System.

iii. Imo River-Aba system for gas supply to the International Glass Industry Limited, PZ, Aba Textile Mills and Aba Equitable industry.

iv. Other systems are Obigbo North-Afam system which caters for NEPA Power Station at Afam.

v. The Alakiri to Onne Gas pipeline system for supply of gas to NOTORE, former National Fertilizer Company (NAFCON) for fertilizer production.

vi. The Alakiri-Afam-IkotAbasi system for gas supply to the Aluminum Smelting plant (ALSCON), Ibom Power Company (IPC).

vii. The Escravos-Lagos pipeline (ELP) which supplies gas to NEPA's Egbin power plant near lagos, Subsequent spur lines from the EPL supply the West African Portland Cement (WAPCO) plant at Sagamu and Ewekoro, PZ Industries at Ikorodu, City Gate in Ikeja Lagos, NEPA Delta IV at Ughelli and Warri Refining and Petrochemical Company at Warri.

NGC pipeline system comprises of over 2000 kilometers of pipeline ranging from 4" to 36" In diameter with an overall design capacity of more than 2.5 billion standard cubic feet of gas per day (bscf/d), 16 compressor stations and 34 metering stations. The facilities represent a current asset base of than N51 Billion.

The NGC has its headquarters at Odin Road, Ekpan, Warri, Delta State, Nigeria.

Its Major Operational Departments are;

i. Western Operations Department (WOD), Off Isoko Road, Ughelli, Delta State.

ii. Eastern Operations Department (EOD), 4-9, Moscow Road, Port Harcourt, Rivers State.

iii. Lagos Operations Department (LOD), Egbin, near Ikorodu, Lagos State.

iv. Northern Operations Department (NOD), Wuse Zone 6 Abuja.

In addition to these Operational Departments, NGC has embarked on the following projects;

1.1.1 West African Gas Pipeline

The feasibility study for this project which is designed to export gas by pipeline to the West African Countries (Benin, Ghana and Togo) has been completed and the agreement signed by the Heads of Governments sponsored by NNPC through NGC , Ghana National Petroleum Corporation, Chevron, Shell SocieteBeninoise du Gaz and SocieteTogolais du Gaz. The project is still open to investors. The long-term plan is to extend this pipeline to Dakar (Senegal) to make Nigeria's gas available to the whole region.

1.1.2 Trans Nigeria Pipeline

NGC plans to integrate all gas transmission systems in the country. It is also planned that extensions of the systems would be made to the far Northern States of Borno and Sokoto as well as to the central industrial state Kano. The resulting highly interconnected system would provide full flexibility and better management or adjustment of supply and demand throughout the country. In the domestic market investment options exist for investors who may wish to do so in gas transmission and distribution joint ventures with NGC for specific projects such as gas-based independent power plant (IPP) and such energy intensive sectors as cement, glass and paper industries.

Third parties could also purchase gas from NGC at city gates and distribute to industries and other users. The Company has already signed agreements with Unipetrol Plc, Gaslink and Shell, in this regard for gas distribution to two major industrial areas in Lagos and Ogun State in Nigeria.

1.1.3 Compressed Natural Gas as Automotive Fuel

In transportation, Compressed Natural Gas (CNG) as an alternative vehicle fuel has a great future in Nigeria especially in view of the need to export more crude oil or refined products for additional foreign revenue.

Other business lines being considered by NGC, in line with government natural gas utilization objectives are the establishment of gas-based fertilizer plants, Natural gas liquids extraction and domestic use of natural gas. These are open to private, local and foreign investors for which NGC is ready to engage in useful discussions.

1.2 EASTERN OPERATIONS DEPARTMENT

Eastern Operations Department (EOD) Head Office is located at the 5th floor of the NNPC Zonal Office Building situated at 4-9 Moscow Road Port Harcourt Rivers State. It is made up of various sub-divided departments to ensure adequate functioning of the company. The Operations Department, to which I was assigned, is responsible for the work force needed at various gas metering stations to run its daily activities which involves monitoring, recording and calculation of gas plant parameters. Each staff is posted to a metering station for this purpose.

The Eastern Operations Department (EOD) maintains the following gas metering stations:

i. Onne Metering Station: This was built to supply gas to former Nigeria Fertilizer Company (NAFCON), now called NOTORE.
ii. Afam Metering Station: It is responsible for supplying gas to former National Electric Power Authority (NEPA), now Power Holding Company of Nigeria (PHCN).
iii. Owaza Compressor Station: This station supplies gas to Glass Industry Limited (GIL), a glass manufacturing plant located at Owaza in Aba, Abia State.
iv. Eleme Metering Station**:** This metering station is built to supply gas to Genesis Electricity.
v. Ikot-Abasi Metering Station: This metering station supplies gas to former Aluminium Smelting Company (ALSCON) now called Russian Aluminium (RUSAL) and Ibom Power. It is located at Ikot-Abasi, Akwa-IbomState. They use this gas for power generation.

1.3 ORGANIZATION CHART;

The broad organogram of NGC is presented below:

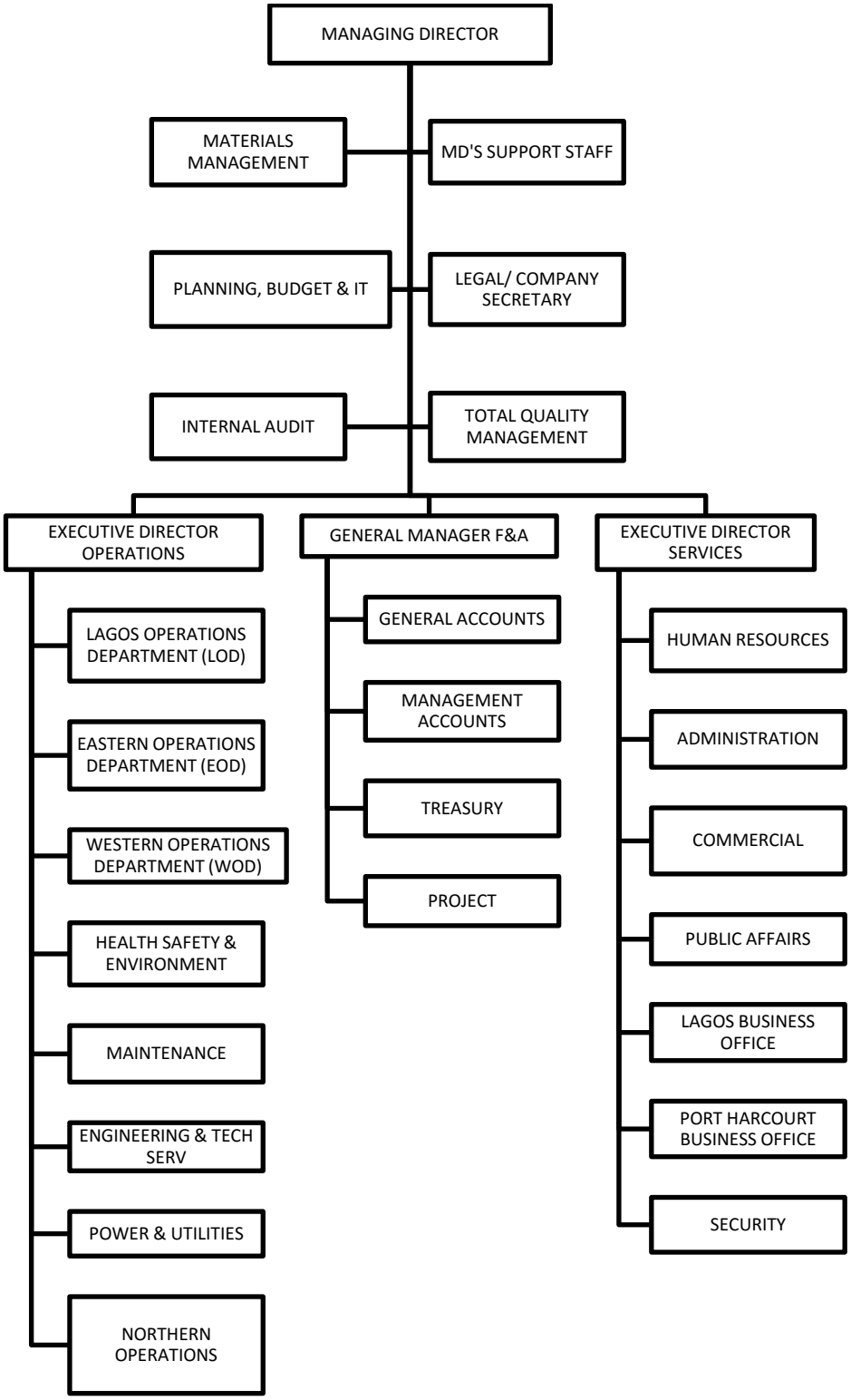

Figure 1: NGC Organogram

1.4 VARIOUS DEPARTMENTS AND FUNCTIONS

Responsibilities of key position in the organogram above are summarized below:

Managing Director:	Responsible for all activities in NGC and assisted by Operations and Service Director as well as General Manager Finance and Account. He also oversees the Legal Administration, Audit, Planning, Budgeting, Information Technology and Material Management functions.
Executive Director, Operations:	Responsible for all the operations of NGC pipeline systems and associated facilities, management, maintenance and technical services, Health, safety & environment functions. He also oversees the operations departments (LOD, WOD, EOD, & NOD).
Executive Director, Services:	Responsible for all the Human Resources, Commercial, Administrative and Public Relations as well as Security function in NGC. He also oversees the business development departments (LBO & PHBO).
GM, Finance & Accounts:	Responsible for all financial activities of NGC, He also oversees Billing, Treasury, General, Projects and Management Account functions.
Manager, ETSD:	Responsible for project management of new pipeline systems and facilities and upgrade of

	existing gas processing, conditional/metering facilities and associated civil works. He also oversees pipeline/facilities protection and quality control.
Mangers, WOD, LOD, EOD, NOD:	Responsible for the receipt, transmission, treatment, metering and delivery of on-specification natural gas to various end users. Also oversees monitoring and routine maintenance of gas pipelines, processing/conditioning and metering facilities.
Manager, Commercial:	Responsible for Gas Business Development, Market Research and management of gas purchase and sales/transportation agreements.
Manager, Materials Management:	Responsible for the procurement of equipment, spare parts and other materials, warehousing and inventory management of the equipment and spare parts for operational purposes.
Human Resources Manager:	Responsible for management of human asset, placement, training & development of staff in

	NGC. Also ensures the integrity of staff database, maintain industrial peace by the provision of enhance welfare services and career development opportunities to staff.
Company Secretary / Legal Adviser:	Responsible for ensuring NGC activities are run within the limits and expectations of the law by providing and proffering legal advices and opinions. Conduct due diligence at Corporate Affairs Commission, Coordinate and monitor litigation matters. Draft review and negotiate agreements and other legal instruments. Handle documentation and registrations of contractors. Also oversees and organizes Management Executive Committee meetings, NGC's Board Meetings and Management Tenders Committee meetings.
Manager, HSE:	Responsible for ensuring safe operations by NGC's staff and third parties working for or on-behalf of NGC. Also monitors operations to ensure positive impact on the environment.
Manager, Public Affairs:	Responsible for managing the corporate image of NGC. Also ensures the establishment and sustenance of good relationships between NGC and its host communities and provision of protocol services and publications.

Manager, PBIT:	Responsible for Planning and Budget Monitoring, Strategic planning, implementation and development of Information System Strategy and process improvement for NGC.
Manager Admin:	The Administration Department of the Nigerian Gas Company (NGC) provides efficient support services to all NGC personnel and operations and ensures day-to-day activities of the organization meet customers' expectations and requirements.
Manager, MTCE	Maintenance Department (MTCED) of the Nigerian Gas Company Limited (NGC) is saddled with the responsibility of maintaining NGC's plant, pipelines and associated facilities in all the areas of operation viz, Northern Operations Department (NOD), Lagos Operations Department (LOD), Western Operations Department (WOD) and Eastern Operations Department (EOD). This also includes upgrades/rehabilitation of gas processing, conditioning, metering facilities and Planning of Maintenance of operational facilities.

Manager, Audit:	The Internal Audit Department of Nigerian Gas Company Limited (NGC) is committed to ensuring that all activities in the organization are carried out in compliance to laid down procedures of the organization.
Manager, General Accounts:	Responsible for ensuring the reliability of data posted into the ledger for the production of statutory accounts and periodic financial statements. It is made up of general ledger, Billing & Credit Control Invoice Processing and stock accounting sections.
Manager, Treasury	Monitor and maintain accurate record of receipts and payments by the company. It has four sections; local payments, cash & banking operations, payroll and advances.
Managements Accounts:	Provide qualitative and quantitative evaluation of performance on regular basis to assist management in decision making. It comprises of budget, Management information system and Assets sections.
Manager, Project Accounts:	Handles capital expenditure on local projects, project with franchise holders of Build Operate and Transfer (BOT) or Build and Transfer; project on behalf of the federal government.

The functional / departmental structure of the company is present below.

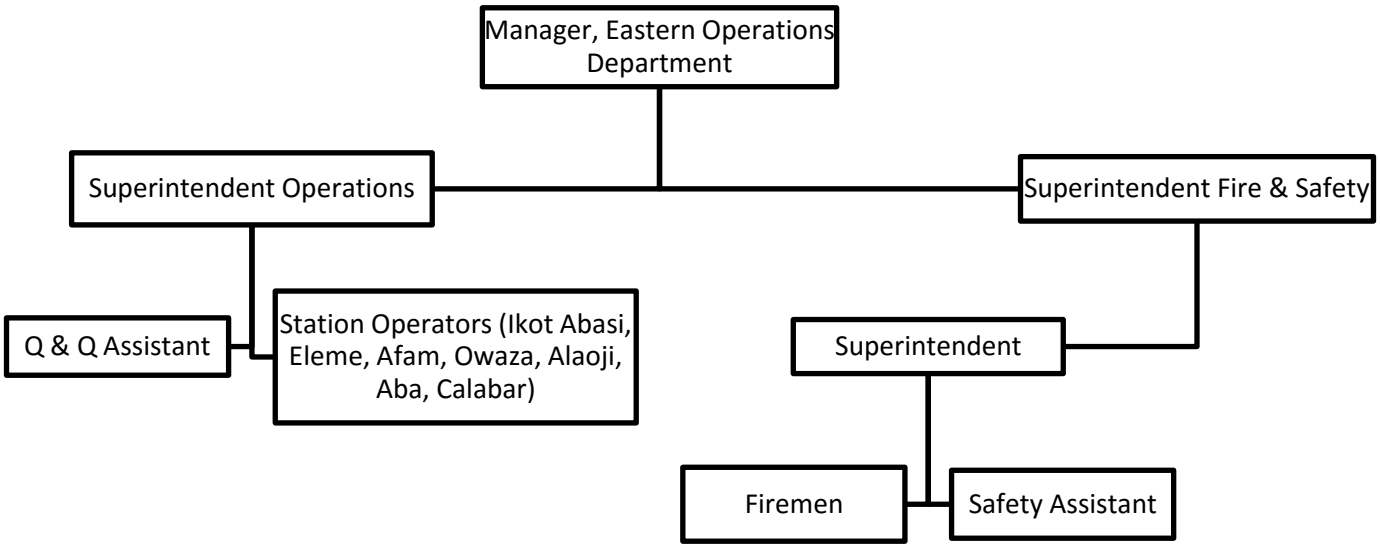

Figure 2: Functional / Department Organogram - EOD

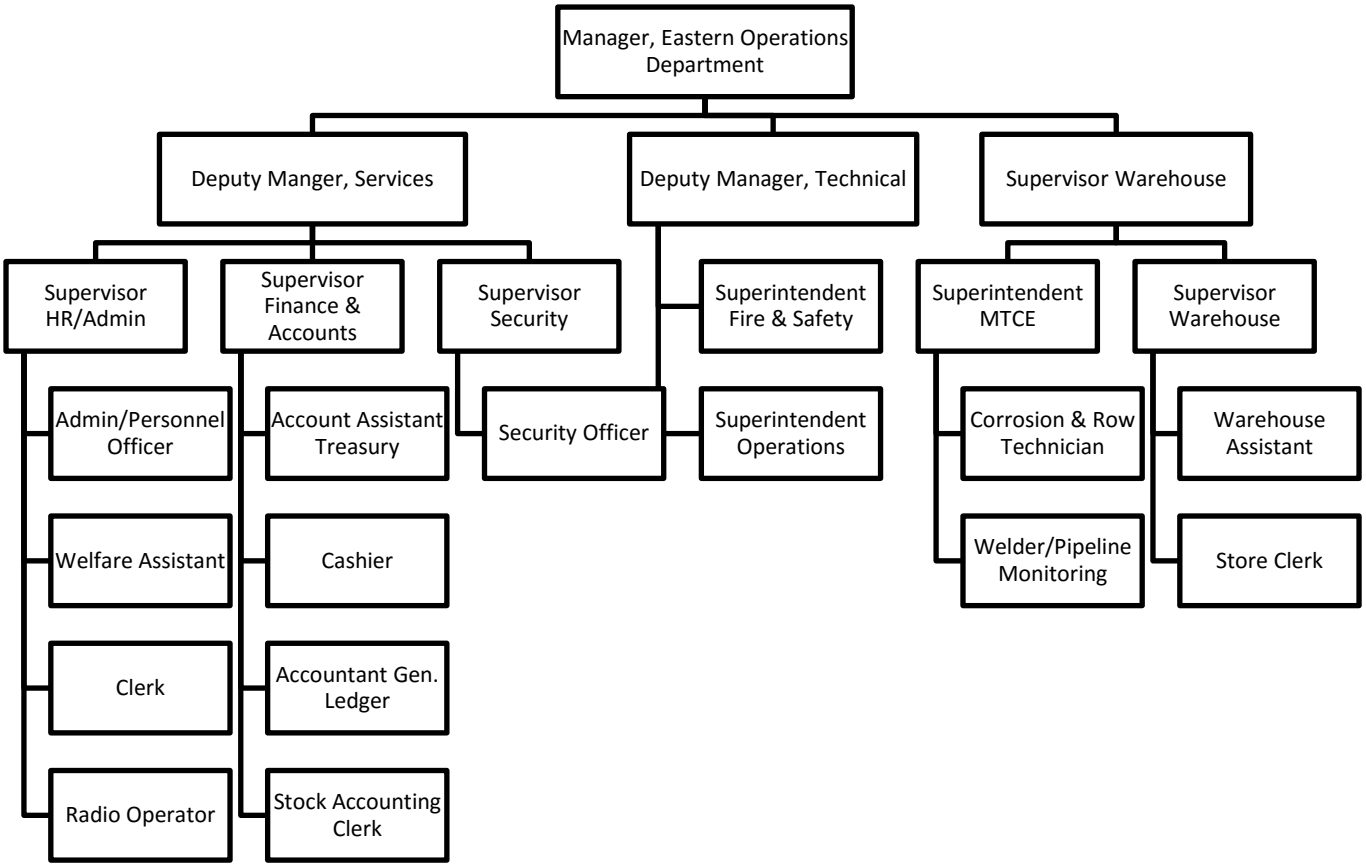

Figure 3: Functional / Department Organogram Cont'd – EOD

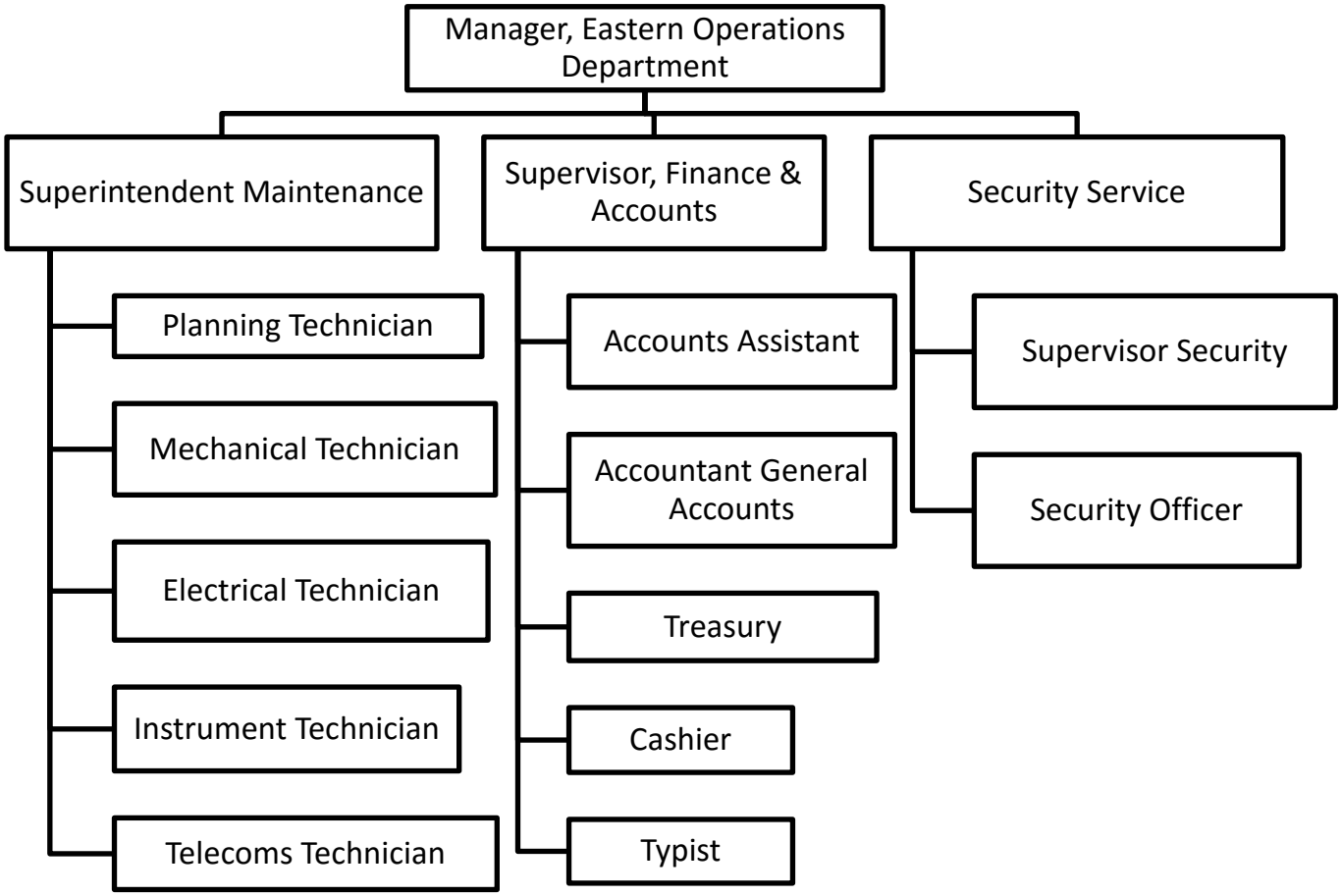

Figure 4: Functional / Department Organogram Cont'd – EOD

CHAPTER TWO

2.0 ACTIVITIES DURING THE SIWES PERIOD

PREAMBLE

The Gas Metering Station of NGC at Onne consists of a Gas Plant, with a Control Room inside. This chapter elucidates the importance of this plant; Natural gas formation and its uses, Gas delivery and delivery conditions, Gas characteristics, Process facilities description, Instrumentation and Natural gas measurement.

2.1 IMPORTANCE OF THE PLANT

This plant was set up to gather, treat, and transmit free natural gas from the gas producing field at Alakiri and Obigbo North through Alakiri/Obigbo North-Onne Pipeline System which transports natural gas under pressure, to the NOTORE fertilizer producing plant at Onne. The gas received is pure methane (CH4).

Its sole aim is to meter gas transmitted to her customers by ensuring:

i. The gas supplied to the customers is moisture free
ii. The gas is supplied at the recommended pressure and temperature specification.
iii. Daily measurement of the actual amount of gas supplied to the customers.

And these are achieved through the gas processing facilities installed in the metering station.

2.2 FORMATION OF NATURAL GAS

Natural gas is a fossil fuel formed when layers of buried plants, gases, and animals are exposed to intense heat and pressure over thousands of years. The energy that the plants originally obtained from the sun is stored in the form of chemical bonds in natural gas. Natural gas is a nonrenewable resource because it cannot be replenished on a human time frame. Natural gas is a hydrocarbon gas mixture consisting primarily of methane, but commonly includes varying amounts of other higher alkanes and even a lesser percentage of carbon dioxide, nitrogen, and hydrogen sulfide.

Natural gas is also found in deep underground rock formations or associated with other hydrocarbon reservoirs in coal beds. Petroleum is another resource of fossil fuel found in close proximity to, and with natural gas.

2.2.1 Uses

Before natural gas can be used as a fuel, it must be processed to remove impurities, including water, to meet the specifications of marketable natural gas. The by-products of this processing include ethane, propane, butanes, pentanes, and higher molecular weight hydrocarbons, hydrogen sulfide (which may be converted into pure sulfur), carbon dioxide, water vapor, and sometimes helium and nitrogen.

i. Power generation: Natural gas is a major source of electricity generation through the use of cogeneration, gas turbines and steam turbines.
ii. Domestic uses: Natural gas dispensed from a simple stovetop can generate temperatures in excess of 1100 °C (2000 °F) making it a powerful domestic cooking and heating fuel. In much of the developed world it is supplied through pipes to homes, where it is used for many purposes including ranges and ovens, gas-heated clothes dryers, heating/cooling, and central heating.
iii. Fertilizers: Natural gas is a major feedstock for the production of ammonia, via the Haber process, for use in fertilizer production.
iv. Aviation: It helps the jet engine and because, it has more specific energy than the standard kerosene. And the low temperature can cool the air which the engine compresses for greater volumetric efficiency.

2.3 GAS DELIVERY AND DELIVERY CONDITIONS

2.3.0 From SPDC Gas Production Center;

Gas to be transported by pipeline is Free Natural Gas, produced by SPDC from the Alakiri/Obigbo North gas field.

Gas delivery conditions are P(58 barg) and T(20-30C).

2.3.1 To Onne Notore Fertilizer Plant;

This gas is delivered to Notore Fertilizer Plant of Onne at a pressure of 44 barg @+ or -2barg and close to actual ground temperature.

2.4 GAS CHARACTERISTICS

Table 1: Composition of gas

Compound	Percentage By Volume
C1	81.48
C2	8.17
C3	4.64
iC4	0.81
C4	1.19
iC5	0.30
C5	0.20
C6	0.12
C7+	0.05
N2	1.16
CO2	1.88
Total	**100.00**

Molecular Weight;. 20.403KMole.

2.5 ONNE TERMINAL MAIN PROCESS FACILITIES DESCRIPTION (NNPC, 1987)

2.5.0 The Plant/Pipeline Description

The Gas Plant is located at Onne in Eleme L.G.A of Rivers State, and was designed for a capacity of 140MMscf/d (One hundred and forty million standard cubic feet per day). The

primary source of gas supplied to the station is the Shell Petroleum Development Company (SPDC) field through a 114km underground pipeline network from the SPDC associated gas well in Okoloma, to Alakiri, Eleme and Obigbo North respectively.

The pipeline's length is about 118.4km comprising two major segments which link all the gas sources into the same system.

Segment 1 has its starting point at Alakiri launching/scrapper trap station and end point at Obigbo North Tie-in receiving trap station. The line diameter is 14" class 600 and the segment is about 37km, the first 19.7 km of the line runs parallel to the existing NGC Alakiri-Onne gas pipeline and transverses mainly swampy areas and crosses the Bonny River.

Segment 2 has a line diameter of 14" class 600 and about 44km from Obigbo North Tie-in scrapper trap station to the intermediate scrapper trap station. The segment transverses predominantly dry terrain and cross the following main features, Imo River, express road, railway track, pipelines and tarred road.

2.5.1 Terminal Inlet

It consists of two 14'' lines on which the following apparatus are provided;

i. Terminal inlet gas powered valve MOV 209,

ii. Temperature gauge TI 202,

iii. Pressure gauge PI 204.

Figure 5: Alakiri's Terminal Inlet.

Figure 6: Obigbo North's Terminal Inlet.

The pipe which runs from the ground at the inlet part of the plant is surrounded or armed with high density of concrete. It is buried for its integrity and coated with coal tar/fiber glass. The concrete provides to the pipeline the negative buoyancy, as required to keep it in steady position, even if the entire route is submerged.

2.5.2 Scraper Receiving Section

This is located, within a trap inside the Onne terminal area. This scrapper has some valves provided on it for control. The receiving trap is a mechanism designed to receive an incoming pig during pigging operation. It consists of a receiver barrel connected to the pipeline in series with a valve that allows the trap to be in line with pipeline flow, vent drain thermal expansion safety valve and pig signaler (a field transmitter that relays the signal to the control panel as the pig approaches the trap).

Pigging in pipeline is a maintenance procedure carried out using Pig Inspection Gauges (PIGs) to perform the operations of cleaning and inspection of the pipeline without stopping the flow of the product(methane gas in this case) in the pipeline. This is done by inserting the pig into a pig launcher, thereby creating a differential pressure within, before the launcher is closed and the pressure of the product is used to push the pig along inside the pipeline until it reaches the receiving trap.

Figure 7: The Scrapper Receiving Trap.

2.5.3 Gas Scrubbing Skid GS1 and GS2

This system consists of two parallel skid mounted horizontal scrubbing/filtering vessels, separating from gas stream possible solid impurities and condensate liquids if any. One is operating; the other scrubber is on standby.

Each contain interconnected horizontal vessels of which the upper one is the demister and the lower one the liquid/dirt settling chamber. The filter is of the cartridges filtering type and each scrubber includes 16 cartridges; the demister is of vane type.

The natural gas flowing to the terminal passes through one of the scrubbers (either GS1 or GS2) and due to both the reduction of the flow velocity and the action of the filtering cartridges, the gas is cleared as specified from all possible impurities and as well from water, if any. The separated solids and liquids are collected in the lower chamber of the scrubber from where it is evacuated through the level control valves (LCVs) or through the bottom drain. The whole scrubbing system can be by-passed by the operator, subject to ground conditions.

The gas scrubber has the following:

i. Centrifugal inlet device where the primary separation process takes place.

ii. Settling section that reduce the turbulence of fluid stream and allows the liquid droplets to fall to the bottom of the equipment.

iii. Mist eliminator to eliminate small liquid droplet that did not settle

iv. Level control, liquid dump valve, gas back pressure and relief valves, pressure gauge, site glass, instrument gas regulator and piping.

Figure 8: Gas Scrubbing Skid GS1 and GS2

2.5.4 Gas Preheating System

Recall that the expansion of gas, due to the lamination control in gas pressure, causes a temperature drop which is a direct function of both the pressure drop and the absolute level of

the initial pressure. It is important to note that to avoid liquid condensation, it is necessary that the final gas temperature, after lamination, be well above the gas dew point of 15 degree Celsius. To abide to such a condition, it is necessary to provide to the gas before lamination, the heat which it shall loose passing from high to low pressure level.

This heat required to pre-heat the natural gas before pressure control is generated by an "Indirect Bath Heater" GH1. Here, is its working principle;

First, the gas flowing into the main 14'' process line is partialized in two streams, depending from the opening degree in either direction of the three way control valve (TCV 201). One stream proceeds in the normal direction, while the second one enters the heat exchanging section of the heater. After heating, it returns to the main process line, and then the hot gas stream mixes with the cold one to attain the desired temperature (set point) after pressure lamination.

The level of the gas temperature, before pressure control, is governed by adjusting the mixing ratios of the hot and cold gas, through the three-way valve (TCV) according to the quantity of gas entering the heater. The governing factor is the final temperature after pressure control which is detected and transmitted by TT 201 to TIC 201 that operates the positioner of valve TCV 201.

Figure 9: Indirect Bath Heater.

2.5.5 Gas Pressure Control System

The pressure reduction takes place after heating and before gas measurement. To gain a good pressure control under system standard conditions, two independent systems are provided. One of them operates on low-flow and the other on high-flow. Each one of the independent systems includes two parallel connected lines, of which one is operating or on service and the other on standby.

Also, each line includes two pressure control valve, one is on service, the other one monitoring. Change over between the high and low flow systems takes place upon manually operated remote control, while change over between service and monitor valve is automatic. Each pressure control line includes one up-stream manually operated ‘’ball valve’’ and one-down-stream “gas operated ball valve”. If operated in association, the up and downstream valves isolate the control lines from gas stream and can be utilized to carry out maintenance works on the pressure control valves.

On each line the “active valve” is normally operating while the monitor valve is fully open. In case of failure, the “active valve is fully open and the “monitor” takes over the pressure control. And if the “monitor” valve fails as well, then it shall fully close. In such a case, an alarm is directed to the control room to alert the operating personnel on the “terminal shut-off”, thus, on the need to put “ON STREAM” an alternate pressure control line.

The active valve and the monitor valve operation takes place due to the fact that the control pressure of the two control valves is set at slightly different levels (lower for “active” and higher for “monitor”). Therefore, when the “active valve opens, the pressure delivered tends to rise up and upon reaching its “set point”, the monitor valves takes over the control. If there is malfunctioning, both control valves of each individual line remains open, then the terminal delivery pressure increases and, in such a case, the line gas operated ball valve MOV 201, A/B, MOV 202 A/B is shut off, therefore, the operated line is so put off-service.

Figure 10: Gas Pressure Reduction Skid.

2.5.6 Gas Metering Skid

After pressure control, the gas is measured through four metering lines, parallel connected, of the calibrated disk type. The four lines are governed by process flow control computers. The four lines are; “two 04 meter run” and ‘’ two 08 meter run”. If any of the above lines, each of the “04 meter run” or ”08 meter run” is not operating, we can use any one of the

other ‘’04 meter run’’ or “08 meter run” and vice versa. The metering lines have the following capacities:

i. Lines MS 1A & 1B = C.M/h 4,000 to 38,000

ii. Lines MS 1C & 1D = C.M/h 36,000 to 80,000

Figure 11: The Gas Metering Skid.

Therefore, the total measuring capacity ranges between a minimum of 4,000 and a maximum of 236,000c.m/hr. The operational priority of the metering lines has to be programmed, as

convenient, on the flow computer. The following factors are measured, along with the pressure drop through the calibrated orifice,

i. Gas absolute pressure

ii. Gas absolute temperature.

To measure the gas quantity with adequate accuracy, the no. of operated lines are controlled by the flow computer which helps to put on the on-stream and down-stream themselves, by opening and closing the down-stream themselves on each line, when the flow rate exceed (positively or negatively) the total accuracy range of the operated line(s).

Table 2: Each metering line includes the following apparatus;

		MS-1A	**MS-1B**	**MS-1C**	**MS-1D**
Inlet gas operated	MOV	203	202	203	204
Flow straighter	FV	204	202	203	201
Flow calibrated disk	FE	201	202	203	204
Manually operated	BV	020	021	022	204
Temperature operated	TI	206	208	210	209
Press indicator	PI	207	208	209	205
TRANSMITTERS					
- Flow (Low)	FT	201	203	205	209
- Flow (High)	FT	202	204	206	210
- Pressure Transmitter	PT	210	220	230	240
- Temperature Transmitter	TT	201	203	205	209

All these transmitters feed the flow computers which are:

Flow computer	FY	201	202	203	204

2.5.7 Gas Analyzer

The following gas analysis is performed by this instrument;

i. Gas density for computers

ii. Gas density for recorder

iii. Gas thermal heat (gross)

The *gas density* is continuously measured and referred to the standard conditions (the standard atmospheric pressure (760mmHg) and the temperature of 15 degree centigrade).

The *gross thermal heat* is continuously measured and referred to STP also defined above.

Both the above measured values are conveyed to the ''Master Computers'' on the control panel, for proper computation and recording on ''printer'' of both delivered gas quantities and calories.

Figure 12: Gas Analyzer

2.5.8 Process Control Flow Computers

The control computer controls almost every part of the unit in the plant. The operation of the metering lines (on or off-stream insertion, flow and gas characteristics computing and

recording, total delivered gas computation as c.m and energy etc.) are carried out by the computer system, installed on the control panel in the control room. They consist of four computers, one on each measuring line and two master flow computers with printers.

Among the two master computers, one is the “main” and the second one is “back up” of the first one i.e. the second flow computers which is the master computers, the one which is called the “back up”, backs up the first one which is the “main”. (The function is interchangeable). In case, of computer failure, the control is taken over by the backup unit, which having recorded all process data, continue the governing of the operations and the recording of all data, with no interruption. Printers are provided for each master computer to print out all process data under computer control.

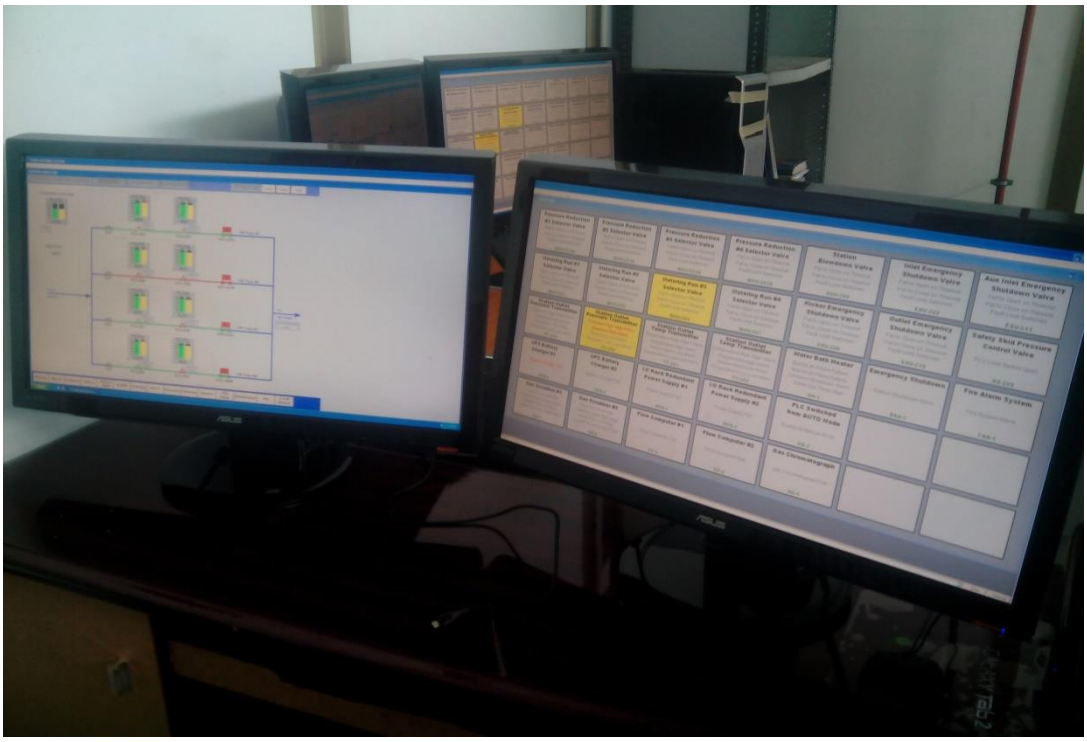

Figure 13: Process Control Flow Computers.

2.5.9 The Control Building

The control building or the control room is a place that houses all electrical and instrumentation apparatus. In the control room, fire extinguisher, flow computers, control panel, etc. is found. The control building is provided with an automatic fire fighting system

consisting of flame and smoke detectors as well as Halon gas sprayers actuated from the smoke and flame detectors.

Also, eight wall mountable portable fire extinguishers are provided in the control room for emergency. The external area is provided with wheel mounted, 50kg capacity and 10 portable 12kg capacity powder fire extinguishers.

2.5.9 Safety Devices Against Abnormally High Pressures

To ensure maximum safety of the terminal operation, the safety devices must be provided. It must be provided to relief or ease any abnormal pressure or even to cut-off abnormal flow in case the pressure relief devices fail to operate.

Some of the safety devices which are provided on the safety skid are as follows;

i. Thermal expansion safety valves (PSV) releasing to the atmosphere
ii. Pressure relief system, through safety valves, releasing to the blow down (BD) and venting system.
iii. Automatic venting system, parallel to the pressure relief system
iv. Gas powered relief valve, manually remotely operated from control room
v. Gas delivery shut-off valve, positioned at the terminal outlet, which automatically cut-off the flow, in case the pressure goes above the maximum allowed limit.

Table 3: Some of the main apparatus you can find on the pressure safety skid (PSS);

Terminal pressure control	PCV	209
Automatic pressure relief valve	PSV	201A
Automatic pressure relief valve	PSV	201B
Gas powered, manually remotely controlled pressure relief and terminal venting valve.	MOV	206

Here, the valve PCV 209 controls the internal pressure of the terminal, relieving possible excess pressures generated by sudden changes in the flow rate or by malfunctioning of the main pressure control valves or during pressure control valve change-over. If the PCV 209 fails to achieve the envisaged results, it calls the pressure relief valves PSV 201 A and B to operate, thus relieving the pressure exceeding their set-point which is 50barg. MOV 206 can be controlled remotely from control panel to vent the terminal, should emergency conditions occur. The safety systems are all connected to the BLOW DOWN SYSTEM of the terminal, where the released gas is vented through the VENTS STACK and liquid, if any, is burn-off into the burning pit or disposed by a truck.

Figure 14: The Pressure Safety Safety Skid

2.5.10 Blow Down And Flare Systems

The blow down system consists of one blow-down vessel (V-2), one vent-stack (E-1) one electric pump (MP-2) and one burning pit.

The *blow-down vessel* collects the gas/liquid coming from those vessels where liquid condensation could have taken place (filters, scrapper barrels etc.), while pure gas streams are directly flown to the vent stack. Inside the blow-down vessel, the final separation of gas from

liquid takes place at atmospheric pressure and the separated gas is vented off through the vent E – 1.

Fig (a)

Fig (b)

(c)

Fig 2.1.1- Blow down and flare system;

(a) Blow Down Vessel,

(b) Vent Stack,

(c) Burn Pit.

The liquid collected on the vessel bottom is either evacuated by truck or burn-off into the burning pit. The burning pit operation is of manual type and so the flowing of the liquid to the pit, as well as the ignition of the liquid into the same, is manually done every time burning disposal of the liquids is made.

Table 4: The following apparatus is included in the blow down system;

Atmospheric blow-down vessel V-2;

level gauge	LG	IBD
high level alarm (to control panel)	HLA	IBD
Pressure safety valve	PSV	IBD
To vent valued delivery line	BV	101
Non return valve	-	-
2” bottom drain valve	BV	105
2” vasslve truck loading line	BV	102
2” valve truck loading line (pump section)	BV	103
2” valve burning pit loading line	BV	104
Truck loading pump	MP	2
Atmospheric vent stack	E	1

2.6 INSTRUMENTATION

Instrumentation includes a number of instruments which can be classified according to their function, namely;

i. Local gauging and dialing instruments: detects process parameters and show them as analogic signal on local indicators i.e. pressure and temperature gauges, level indicators etc.

ii. Gauging/Transmitting Instruments: they read the process parameter and transmit them as analogic electric signal, to other, either local/remote, apparatus for further elaboration and or recording.

iii. Alarms and Safety devices: which alert the terminal operating personnel on anomalous operating conditions and or call to directly, operate the safety devices (i.e. relief, shut-down, firefighting)

iv. Process control apparatus: elaborates the received field data and transmit commands to the field apparatus to keep the system running within the desired operational limits of i.e. pressure and temperature.

v. Process data recording apparatus; which records on paper the main process parameters.

vi. A list of instruments performing action is given; the main process data of the Onne Terminal are transmitted to the Control Panel, where the terminal process is remotely controlled.

vii. Master computers MY 201 A and MY 201 B; the "master computers" are one as back-up to the other. They collect and elaborate the data of the flow computers and gas analyzers, to work out the total flow, as volume (c.m) and energy (calories), delivered to NOTORE, and govern the opening/closing of the MOV(s), located at the inlet side of the metering lines, thus governing the number of operated lines. The selection of the operated line(s) is based on the gas demand and takes place according to a programmable sequence.

viii. Recorders; the recorders available in the control room are:

a. Continuous recording of measured station flow and

Gas density

Gas gross/net combustion heat.

b. Master computer printers, which record the data listed below

On each individual metering line

i. Pressure

ii. Temperature

iii. Instantaneous flow rate

iv. Totalized flow rate

v. Energy flow (as kcal.)

On the system as a whole

i. Instantaneous flow rate

ii. Totalized flow rate

iii. Energy flow

iv. Gas gross thermal heat

v. Gas density.

The master computers can be directed by the operator to print data according to a programmed periodicity or at spot demand.

2.7 NATURAL GAS MEASUREMENT

There are various measurement techniques which can be selected by careful analysis of several factors like accuracy desired, expected useful life of measurement device, range of flow, temperature, maintenance requirements, power availability if required etc but the measurement technique I will highlight is that which entails the use of an **orifice meter**(Ikoku, 1992)**.**

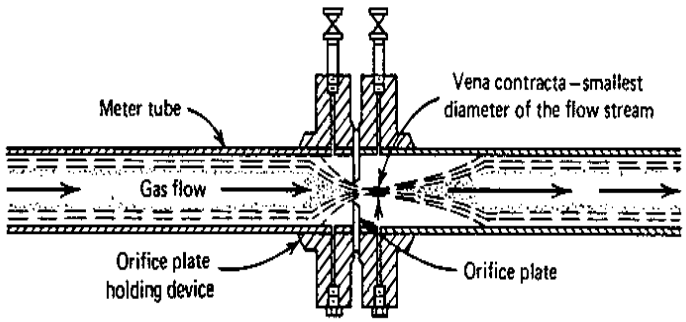

Figure 15: Representation of the primary element of an orifice meter

There are two forms of arrangement, the flange tap arrangement which is used by NGC, as indicated by fig 15 and pipe tap arrangement. This meter consists of a thin flat plate with an accurately machined circular hole which is centered on a pair of flanges or other plate holding device in a straight section of smooth pipe. Pressure tap connections are provided on the

upstream and downstream sides of the plate so that the pressure drop/differential pressure can be measured.

General orifice meter equation is given as;

Qh(cfh)=c'Sqrt(hw.pf) (AGA committee report, No. 3)

Where

Qh=quantity rate of flow at given base conditions,

C'=orifice flow constant, c'=Fbx.Fgx.Ftf.Fr.Fpv.y

Fbx=orifice base factor(cfh) as determined from AGA table,

Fgx=specific gravity factor,

Ftf=flowing temperature factor,

Fr= Reynolds no factor,

Fpv=supercompressibility factor as determined from AGA table,

Y=expansion factor, 1, which is negligible,

hw=differential pressure in inches of water 60F

pf=absolute static pressure in psia

So therefore, quantity of gas transmitted is calculated as Qh(cf) with respect to hours on stream(h).

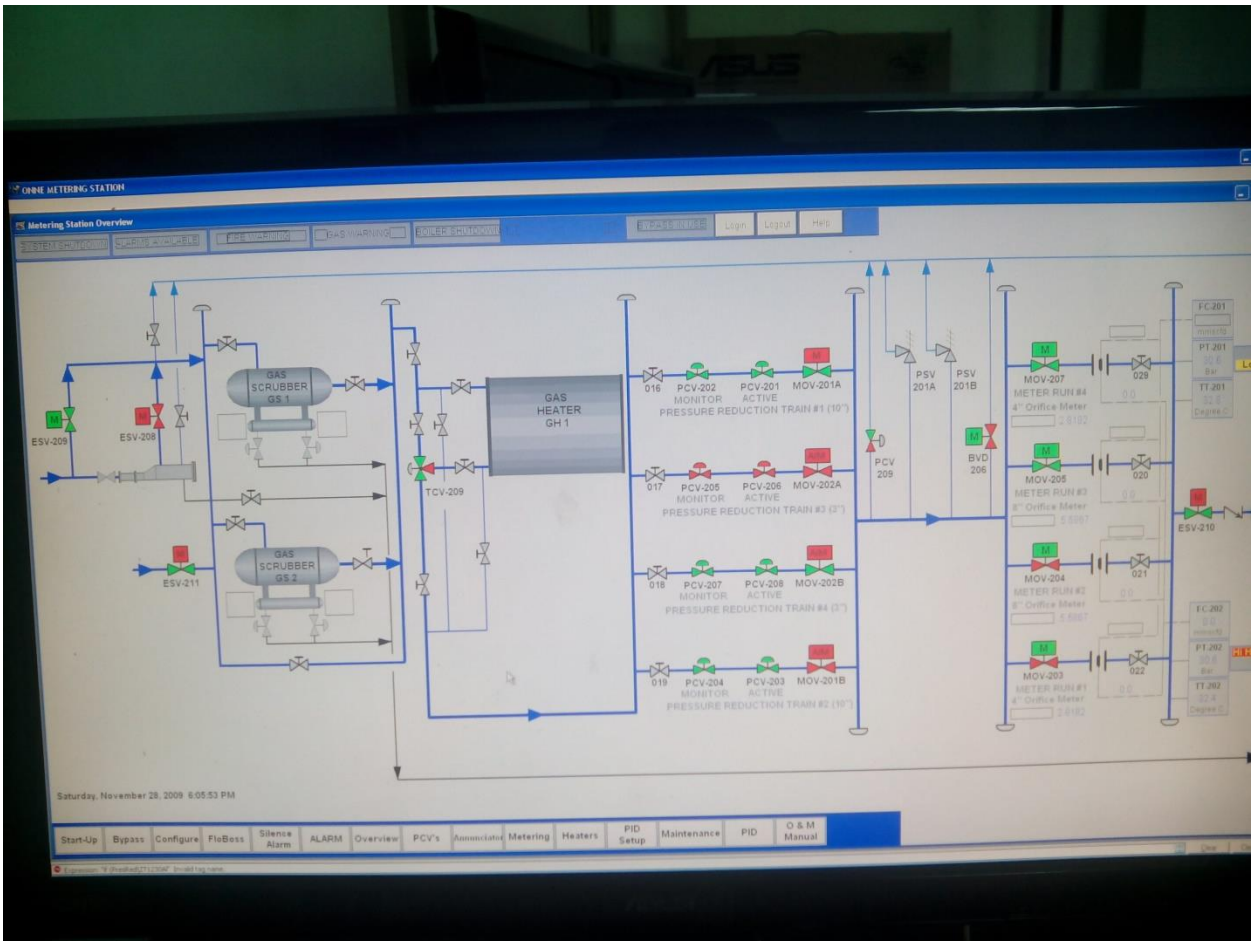

Figure 16: Metering Station Overview

CHAPTER THREE

3.0 PROBLEMS ENCOUNTERED

The problems I encountered during the program spans from sourcing for companies interested in making me their industrial trainee to industrial hazards encountered at the field where I was deployed to.

My first experience of what it takes to search for a job in Nigeria today was a bitter one, in the sense that I had to bear the feeling of being rejected at the gate of the companies I initially approached. This program was established with the intent of the scheme's body to place students in respective organizations related to their discipline. But today, reverse is the case.

I was deployed to the company's station, located far from human habited areas and security. The fertilizer company NOTORE, often vents ammonia gas from their system. Ammonia gas, a colorless gas with a pungent odor makes working at the plant for the specified period of time difficult, as I have to wear a heavy full face mask to counter the effects of irritation on the eyes and odor.

I also had to manage the full effect of condensate encountered from our Alakiri inlet when the level control valve malfunctioned, by timely dumping of excess liquid from the scrubber to the burn pit to avoid carrying over liquid to our customers which will definitely breach the agreement reached between my company and theirs.

3.1 RELEVANCE OF THE SIWES PROGRAMME

The program exposed me to the on field application of Gas Engineering Laboratory 1 & 2 (GNG 301 and GNG 403), where I was able to appreciate the working principles of the gasometering pipeline system which is a small but all-encompassing model that was used to describe the principle of gas metering and accounting to us in the laboratory. Also, Separation Techniques CHE 312 is another course I appreciated while on field because of how I was able to understand the theory I have learnt by applying practical knowledge gained on field.

CHAPTER FOUR

4.0 CONCLUSION AND APPRAISAL OF THE PROGRAM

With the little theoretical knowledge gained at the University, I was able to combine it with the practical on field experience gained at the Nigerian Gas Company. This was made possible by the student's industrial working experience scheme. This scheme has by this been able to bridge the gap between industry and the classroom.

Ways Of Improving The Program;

i. The ITF and the SIWES unit of the school should play their part to make sure that each and every student gains placement in one organization or another. This would help to eliminate the case of students searching for placement.

ii. The ITF should include timely payment of allowances to student so as to help them cater for little hitches that might undermine their efforts during the period of the program.

Advice for Future Participants;

i. Students should avail themselves of this wonderful opportunity created by SIWES to gain all the experience required so as to be well positioned for the real employment situation when they finally graduate.

ii. They should apply in as many organizations as possible so as to enable them have wide range of alternatives when they decide to begin the program.

iii. Each student should target organizations that will immensely contribute to their knowledge.

Advice for SIWES Managers;

i. Companies and establishments should be informed of the likely months in the year when the SIWES program will commence so that adequate preparations will be made by school and the student to be able to beat the competition for placement.

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