IMPROVING THECAPACITY OF INSTITUTIONS TO STRENGTHEN THE MANAGEMENT OF NATIONAL OIL AND GAS RESOURCES

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Abstract - Proper management of measurement activities in the oil and gas industry by the designated bodies is a challenge in most parts of the world, particularly in the upstream sector of the industry. This is evident as the problem cuts across both developed (U.S.A) and the developing (Nigeria) countries. In the United States, the Government Accountability Office (GAO) said, "The Department of the Interior's oil and gas production verification efforts do not provide reasonable assurance of accurate measurement of production volumes" while in Nigeria, the Nigeria Extractive Industries Transparency Initiative (NEITI) said that the Department of Petroleum Resources has no system for measuring crude oil production. This paper thus reviews the key causes of and the recommended solutions to this problem. While there are several challenges hindering effective measurement verification practices relative to national oil and gas management, and several recommended solutions, this paper portrays building the capacity of the designated bodies through provision of appropriate training as the key solution to the problems.

Keywords - United States, Nigeria, Oil and Gas, Measurement, Training

I. INTRODUCTION

The oil and gas sector is a large and complex sector that requires the expertise of various bodies to ensure proper governance [1]. According to Bertocco and McCreery [2], better performance management starts with a more focused approach to measurement and reporting systems. Inaccurate measurement leaves nationally owned oil and gas resources exposed to the risk of large losses whether at the exploration, production or distribution stage.

The correct measurement of petroleum and natural gas volumes is a very significant issue for the petroleum industry, as suitable measurement ensures integrity in the calculation of royalties and other taxes to be paid by concessionaries to the government, states and municipalities [3]. Given that proper measurement of oil and gas is critical to accurate royalty collections, all oil producing nations have designated bodies with established programs intended to provide reasonable assurance that the royalty-bearing volumes of oil and gas are being measured accurately. These measurement verification practices can include production verification regulations and policies, production accountability inspection programs and management of the production verification.

The purpose of the measurement verification practices, as far as oil and gas measurement is concerned, is to supervise the operator's adherence to relevant law relating to fiscal measurement activities. The objective of the supervisory activity is to verify the accuracy of the measurement equipment and the status of related procedures which are being used by the licensees to determine the quantity/quality of fiscal hydrocarbon streams. Oil and gas measurements serve as a basis for royalty tax stipulations and therefore determining the licensee's income.

However, the proper management of these activities by the designated bodies is a challenge in most parts of the world, particularly in the upstream sector of the industry. For instance, in Nigeria theefforts of the designated body in charge (the Department of Petroleum Resources (DPR)),were found not to provide sufficient guarantee of correct measurement of production and missing quantities. This is evident as up to the present date, no one can say with confidence how much crude oil Nigeria is producing or losing per day [4, 5]. The Nigeria Extractive Industries Transparency Initiative (NEITI)[6, 7]said the DPR "has no system for measuring crude oil production". Similarly in the United States (U.S),the Government Accountability Office (GAO) [8] said, "the Department of the Interior's oil and gas production verification efforts do not provide reasonable assurance of accurate measurement of production volumes". Thus, this paper is keen to explore the problem source and offer potential solutions using Nigeria (developing country) and United States(developed country) as case studies. The research is conducted using secondary resources.

II. PROBLEMSASSOCIATED WITH MANAGEMENT OF NATIONALLY OWNED OIL AND GAS RESOURCES USING NIGERIA AND THE UNITED STATES AS CASE STUDIES

2.1. Nigeria

DPR is the regulatory agency of the Ministry of Petroleum Resources. This Department is the core body responsible for the day-to-day monitoring of the petroleum industry, supervising all the petroleum industry operations carried out under licences and

leases in the country [9]. Its objective is ensuring compliance with the applicable laws and regulations in line with good oil field practices. The discharge of these responsibilities involves monitoring of operations at drilling sites, producing wells, production platforms and flow stations, as well as crude oil export terminals and all pipelines carrying crude oil, natural gas and petroleum products. However, despite the existence of this body, no one in or outside Nigeria is able to quote a totally reliable production volume or missing figure as revealed in a study by Ibrahim, Bills and Allport [10].

The Nigeria Extractive Industries Transparency Initiative (NEITI) (a subset of the global Extractive Industries Transparency Initiative (EITI), established in 2002 to promote and support improved governance in resource-rich countries through the full publication and verification of company payments and government revenues from oil, gas, and mining [11],shows concern that Nigeria does not know how much crude oil it actually produces or loses daily. Analysis conducted by NEITI [6, 12] through a questionnaire survey of the Oil and Gas industries and the Department of Petroleum Resources (DPR), thus enabling data from both sources to be verified, shows knowledge impediment among both bodies, although this varied among the operators. As revealed by NEITI [6, 9], the Department of Petroleum Resources (DPR) has no system for establishing accurate measurement of production volume, other than through monitoring terminal receipts. In consequence, DPR has no data from which possible product losses between the production point and the terminal can be estimated, measured or inferred. The body has neither measurements guidelines nor any corresponding regulations for upstream measurement at wellheads and flow stations. The only set of measurement guidelines they have according to NEITI [6] is the Manual of Procedure Guides for the Petroleum Inspectorate, of which the so called guidelines contain only two measurement guidelines: one on meter proving and the other on ship to shore differences. The manual does not specify the accuracy of the metering at any of the stages e.g. wellhead, flow station or custody transfers. All that is specified is the maximum ship to shore difference.

As revealed by NEITI [6], the personnel involved in measurement management lacked the general knowledge of how to calculate the royalty volume. The DPR response to the definition of volume to be used for the royalty calculation was declared to be inconsistent in the questionnaire responses. Moreover, since there is no guidance from DPR, the industry has no consistent practice regarding the point at which production is measured for royalty purposes, hence there have been definition issues surrounding the volumes to be used for calculation of royalties. The law is unclear on this point. DPR has not promulgated a standard interpretation. Also the method employed for the hydrocarbon mass balance was found to be insufficient to determine unaccounted oil or to estimate oil theft. There are no procedures to cope with mismeasurements. Moreover, there is no consistency in measurements of quantities and presentation of volume [6].

NEITI [6, 7] also revealed that the use of standardised definitions is not in any way adhered to by the industries and no culture of striving to follow international best practice, thus leading to conflicting interpretations. Most operators of the oil companies and the DPR personnel declared not to know the uncertainty of measurements for wellheads and flow stations. The only one declared to be known is the ship to shore measurement difference. The metering infrastructure and the records stipulated do not allow the hydrocarbon balance (oil, gas and water) to address the question of unaccounted oil. There is a range of issues on the definitions and practices to be applied in arriving at the report mass balance.

The work of Nwokeji [13] also revealed that DPR is extremely backward in carrying out its function. On royalties alone, Nwokeji [13] revealed DPR uses different criteria from the operating companies to calculate the royalty payments. The impediment of DPR in this area was also highlighted by NEITI [6]. Nwokeji's [13] study further revealed that DPR relied on monthly figures supplied by Nigerian National Petroleum Corporation to both DPR and oil companies while in most cases, the oil companies unilaterally determined the royalty payment they paid, often based on export rather than production figures [6, 13]. Aderalegbe [14] also questioned the competency of DPR, alleging that the regulatory powers of DPR are suspect. Nwokeji [13] attributed the DPR drawbacks to lack of skilled personnel.

Thus, the summary of the measurement management issues deduced from the review can be said to be; inadequate measurement guidelines, absence of regulatory enforcement over a variety of measurement activities or inadequate inspection program and gaps in staff knowledge.

2.2. The United States

In the United States, companies that develop and produce oil and gas from federal lands and waters do so under leases issued and administered by agencies of the Department of the Interior—the Bureau of Land Management (BLM) for onshore leases, and the Minerals Management Service's (MMS) Offshore Energy and Minerals Management (OEMM) for offshore leases. The oil and gas produced from these leases needs to be accurately measured and reported to MMS monthly. To verify that royalties are paid on the correct volumes of oil and gas, the Department of the Interior (Interior) verifies the quantity and quality of oil and gas, both onshore, through the Bureau of Land Management, and offshore, through the Offshore Energy and Minerals Management Service. This is intended to provide reasonable assurance that

the royalty-bearing volumes of oil and gas are being measured accurately [8].

Given that proper measurement of oil and gas is critical to accurate royalty collections, both the Government Accountability Office (GAO) and the Royalty Policy Committee, a group convened in 1995 by the Secretary of the Interior,carried out an analysis on Interior data on oil and gas inspections and human capital, as well as interviewing officials from Interior, states, oil and gas companies, and other countries. This was to assess the extent to which:

- Interior's production verification regulations and policies provide reasonable assurance that oil and gas are accurately measured;
- Interior's offshore and onshore production accountability inspection programs consistently set and meet program goals and address key factors affecting measurement accuracy; and
- Interior managed its production verification programs.

The results of the analysis as declared by the GAO [8]concluded that Interior's measurement regulations and policies do not provide reasonable assurance that oil and gas are accurately measured. Interior's varied approaches for developing and revising its measurement regulations are said to be ineffective and inefficient. The onshore measurement regulations were found not to be addressing current measurement technologies and moreover, the staff have infrequently coordinated on measurement issues. Both onshore and offshore policies for tracking and approving where and how oil and gas are measured was said to be inconsistent.

According to the GAO [8], the offshore and onshore production accountability inspection programs of Interior do not adequately address key factors affecting measurement accuracy. The offshore and onshore inspection program goals differ in key areas, with only the offshore program establishing goals for witnessing meter calibrations, a key control for accurate measurement. Additionally, while the onshore inspection program includes an activity to independently verify gas volume calculations, the offshore program does not. Moreover, Interior has not consistently met its inspection goals; offshore inspectors met program goals once between fiscal years 2004 and 2008, and onshore inspectors met program goals about one-third of the time over the past 12 years. The GAO [8] concluded that neither program sufficiently addresses key areas affecting measurement accuracy, including how gas samples are collected.

The GAO [8] asserts that limited oversight, gaps in staff skills, and incomplete tools hinder Interior's ability to manage its production verification programs. A specific case identified by GAO [8] was of several instances where production measurement staff work with limited oversight, for instance, onshore engineers generally making decisions autonomously in the absence of central guidance and oversight. In addition, some key production verification staff lack critical skills, in part, because Interior has not provided training. For example, Interior has provided training only once in the past 10 years for its onshore engineers, despite significant changes in technology used by industry. Interior's efforts to provide its inspection staff with tools to obtain real-time gas production data directly from producers, and the ability to electronically document production inspection results in the field have shown few results.

III. THE POTENTIAL SOLUTION BASED ON THE EVALUATION OF THE COMMON FACTORS BETWEEN THE GAO AND NEITI RECOMMENDATIONS

With regard to oil and gas measurement verification practices, both GAO [8]and NEITI [6, 7]have made similar recommendations. GAO [8]recommended improvement in measurement regulations and policies, clarification of jurisdictional authority over gas plants and pipelines and provision of appropriate and timely training for key measurement staff. NEITI [6, 7]also recommended improvement of measurement guidelines, installation of robust metering infrastructure and comprehensive training to the designated bodies.

This paper thus argues that, although the other recommendations cannot be neglected, the key recommendation proposed as the solution to the aforementioned challenges is provision of training to the designated bodies. To address this hypothesis, this thesis seeks to review this criteria across board, from developing country (Nigeria) to developed country (The U.S).

This paper postulates that, the recommended solutions of NEITI and GAO are interconnected. This implies the solving of one (provision of training) will invariably impact the improvement in the measurement regulations and policies, adequate inspection program and gear up the installation of the necessary facilities by the oil and gas industries. The chain could be proof as: training of personnel will promote human capital which will produce a pool of skilled man power from which regulators and enforcement body can be sourced. Skilled regulators and enforcement bodies will also produce comprehensive regulations and policies, establish sound accountability inspection programs, and effectively manage the entire production verification programs. On the other hand, effective industry regulation, sound accountability inspection programs and sound management of production verification programs will be able to address key factors affecting measurement accuracy and fraud such as in the case of Nigeria, striving for the installation of necessary facilities, thus promote accurate measurement of

production volume. This will lead to better management of the oil and gas industry, increase government revenues, benefit the wider economy generally, and in particular will enhance Nigeria's local development since the government will be in a better position to invest in research and fund scholarships.

Skilled personnel are the most valuable assets of any organization [15]. There could be state of the art, machines, materials and even money yet nothing gets done without man-power. Knowledge and skills are what every employee needsto acquire in order to function effectively and for the organization to function efficiently. Therefore, training and development play a vital role in improving performance as well as increasing productivity, and eventually putting an organisation in the best position to succeed. This means that there is a significant difference between the organizations that train their employees and organizations that do not.

Efficiency and effectiveness are key ingredients of performance; training is a way of increasing organizational performance through increase in individual employee contribution [16].

IV. RECOMMENDATIONS

In commerce and industry, many major investment and management decisions are based on measurements. Thus, the significance of metrology, the science of measurement, cannot just be disregarding when considering oil and gas measurement management. Indeed, trade will be more profitable in the oil and gas industry if, for instance, flow measurements were accurate enough. Aside from the intentional oil theft that is confronting Nigeria's oil and gas industry [17], the unintentional losses are even more damaging. A typical example is erroneous measurements in custody transfer of the oil and gas. The overall measurement accuracy can be affected by numerous factors, including the type of meter used, the specific qualities of the gas or oil being measured, the rate of production, and whether oil and gas of differing qualities are mixed together from multiple wells prior to measurement. Since billions of barrels are measured daily in this process; the slightest error in measurement could lead to loss of millions of dollars [18]. For this reason, designated bodies must have a solid knowledge of metrological control of the measurement activities in the oil and gas industry for effective management of the sectors, which include the knowledge of:

- general metrology
- Flow metrology
- Industrial metrology and
- Legal metrology

Metrology is a practical profession, thus, training in metrology needs to encompass actual measurements, with the necessary requirements, utilising actual measurement equipment. The training must include the potentials and limitations of the equipment used. It must contain treatment of data and uncertainty estimation. Moreover, it is significant that the training explains the distinction between reality and theoretical models. There should be sufficient experimental work to explain the dynamics of measurement together with consideration of dynamic retort of instrumentation and errors that may arise from it. It is desirable that participants are exposed to a variety of flow meters, preferably with some problems relating to flow meter characteristics, to their principles of operation and the main features of their physical embodiments. In respective circumstances where a laboratory scenario is required to inculcate the understanding of the measurement activities, it needs to be explained clearly and buttressed with adequate training material that links the theory of measurement and instrumentation to the experimental task involved. This prerequisite surpasses the demonstration of phenomena and equipment by physical instances. The teaching must be explicit, systematic and comprehensive.

CONCLUSIONS

The oil and gas sector is a large and complex sector that requires proper governance, however it has been found to be a challenge in most parts of the world. Building the capacity of the bodies designated for the management of the sector, through provision of appropriate training has been identified as the key solution. Skills and knowledge in flow measurement and metrology have been identified as key subject areas that need consideration in delivery of the training.

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