# Developing Electrical Metrology in Trinidad and Tobago

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**Abstract:** This paper provides an overview of the current capabilities and future developmental plans for Electrical Metrology in Trinidad and Tobago. Low frequency electrical metrology is specifically highlighted since the categories of this aspect of electrical metrology are fundamental to building an adequate electrical measurement infrastructure. The five main categories of electrical measurement services emphasized are dc voltage, resistance, time and frequency, impedance, and electric power and energy since these are considered of most importance at this time in the developmental process.

**Keywords:** Electrical Metrology, National Measurement System, Low Frequency DC Metrology, Electrical Measurement Infrastructure.

## 1. INTRODUCTION

Metrology in Trinidad and Tobago developed from Colonial Legislation which existed in 1878. Following this the Weights and Measures Ordinance of 1935 was in effect. After independence in 1962, an attempt was made through a Metrication Board to convert the national measurement system from imperial to metric between 1969 and 1987.

The Trinidad and Tobago Bureau of Standards (TTBS) was formed in 1973, and the responsibility for metrification was passed from the Metrication Board to TTBS in 1987. At that time, the Metrology Section formed a part of the Testing Division of TTBS until the Metrology Act of 2004 was passed. The Metrology Act 2004 made TTBS responsible for establishing and maintaining the measurement system in Trinidad and Tobago. In 2006, the Metrology Division of TTBS came officially into being. The Division is composed of the Legal Metrology Inspectorate, the Calibration Laboratory and the Standards Laboratory. Since its creation, the Metrology Division has sought to establish an internationally recognized and acceptable measurement system for all the measurements conducted in Trinidad and Tobago.

Prior to this, however, in the absence of the necessary legislative framework, metrology in the TTBS developed along the lines of a calibration service facility. TTBS has been conducting electrical instrument calibrations since the late 1980's. We have over the years acquired and maintained many industrial clients who have come to routinely rely on our calibration services. TTBS routinely calibrates Process Meters, DMM's, Insulation Testers and a number of other electrical measurement instruments. Traceability was assured via the external calibration of measurement instruments by accredited laboratories.

After 2006, with the Standards Laboratory established as entity within the new division, more emphasis is now being placed on securing new primary standards, where deemed necessary, and on ensuring internationally recognized traceability, as far as possible, though the Standards Laboratory.

## 2. THE PRESENT CONTEXT

The importance of a proper Metrology Infrastructure to efficient and sustained national development is without question. Electrical Metrology in particular is of tremendous importance, especially since so many other measurements in industry and otherwise depend on good electrical measurement accuracies in order to provide trusted data. This trend too, is likely to increase even more as technology becomes an ever larger and more important part of day to day activities, especially since the country is aspiring to attain developed nation status by 2020.

The Trinidad and Tobago economy is largely hydrocarbon based (oil and gas) to the extent that in excess of 40% of GDP is attributable to the direct and indirect sales of these natural resources (80% of exports). These are, unfortunately, diminishing resources.

Industrial Production, which is heavily energy dependent, contributes in excess of 50% of GDP. The industrial base includes the production of petrochemicals, iron and steel, food, beverages, prepackaged goods and agricultural products. To ensure balanced and sustainable development and to curtail the economy's obvious over-dependence on the fortunes of the oil and gas markets, sustained growth in the non-oil manufacturing and service-oriented sectors has to be facilitated. Further planned

industries include aluminum smelting and plastics production.

Significant investments are also being made in Technical and Tertiary Education. Along with a more educated and technically savvy populace, advances in research and value-added technological applications and products are anticipated as a result of these investments.

The advent of the Metrology Bill 2004 has made TTBS now more than ever before, the critical element in the Measurement Infrastructure of the country and thus, critical to the efficient, effective and sustainable development of the national economy.

Some studies estimate that metrology contributes some 3 to 6% of GDP in industrialized economies and as much as 15% in developing economies [1]. This, along with the reality of the country's inordinate dependence on oil and gas, and the imperative need to develop competitive industries both for domestic and foreign markets, provides sufficient added motivation for the Metrology Division to actively pursue the establishment of an adequate, effective and internationally recognized measurement system, particularly in Low Frequency DC Metrology.

The Division's current strategy is to develop Low Frequency DC metrology to meet current and expected measurement needs and to participate in International measurement activities so as to ensure compatible measurements with international recognition and facilitate trade. Thereafter, with this measurement foundation firmly in place, plans are to branch into the RF and AC Metrology areas as required, in the national interest.

The planned developments in the Low Frequency DC Measurement areas are as follows.

### *2.1. DC Voltage Metrology*

Our primary standards in DC Voltage consist of four (4) Fluke 732B Solid State (Zener Diode) Voltage standards. In addition, we disseminate DC voltage using Fluke 5720 and 5500 Calibrators. We do not envision acquiring a Josephson Array, however we will likely acquire at least two (2) additional solid state standards and appropriate DC Voltage Dividers to reduce our uncertainties for dissemination and recalibrate our calibrators in-house. Where feasible we always seek to improve our capabilities.

Our standards for Current would be derived from our improved DC Voltage and Resistance standards capabilities.

### *2.2. Resistance Metrology*

Resistance metrology, thus far, has been developed to support the calibration of industrial instruments. Currently, our highest level resistance standards are obtained from a Fluke 5720 Multifunction Calibrator. In order to raise measurement capability in this area we will seek to acquire a series of suitable resistance standards (1, 10, 100, 1k, 10k, 100k, 1M & 10 MΩ), in oil and/or air.

This development is particularly important since we are also intent on enhancing our temperature measurement capability. We will also seek to acquire an AC and/ or DC Bridge, calibrators and other artifact resistance standards necessary for proper dissemination of resistance traceability and accuracy at the levels required for adequate electrical and temperature measurements.

### *2.3. Time and Frequency Metrology*

We recently acquired two GPS Disciplined Oscillators (Rubidium and Crystal) as our Time and Frequency Standards. We intend to utilize these new standards to disseminate accurate time and support our services in the areas of time and frequency dissemination, calibrations and measurements. We expect to soon link our Rubidium Standard to the SIM Time Standard Network via a NIST or SIM Common-View Time and Frequency Measurement System.

### *2.4. Impedance Metrology*

Our immediate plans for this aspect of Low Frequency DC Metrology are to attain an acceptable minimum capability in accordance with our actual and expected needs as our circumstance requires. Our standards in this area currently include Fluke Multi-function and Multi-product calibrators as well as an Agilent LCR Meter. In the future, we will likely seek to acquire standard capacitors, inductors and an appropriate impedance bridge to reduce our uncertainties to the level required by the national economy as well as participate in regional and/ or international inter-comparisons.

### *2.5. Electrical Power and Energy Metrology*

We have limited experience in these areas of metrology. However, there is major energy consumption in Trinidad and Tobago, particularly in some current and future heavy industries and manufacturing concerns. In 2007, Trinidad and Tobago produced some 7.704 billion kWh of electricity energy and consumed 7.083 billion kWh. The two local power suppliers have been providers for a number of years and a third is soon likely to begin operation.

To execute its responsibility for establishing an adequate measurement system for this market and in recognition of the specifics of local circumstances, TTBS is seeking to move progressively forward with a cooperative approach. By forming cooperative partnerships, in concert with the regulatory authorities and other established stakeholders, TTBS is attempting to harmonize its intervention so as to minimize inconvenience to suppliers while at the same time implementing a system which ensures that the consumers, and society, get value for money. Market efficiency is a particularly important reason for the intervention in this area of measurement since there are potentially many long term benefits to the environment and for the industrial competitiveness of the national economy.

The current standards for power measurements at TTBS are the Fluke 5720 Multi-function and Fluke 5500 Multi-product Calibrators. However, in collaboration with our industry partners, TTBS will acquire a calibration bench and establish a sampling regime for the objective calibration/ verification of power and energy meters. The hardware and training for this system are currently being sourced. Once this consumption-based measurement infrastructure has

been established, it will server as a platform for examining supply quality and loss reduction measurements.

The overall objective is to establish TTBS securely and intimately with the process of power supplies for consumption. Thereafter, efforts will be made to expand into energy measurements generally, inclusive of chemical energy production, and eventually to expand more fully into power measurements.

## 3. CONCLUSION

Electrical Metrology has to keep pace with the developmental thrust of the national economy. Where this is not currently the case timely and thoughtful intervention will be made in the appropriate way. As circumstances change the focus may be altered to suite, but the path of continuous development and improvement in electrical metrology will not be altered.

By seeking to advance its level of measurement capability in voltage, resistance, time, frequency, power, energy and impedance, the Trinidad and Tobago Bureau of Standards is crafting the establishment of a proper national electrical measurement infrastructure that will over time contribute tangibly and intangibly to the improvement of electrical measurements nationally and by extension the development of the national economy and the quality of life of the society.

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## REFERENCES

[1] Quinn T.J., Metrology, its role in today's world, *Rapport BIPM*/94-5, May 1994.