SGS Report - Summary and Explanation

Lutec Australia has been working on a larger prototype of it's LEA, a 3kW (output) device. Having completed this prototype, the decision was taken to engage an independent party to test and report on its efficiency.

We engaged SGS Australia Pty Ltd and specifically their head office in Perth. SGS Australia is part of the worldwide SGS network which is the world's leading inspection, verification, testing and certification company comprising over 1,000 offices and laboratories and more than 59,000 employees throughout the world. A précis, taken from their website is attached.[1]

A representative from SGS travelled to North Queensland on 31 March 2010 to oversee and report on the testing of the new machine. He oversaw and reported on the testing of a smaller device as well.

We deliberately did not ask SGS to give a report on the workings of the device itself. The intellectual property associated with the device is, of course, proprietary and confidential information. SGS were quite happy that they did not need to know how the device worked. They were engaged to verify the testing process and witness the results of that testing process.

One of SGS's requirements, prior to the test, was that the calibration of all the testing and metering equipment be current and performed with NATA traceability. NATA is the National Association of Testing Authorities. An excerpt from the NATA website, regarding NATA and traceability is attached.[2]

In order to comply with the NATA requirement we had to send all of the meters down to Sydney and have them calibrated, sealed and returned. Unfortunately, a Tie-Pie (4 channel oscilloscope) that was sent down to Sydney for calibration was incorrectly returned by road, instead of air, and did not arrive in time. Fortunately we had an identical device available for testing and, immediately after the testing took place in North Queensland, that device was forwarded to Sydney and it was certified as being accurate and requiring no calibration.

A copy of the SGS report is attached.[3]

You will see that the introduction to the report sets out the basis upon which the inspection was conducted.

[1] Attachment A - SGS précis
[2] Attachment B - NATA information
[3] Attachment C - SGS Report

The report confirms:

- That SGS oversaw the set-up and conduct of the tests;
- That all meters and the Tie-Pie were verified as appropriately calibrated;
- That the meters and test equipment were suitable for the tests;
- That all of the wiring and that the placement of the test leads was correct;
- That the motors were run with resistive loads (a bank of light bulbs) and appropriate readings taken from input and output meters;
- The input watts given, included all losses of windage, friction and rectification.
- That the input and output watts were verified by observing and confirming meter readings.

The purpose of the test (and the report) was to meter and record the input and output (as a DC current) of 2 test devices, the larger 3kW device mentioned above, and a smaller device.

The reason we also tested the smaller device was that we were able to test this device using the Tie Pie. The purpose of this was to be able to graphically identify the features of the electrical cycle (rather than simply the input and output). Whilst this was strictly not necessary, it was included in the tests (and therefore in the report) primarily for the benefit of the more technically minded.

The large machine was tested using specially obtained DC wattmeters to measure the input and a DC Ammeter and Voltmeter to measure the output. There are 6 input wattmeters, 1 for each section of the device.

In relation to the smaller machine (referred to as a 4 pole/4 coils machine) you will see (on pages 4 and 5 of the report) that:-

(a) At half load it produced 145.6 Watts while consuming only 10.1059 Watts for an efficiency of 1440% (14.4 times over unity).

(b) At full bank load it produced 244.4 Watts and consumed 22.2718 Watts for an efficiency of 1097.35%.

You will note that these efficiency figures are calculated from readings taken from the Tie-Pie and from other meters. The calculations are, again, included for the more technical.

As pointed out above, the larger machine was tested using 6 DC wattmeters (to measure input) and a DC Ammeter and Voltmeter (to measure output). This setup requires no complicated calculation. The input is simply the sum of the readings from the wattmeters. The output is measured by multiplying the 2 readings (watts = amps x volts). You may ask why we did not use a wattmeter to measure the output. Quite simply we couldn't find one big enough. The machine is capable of output in excess of 3kW. The calculation via the DC Ammeter and Voltmeter is non-contentious. It is standard practice. In any event, the measurement of output has never been an issue as it is represented physically (via a bank of glowing light bulbs). It has always been the input that has been the most difficult to establish to the satisfaction of others. It is in this respect that the report is so important.

The results of the test of the larger machine (described as the 8 pole/16 coils machine) are on page 10 of the report.

You will see from the report that:-

(a) Running at half load (30 lights) it produced 1000 Watts (12.5A x 80V) whilst consuming only 345 Watts (the total of the 6 input meters) for an efficiency of 289% or 2.89 times over unity.

(b) At full load (60 lights) it produced 1800 Watts whilst consuming only 375 Watts for an efficiency of 480% or 4.8 times over unity.

You may ask why the small machine is more efficient. The larger machine was only run at approximately half speed. The reason for this is that the meters used would not have been able to record the required data (as it would have been beyond range). Of course, this was not an issue for the smaller machine.

You will also note that as the load (and speed) increased, the efficiency of the large machine also increased significantly (for an additional input of 30 Watts a further 800 Watts was produced). The test was not designed to calculate the maximum capability of the large machine. It was designed purely to prove the technology.

Annexure A

About SGS

SGS is the world's leading inspection, verification, testing and Certification Company. Recognized as the global benchmark for quality and integrity, it employs 59,000 people and operates a network of more than 1,000 offices and laboratories around the world.

SGS is constantly looking beyond customers' and society's expectations in order to deliver market leading services wherever they are needed. As the leader in providing specialized business solutions that improve quality, safety and productivity and reduce risk, SGS helps customers navigate an increasingly regulated world. Independent services add significant value to our customers' operations and ensure business sustainability.

Vision

SGS aims to be the most competitive and the most productive service organization in the world. The core competencies in inspection, verification, testing and certification are being continuously improved to be best-in-class. They are at the heart of what SGS is. Chosen markets will be solely determined by our ability to be the most competitive and to consistently deliver unequalled service to our customers all over the world.

History

Established in 1878, the company started by offering agricultural inspection services to grain traders in Europe. From those early beginnings, it grew in size and scope as agricultural inspection services spread around the world. On 19 July 1919, the company adopted the name of Société Générale de Surveillance (today, known as SGS). During the mid-20th century, it began to diversify and started offering inspection, testing and verification services across a variety of sectors, including industrial, minerals and oil, gas and chemicals, among others. In 1981, the company went public.

The current structure of SGS, consisting of 10 business segments operating across 10 geographical regions, was formed in 2001. From beginnings in 1878 as a grain inspection house, it has steadily grown into the role as the industry leader. This has been assisted through continual improvement and innovation and through supporting our customers' operations by reducing risk and improving productivity.

Annexure B

About NATA and Traceability.

A proven network of best-practice technical experts

The National Association of Testing Authorities, Australia (NATA) provides a foundation for confidence in Australia’s calibration, testing, and inspection activities. NATA technical auditing also underpins the certification of a range of products and services. NATA adds value to thousands of such services in business, industry and government, both in Australia and internationally.

What is NATA?

NATA is the authority responsible for the accreditation of laboratories, inspection bodies, calibration services, producers of certified reference materials and proficiency testing scheme providers throughout Australia. It is also Australia's compliance monitoring authority for the OECD Principles of GLP.

NATA provides independent assurance of technical competence through a proven network of best practice industry experts for customers who require confidence in the delivery of their products and services. NATA formally recognises that these facilities produce reliable technical results which make the world a safer and more certain place. NATA’s work increases community confidence and trust in a facility’s services, mitigates risk, improves tendering success and facilitates trade.

Established in 1947, NATA is the world’s first comprehensive laboratory accreditation body, and is still one of the largest. The Australian Government uses NATA-accredited facilities wherever possible and encourages state and territory governments and other instrumentalities to do likewise.

More than 3000 facilities in Australia and around 50 other economies are NATA members.

Traceability

VIM defines traceability as *the property of the result of a measurement or the value of a standard whereby it can be related to stated references, usually national or international standards, through an unbroken chain of comparisons all having stated uncertainties .... The unbroken chain of comparisons is called a `traceability chain'*.

An unbroken chain of comparisons is a logical and easily understood component of traceability. In its simplest form a traceability chain can be thought of as a pedigree or list of makes, models and serial numbers of instruments or artifacts in the chain. The manager of a non-accredited lab might claim that his/her calibrations are traceable because he/she is able to trace the calibration pedigree of the references and standards he/she uses. However, there is more to traceability than a simple list of hardware.

Annexure C

SGS Report

SGS

ENGINEERING SERVICES REPORT

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Our Ref: **ES-2010-Q085**

3rd of May 2010

Lutec Australia Pty Ltd
C/O 1A Water Street
Cairns Queensland 4870

Attention: John Christie

DC-DC CONVERTER WITNESSING REPORT

Dear John,

Attached herewith, please find our report for the witnessing of the efficiency tests of the Lutec designed DC-DC Converter as witnessed in Atherton, North Queensland on the 31st of March 2010.

Introduction

SGS Australia Pty Ltd were employed by Lutec Pty Ltd to witness the efficiency tests of the Lutec designed DC-DC Converter.

The tests were witnessed by our Engineer, Mr. Roberto Lozaga as follows:

- The client performed all the set-up of measuring systems and tests under the oversight and observation of the SGS representative;
- SGS verified that all meters being utilised during the tests were calibrated and had NATA traceability, with exception of the Tie-Pie (Oscilloscope), which was calibrated after the tests in order to confirm its accuracy;
- That the metering and testing equipment used were suitable for the identification of the input and output DC Watts;
- SGS inspected all wiring, connections and confirmed the circuits and current flow to and from the machine, and to and from the DC analogue meters, including the DC voltmeters and ampere-meters on the load circuit as indicated on the various measuring devices;
- SGS confirmed the placement and positioning of the test leads as being correct to obtain the readings as detailed below;
- The motors were run with resistive load and appropriate readings taken from the input meters and output meters. Input watts given included all losses of windage, friction and rectification of the output generated;
- A number of resistive loads were applied to the system by turning on a bank of light bulbs and measuring and verifying the input and output watts by observing and confirming the meter readings.

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Machine: 4 Pole / 4 Coils

1. **Machine running at no-load**

***Meter Readings*:**

LUT005: 0.25 A   LUT007: 0.00 A
LUT003: 0.25 V   LUT002: 0.00 V

Lutec calculations (based on Oscilloscope and Meters):

Channel 1:
Cycle time: 27.20msec
On time: 4.20msec
True RMS: 1.464V

Channel 2:
125.0V V_{max+}
-118.5V V_{max-}
diff 6.5V

Ratio= Cycle/On time: 6.476
I_{ave} = True RMS/Ratio: 0.266A
Power = 6.5V x 0.226A = 1.469W (power consumed)

2. **Machine running at ½ load (3 x bulbs)**

***Meter Readings*:**

LUT005: 1.60 A   LUT007: 1.40 A
LUT003: 1.60 V   LUT002: 104 V (using Fluke meter)

Lutec calculations (based on Oscilloscope and Meters):

Channel 1:
Cycle time: 32.60msec
On time: 5.80msec
True RMS: 10.27V

Channel 2:
120.2V V_{max+}
-104.4V V_{max-}
diff 15.8V

Ratio= Cycle/On time: 5.62
I_{ave} = True RMS/Ratio: 1.8274A
P_{System} = 15.8V x 1.8274A = 28.8729W (power consumed)
P_{Output} = 104V x 1.4A = 145.6 W (output power)
$P_{Resistor}$ = I^2 x R = 10.27^2 x 1 = 105.4729W

105.4729/Ratio = 18.767W

P_{IN} = P_{System} - $P_{Resistor}$
= 28.8729 – 18.767
= 10.1059W

%η = P_{Output} / P_{IN}
= 145.6 / 10.1059
= 1440%

3. **Machine running at full bank load (6 x bulbs)**

***Meter Readings*:**

LUT005: 2.90 A   LUT007: 2.60 A
LUT003: 2.80 V   LUT002: 94.0 V (using Fluke meter)

Lutec calculations (based on Oscilloscope and Meters):

Channel 1:
Cycle time: 37.20msec
On time: 6.40msec
True RMS: 16.19V

Channel 2:
116.9V V_{max+}
- 91.9V V_{max-}
diff 25.0V

Ch.3 diff 23.4V

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V_{AVE} between Ch.2 & Ch.3   24.2V

Ratio= Cycle/On time: 5.8125

I_{ave} = True RMS/Ratio: 2.785A

P_{System} = 24.2V x 2.785A = 67.367W (power consumed)

P_{Output} = 94V x 2.6A = 244.4 W (output power)

$P_{Resistor} = I^2 \times R = 16.19^2 \times 1 = 262.116W$

262.116/Ratio = 45.0952W

$P_{IN} = P_{System} - P_{Resistor}$
= 67.367 – 45.0952
= 22.2718W

%η = P_{Output} / P_{IN}
= 244.4 / 22.2718
= 1097.35%

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Data Taken During Tests

Machine: 8 Pole / 16 Coils

Six Input DC Wattmeters
LUT009
LUT010
LUT011
LUT012
LUT013
LUT014

Output Monitoring
LUT006 – DC Ammeter
LUT001 – DC Voltmeter

4. Machine running at no-load

***Meter Readings*:**

Input
LUT009 – 10W
LUT010 – 8W
LUT011 – 12W
LUT012 – 10W
LUT013 – 8W
LUT014 – 8W

Total : 56W

Output
LUT006 – 0A
LUT007 – 0V

5. Machine running at ½ load (30bulbs)

***Meter Readings*:**

Input
LUT009 – 70W
LUT010 – 30W
LUT011 – 65W
LUT012 – 70W
LUT013 – 55W
LUT014 – 55W

Total: 345W

%η = 1000/345 = **289%**

Output
LUT006 – 12.5A
LUT007 – 80V

6. Machine running at full-load (60bulbs)

***Meter Readings*:**

Input
LUT009 – 65W
LUT010 – 40W
LUT011 – 70W
LUT012 – 70W
LUT013 – 60W
LUT014 – 70W

Total: 375W

%η = 1800/375 = **480%**

Output
LUT006 – 24A
LUT007 – 75V

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Conclusion

As SGS Australia Pty Ltd was witness only to the above tests, this report does not imply that we either agree or disagree with the calculations, theories or methodologies applied by the client as detailed herein.

The intention of this report is to detail the tests and calculations as applied by the client in the above tests and measurements.

We appreciate the opportunity to be of service to Lutec and trust that the information provided meets with your approval.

Please do not hesitate to contact us should you require any further information.

SGS AUSTRALIA PTY LTD

Prepared By:

Roberto Lozaga
Electrical Engineer

Reviewed By:

Paul Van Wyk
Engineering Business Manager

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