

SISTEMA INTERAMERICANO DE METROLOGIA

Electricity and Magnetism Working Group

REPORT OF THE 2008 MEETING (25-29 February 2008)

by G.A. Kyriazis (EMWG Chair)

The present report was compiled based on detailed notes by H. Sanchez (ICE) and F. Hamilton (TTBS).

1 OPENING OF MEETING; APPROVAL OF AGENDA

The SIM Electricity and Magnetism Working Group (SIM EMWG) held its 2008 meeting on 25-29 February 2008 at the Quantum Electrical Metrology Division, National Institute of Standards and Technology, Gaithersburg, Maryland, USA.

The following NMI representatives attended the meeting:

Country	NMI	Name	E-mail
USA	NIST	Nien Fan Zhang	zhang@nist.gov
Brasil	INMETRO	Gregory Kyriazis	gakyriazis@inmetro.gov
Paraguay	INTN	Robert Duarte	Rob_duarte@hotmail.com
Canada	NRC	Peter Filipski	Peter.Filipski@nrc.ca
Panama	CENAMEP	Carlos Sauders	csauders@cenamep.org.pa
Argentina	INTI	Lucas Di Lillo	ldili@inti.gov.ar
Mexico	CENAM	Felipe Hernandez	fhernand@cenam.mx
Uruguay	UTE	Alejandro Santos	ASantos@ute.com.uy
Tobago	TTBS	Francis Hamilton	Francis.Hamilton@ttbs.org.tt
USA	NIST	Tom Nelson	Thomas.nelson@nist.gov
USA	NIST	Nile Oldham	Nile.oldham@nist.gov
USA	NIST	Andrew Koffman	andrew.koffman@nist.gov
USA	NIST	Mark Parker	Mark.parker@nist.gov
USA	NIST	Rand Elmquist	elmquist@nist.gov
Mexico	CENAM	David Aviles	caviles@cenam.mx
Costa Rica	ICE	Harold Sanchez	hsanchez@ice.co.cr

The past Chairman of the SIM EMWG (Harold Sanchez) opened the meeting at 8.00 a.m. and welcomed the participants.

The meeting agenda was considered and approved by the participants.

Monday 25 February 2008

SIM.EM-S2 Electric Energy Comparison

Review of results and approval of Draft A Report.

Additional information needed for Draft B Report and publication.

Harold Sanchez (ICE) opened the meeting by informing on the importance of keeping frequent key comparisons. It was mentioned that a number of the inter-comparisons which were started a few years ago were held up for one reason or another. There are international and regional requirements for the time for the completion of inter-comparisons.

The SIM Inter-Comparison of 50/60 Hz Energy was discussed in some detail. Statistical analysis of the data for key comparisons with linear trends was also discussed. Nile Oldham (NIST) started presenting the SIM.EM-S2 Electric Energy Comparison. Nien Fan Zhang (NIST) suggested last month to change the data analysis to a new configuration: a two loop comparison linked by NIST. One loop for South America and another for North America. This was reasonable as two standards were used: one for South America and one for North America. A presentation on the results was made. Only NIST data values are used for estimating drift slope. Each laboratory has its own intercept. Pairwise degrees of equivalence were discussed (a) within the same loop and (b) in different loops. The final report of the results (Draft B) is to be published at the earliest possible time (see corrective actions below).

A problem during the Inter-comparison was reported by Lucas di Lillo (INTI). A transformer loop was at fault. INTI has corrected the problem and requested an opportunity to retest the travelling standard RM11. This was accepted by the group. NIST will send the standard to INTI. However, the arrangement will be a bilateral one, between INTI and NIST. A new bilateral comparison will be started between NIST and INTI. The problem, which prompted its redoing, will be included in the bilateral comparison report. INTI will write a report explaining that the systematic errors were corrected.

The working group approved the comparison results. The report of the inter-comparison will be published by October 2008 (see corrective actions below).

The transportation of travelling standards was discussed, including the problems associated with customs and how arrangements can be better made to facilitate easier movement of standards from lab to lab. NIST and NRC informed about carnet that could be obtained from Chamber of Commerce.

It was suggested that another inter-comparison be done, but perhaps with power instead of energy measurement. It was mentioned the existence of some new travelling standards outputs for both power and energy. At the appropriate time, the participants will be polled in order to determine whether power or energy would be more favored. A time-division-multiplying converter was used as the standard.

An interest in measuring Harmonics Power Voltage and Current (Non-Sinusoidal Comparisons) was expressed (Power Quality Measuring Instruments). Interest for these tests however, came mainly from manufacturers, not from utilities. This type of measurement is not very popular due to the lack of demand.

A base frequency of 50 or 60 Hz, was used as an inter-comparison protocol between NRC and Sweden. The details are to be provided. INMETRO expressed interest in Power Harmonics Measurement. The information on the protocol can be accessed easily from NRC. INMETRO indicated that digital sampling of power can be done using the HP 3458A multimeter and can be extended to Harmonics Measurements. INMETRO will ask NRC for a bilateral comparison on harmonic power measurements.

It was observed that the review of CMC has, like so many things involving inter-comparisons, fallen short of desired efficiency.

The Electricity and Magnetism Working Group website is:

www.eeel.nist.gov/SIM (working group website)

user: last name (LC)

Or

user: bell

Password: sim!02

Energy comparison presentation by Nile Oldham, Tom Nelson, Nien Fan Zhang

Measurements finished by NIST, NRC, CENAM, ICE, CENAMEP, CONACYT, CENACYT, INDECOPI, INTI, UTE, INMETRO, INTN.

Jamaica sent back the standard but no data has been sent to the pilot.

Measurement data received by pilot laboratory (NIST)

Traveling standards in NIST.

Preliminary results in Draft A

CRV value NIST based. Some NMIs do not contribute to CRV. CRV is time variable.

Action agreed	Responsible	Date
Draft B to be finished and approved.	Nile Oldham, Tom Nelson	15 March 2008
Draft B to be published in Simposio Metrologia, CENAM, Mexico, and/or InfoSIM	Nile Oldham	Full paper 16 May 2008
NMIs will report corrective actions if necessary	NMI representatives	Together with publication of Draft B
INTI and NIST will start a bilateral energy comparison to verify effectiveness of corrective action	Lucas Di Lillo as INTI representative	Soon after publication of Draft B
INTI CMCs in energy supported by this comparison are maintained with SIM support and report of corrective action	Lucas Di Lillio as INTI CMC manager, SIM EM Chairperson	Now
INMETRO and NRC to propose a bilateral comparison in harmonic (no sinusoidal waveform) comparison	Gregory Kyriazis as INMETRO representative, Peter Filipski as NRC representative	31 March 2008

Tuesday 26 February 2008

SIM.EM-K4, SIM.EM-S4, SIM.EM-S3 Capacitance Comparisons

Review of results and of Draft A Report.

Because NIST served as the pilot lab and conducted multiple measurements of the standard, NIST surely has Type A uncertainty contributions. The other labs measured only for one period and it was therefore decided that only their combined uncertainties will be considered in the analysis. Thus, the results for the labs have to be adjusted.

Humidity can have an effect on the curve of the measurements on the pF standards.

Angel Moreno's (CENAM) comments were all discussed.

Capacitance units were expressed as relative deviation from nominal (in $\mu\text{F}/\text{F}$). The curves generated were sometimes done excluding some labs on order for the linear analysis to be zoomed.

Linear Fit was the regression method used. The reference to quadratic fit was erroneous and will be deleted. Linear fit is much simpler to analyze. Consistency also demands the standardized use of one form of analysis in order to produce consistent results.

Only labs whose traceability is independently established are used to calculate the CRV, in this case NIST. The standards used can stabilize as time passes. However, the standard drift was only defined by the pilot lab which made several measurements.

INMETRO submitted two values due to observed stabilization of the standard; it was decided that the average of the values submitted would be used in the calculation of the CRV. This will not affect the CRV value significantly but will affect the pair-wise equivalence calculations.

The CRV is the weighted mean of the lab values and this can be justified statistically. By choosing of an optimal time of measurement the evaluation of the CRV reduces to one simplified term since higher order terms reduce to zero. The weighting assigned to each lab is proportional to the inverse of the uncertainty quoted by each lab.

1 nF, 10 pF and 100 pF values were used for the Inter-comparison. The results will be published for the NCLSI conference, but will not identify the labs since a draft B is not yet ready. This proposal was accepted. A draft B is required in order for the results to be published fully, inclusive of the participating labs.

At NRC the power setting of the standard was initially incorrect due to the difference in the voltage rating. Clear instructions need to be part of the standard procedures/ precautions needed to be exercised in order to avoid damage to the standard and getting bad results.

AH11A Standards were used for capacitance inter-comparison. They can have drifts which can affect the results obtained. 10 pF standards tend to be used since this value is close to the capacitance of the calculable capacitors held in some NMI's.

The data for the 100 pF measurement at 1000 Hz were also examined. Data results from INMETRO and NRC were not yet included.

The separation of the uncertainties into Types A and B and the subsequent recombination was incorrect. The data tables need to be adjusted.

The uncertainty budgets as well as the individual reports from each participating NMI will be included in the draft B.

Report of results by Andrew Koffman and Nien Fan Zhang

Measurements finished by NIST, CENAM, ICE, NRC, INTI, INMETRO, UTE.

Traveling standards in NIST.

Measurement data received by pilot laboratory (NIST).

Draft A in review.

NIST could provide curves for other frequencies not included in the comparison, if NMIs are interested.

Action agreed	Responsible	Date
Draft A without identification of NMIs, including all participants as authors, for publication in NCSLi	Andrew Koffman	31 May 2008
NMIs to report corrective actions if necessary.	NMI representatives.	August 2008(to be included or referenced in the comparison report)
ICE and NIST to propose a bilateral comparison	ICE representative	31 May 2008
Calibration procedure for 3 terminal capacitors (from quality manual) to be e-mailed to participants	Andrew Koffman	March 2008

Wednesday 27 February 2008

SIM.EM-S5 Digital Multimeter Comparison

Review of measurement progress and traveling standard distribution.

New measurement schedule.

Review of draft report.

Distribution of traveling standards to be hand carried.

The Multimeter intercomparison needs to be completed. SURAMET still needs to complete its measurements. Mark Parker (NIST) will send a multimeter to SURAMET. He will email Lucas di Lillo (INTI) two weeks before dispatching the multimeter informing the instrument serial number and other data. INTI will manage the comparison in SURAMET. Inmetro, INTI and UTE are the participants from SURAMET. INTI will receive the instrument and deliver it to the other countries. Afterwards, INTI will return the instrument to NIST.

CAMET (two countries Costa Rica and Panama) has made measurements, results are to be submitted.

NORAMET (CENAM and NRC), apart from NIST have not participated. CENAM will give an indication in due course.

From CARIMET, TTBS is to be assigned a multimeter in order to participate once the acceptance is officially given. Mark Parker (NIST) will send a multimeter to Francis Hamilton (TTBS) in order to have this institute participating in the comparison. CARIMET participation is expected to come from T&T and Jamaica only, but the other countries in CARIMET will be poled to determine their interest. Jamaica has confirmed receipt of a multimeter that has not yet been returned after 6 months in that country. There is no information on the current status of the instrument.

In ANDIMET only Ecuador may participate.

Wooden cases should not be avoided in comparisons as such cases attract specific customs difficulties in Brazil.

Three (3) weeks were assigned as appropriate time for completion of the measurements, with an additional week for transportation to the next lab (1 month total). It was estimated that the Report should be prepared in approximately 4 months time (see corrective actions below).

DC Voltage, AC Voltage, DC current, AC current and Resistance are the quantities to be measured (in accordance with the protocol). Nine points are set out in the protocol, checking the different models of multi-meter used (HP3458A, Keithley2002, and Wavetek 4808). Each lab is assigned only one multimeter.

Data will be sent to NIST. Zhang (NIST) commented that the group should decide on submitting absolute or relative measurement results. The group finally decided to report relative results. Relative units were accepted as the means of reporting the results and uncertainties. Nile Oldham (NIST) informed that all laboratories should attach an uncertainty budget. The uncertainties need to be provided in Type A and Type B. An

uncertainty budget needs to be submitted as part of the report, in accordance with the protocol. A template for the uncertainty budget is available on the SIM website for those who do not know how to implement the budget. It is estimated that in four months the comparison report could be issued (see corrective actions below).

Nien Fan Zhang (NIST) was asked to analyze the comparison data. Analysis of uncertainty will be done based on all the uncertainty components. If the results show conflicts with the published CMS's, then a note of corrective actions, based on the results, will be included in the report. INTI's results will be averaged for CRV calculation, but the two individual contributions will be used for the regression analysis. It was decided that the participants are going to see the results and then decide the data analysis approach that will be implemented.

Harold Sanchez (ICE) asked if some laboratories were willing to pilot a future comparison.

Nile Oldham (NIST) described the SIM website details. The website of the Working Group (www.eeel.nist.gov) was explored in order to show the uncertainty budget and protocol samples for DMM and Power intercomparisons. The measurement protocol used previously will be used unless a major objection is registered. Important information to be provided would be the Measurement Method, the Uncertainty Budget and the Results.

CMC must go through the comments stage when Draft A is completed. When comments come in, the particular NMI is responsible for making the necessary changes and sending it to the website for the latest update. The website will be password protected, so as to allow public access only where necessary (Draft B) or restricted access only as necessary (Draft A). The chairman should send a copy of the CMC latest versions to Nile (NIST) so that he can insert them in the SIM website.

The only intercomparison report completed is that for Resistance, namely, SIM Comparison on DC Resistance (SIM EM-K1 – two 1Ω resistors, SIM EM-S6 – two $1\text{M}\Omega$ resistors, SIM EM-K2 – two $1\text{G}\Omega$ resistors) piloted by NIST – First round in January 2006 and second round in January 2007.

To improve the efficiency in the inter-comparisons, it was suggested and accepted that the methodologies/ procedures should be standardized so that the administration responsibilities of the intercomparisons can be simplified. Consideration can then also be given to delegating and sharing the work related to the intercomparisons.

Nile Oldham (NIST) requested updated meeting reports for the several comparisons.

Report by Mark Parker.

Measurements finished by NORAMET (only NIST participated as pilot) , CAMET (ICE, CENACYT)

CARIMET: One DMM in Jamaica, delayed 6 months.

ANDIMET: Ecuador asked for customs requirements that could be fulfilled by NIST. No DMM sent.

SURAMET: No DMM has been sent to INTI (pivot laboratory).

5 traveling standards in NIST, 1 in Jamaica.

No draft A yet.

Action agreed	Responsible	Date
JBS Jamaica to finish measurements and return DMM to NIST	SIM EM Chairperson	Not defined
One DMM to be sent to Trinidad and Tobago	Mark Parker	2 nd week March 2008
One DMM to be sent to INTI Argentina	Mark Parker	2 nd week March 2008
INTI to circulate DMM in SURAMET (INMETRO and UTE), 2 measurements in INTI. DMM to return to NIST.	Lucas Di Lillo as INTI representative	30 July 2008
Draft A	Mark Parker	30 August 2008
DMMs to go to pivot laboratories after this comparison.	Mark Parker	30 October 2008
Proposal of sub-regional comparisons coordinated by pivot laboratories	Representatives of pivot laboratories	31 December 2008

Thursday 28, Friday 29 February 2008
SIM EM MWG Annual Meeting

Welcome and introduction of the participants

Present were representatives from: NIST, TTBS, CENAMEP, INTI, INTN, UTE, NRC, Inmetro, CENAM, and ICE.

Approval of the Agenda

The agenda was approved by the participants.

Matters arising from the last CCEM WG on coordination of RMOs meeting

Harold Sanchez (ICE) commented on the following subjects: SIM EM participation, Report on Inter-regional review, Report on SIM.EM comparisons, Links to other comparisons, and SIM.EM comparison identifiers.

The energy inter-comparison to be completed (report) Draft B by March 2008. To be published in the SIM Publication INFOSIM and/or Simposio de Metrología in Mexico. The full paper is to be completed by May 2008. NMI's to submit report on corrective actions for outlying results. INTI is to report corrective actions for outlying results.

For capacitance, work on changing the units to relative indications as well as corrections to the calculations must be completed (by the end of August 2008) Andrew Koffman. Draft A is to be prepared by NCSLI 2008. NMI's are to submit reports on corrective actions for outlying results. Calibration procedure for 3 Terminal Capacitors to be emailed to participants.

DMM Inter-comparison - Multimeter travelling standards are to be sent to T&T and Argentina . INTI will circulate the standards in Suramet (to be completed by August 2008). The unit in T&T may be sent to other CARIMET members depending on whether these other countries express an interested in receiving standard. To be completed in 4 months. Jamaica to be contacted concerning the DMM standard there for 6 months.

SIM and inter-regional CMC review

The Link between CMC and SIM Identifiers to be worked out, the BIPM identifier used, new chairman to investigate.

CENAMEP CMC up for review, scope to be change.

The approval of the QSTF of SIM and Peer Review are required for the CMC to move forward. A list of SIM Approved Peer Reviewers shall be listed for the assistance of SIM NMI's in order to facilitate the progress of their CMC declarations.

CMC declarations from extra regional NMI's are available for review (BIPM website) by SIM. NMI's to submit a list of personnel available to do CMC reviews.

Discussions took place on how to deal with the demand for the peer review of CMC's and how to make the review process more efficient. APMR requests to be sent out again for review agreement by reviewers. Reviewers are not to enter comments directly on to the website. Instead they are to go through the permanent representative on the Council.

Communication with the QSTF to be improved so that there can be greater awareness of the quality systems they review.

Highlights from the NMIs (5 minute reports from participants)

The following institutes presented reports: INTI, Inmetro, NRC, ICE, CENAMEP-AIP, CENAM, INTN, TTBS, and UTE. The representatives agreed to send copies of the reports to Nile Oldham at nile.oldham@nist.gov to be inserted at the SIM EMWG website.

Proposal for 100 A to 1000 A/ 5 A current (instrument) transformer inter-comparison. To be built and done with other interested NMI's, Panama and Brazil interested.

Reports for other SIM comparisons

AC/ DC transfer Intercomparison

Working on draft report to be ready by March 2008 for review and comments
CONTAINS LINK TO CCEM for international traceability.

Resistance

Draft submitted for CCEM approval, INTI observed a difference in the readings before and after the measurement, and may be linked to the temperature of the standard as it was transported. To determine if this changed the standard set point.

Inductance

Problem with transportation INTI to INMETRO traveling standard. Failure reported by pilot lab INMETRO. A new round of comparisons for all participants to be conducted with a new standard fully protected against shock and vibration. First results to be discarded (they can be provided on request only after the comparison is finished). Inmetro will inform the participants.

DCV

SIM Comparison approved and published.

AOS funding for SIM

Discussed, more funding is needed as well as more efficient distribution of that funding. The financial shortcomings were disappointing in the context of the OAS support.

The Budget 2006-2007 submitted by the past Chairman of the Working Group (Harold Sanchez) was also discussed.

Harold Sanchez commented that his 2007 expenses, namely, US\$ 2.048,83 for plane tickets and per diem, for attending CCEM meetings in BIPM, were not reimbursed by SIM.

SIM EM chairperson terms of reference

The terms of reference are to be reviewed and approved by WG members.

Election of new SIM EM WG chairperson

There was only one nominee. Dr. Gregory Kyriazis (Inmetro) was elected unanimously to be chairman of the working group.

Miscellaneous questions

Video Conferencing between NMI's to be investigated with a view to improving communication while keeping costs down. It was decided that email would be used as far as possible.

Date of next meeting

It was suggested that meetings be coordinated to occur with other conferences, and that a training component be included in meetings. It was decided that our meeting occur at least once per year. Proposed date:

VII SEMETRO September 2009 INMETRO, Brazil.

Action agreed	Responsible	Date
Request NIST (Jim Olthoff) formal support for traveling standards and measurements for SIM EM comparisons.	Chairperson	30 April 2008
NMIs to send list of CMC reviewers and peer evaluators	Invitation by Chairman. NMI representatives	30 March 2008
Volunteers for APMP.EM.6.2008 review	Invitation by Chairman. NMI representatives	7 March 2008
NMI presentations to be published in the SIM EM web page	NMI representatives.	7 March 2008
SIM and SIM EM web pages to include reference links.	Chairman and Nile	31 March 2008
AC/DC Draft B to be submitted for review by all participants	CENAM representative	17 March 2008
INTI requests the pilot lab the temperature log for second round of measurements for SIM.EM.K1-K2-S6	INTI representative	7 March 2008
INMETRO will restart the inductance comparison with another traveling standard, including new measurements from UTE and INTI. Update status in BIPM.	INMETRO representative	30 June 2008
Chairperson terms of reference to be reviewed, approved and published in the SIM web page.	NMI representatives	31 March 2008
Gregory Kyriazis unanimously elected as new chairman	NMIs representatives	28 February 2008

Friday 29 February 2008

Visit to NIST laboratories