Electricity and Magnetism Metrology Working Group

2011 SIM EM MWG Meeting
Monday, September 26, 09:00 h – 18:00 h, Room Cedro 6
Praiamar Natal Hotel & Convention – Francisco Gurgel, 33 – Ponta Negra – Natal – RN – Brazil

Agenda

09:00 h – 09:15 h	**Introduction** Welcome Introduction of the participants Approval of the Agenda	Chairperson SIM representatives
09:15 h – 12:00 h	**PTB Energy Project** Presentation of results from May workshop and subsequent discussion	PTB representatives
12:00 h – 14:00 h	**Interval**	
14:00 h – 14:25 h	**General Issues** Matters arising from the last CCEM meeting SIM Technical Review Process for EM CMC Funding for SIM activities	Chairperson SIM representatives
14:25 h – 14:45 h	**SIM.EM-K5 Electric Power Comparison** Comments on status	Pilot: CENAM
14:45 h – 15:05 h	**SIM.EM-S7 Electric Energy Comparison** Comments on status	Pilot: CENAM
15:05 h – 15:25 h	**SIM.EM-K12 AC-DC Current Transfer Comparison** Comments on status	Pilot: INTI
15:25 h – 15:45 h	**SIM.EM-K4, SIM.EM-S4, SIM.EM-S3 Capacitance Comparison** Draft B Report status	Pilot: NIST
15:45 h – 16:10 h	**SIM.EM-S5 Digital Multimeter Comparison** Draft A Report status and DMMs custody by NMIs interested	Pilot: NIST ICE representative
16:10 h – 16:30 h	**SIM.EM-K3 Inductance Comparison** Draft A Report status	Pilot: Inmetro
16:30 h – 16:55 h	**New and Proposed Comparisons** SIM Supplementary Comparison on Current Transformers (Pilot: UTE) SIM Pilot Study on Current Shunts / Low-valued Resistors (Pilot: CENAM) SIM Comparison on RF Attenuation (Pilot: to be defined) SIM.EM-K4.b, SIM.EM-S4.b, SIM.EM-S3.b Capacitance (NIST and ICE) SIM Comparison on Calibration factor of type-N thermistor mounts (Pilot: ICE). SIM Comparison on S-parameters (Pilot: INTI) CCEM.EM-K2 Key comparison on 10 MΩ and 1 GΩ resistances	SIM representatives
16:55 h – 17:20 h	**SIM and Interregional CMC Reviews** CMC SIM.EM.04.2010 – final comments EURAMET.EM.7.2010 – final comments CMC CENAM – final comments CMC INDECOPI Updating the list of SIM reviewers	Chairperson SIM representatives
17:20 h – 17:40 h	**SIM EM MWG Chair (2011-2014)** SIM EM MWG chairperson terms of reference Ballot for choosing the new SIM EM MWG chairperson	SIM representatives
17:40 h – 18:00 h	**Next SIM EM MWG Meetings** Next meetings to be held at CPEM 2012, Washington, July 2012 X Semetro at INTI, Buenos Aires, 2013 CPEM 2014, Rio de Janeiro, August 2014	Chairperson SIM representatives

Electricity and Magnetism Metrology Working Group

Participants

Country	NMI	Name	E-mail
Argentina	INTI	Lucas Di Lillo	ldili@inti.gob.ar
Argentina	INTI	José Luis Casais	jcasais@inti.gob.ar
Brazil	Inmetro	Gregory Kyriazis	gakyriazis@inmetro.gov.br
Canada	NRC	Peter Filipski	Peter.Filipski@nrc.ca
Chile	LCPN-ME	Rodrigo Ramos P.	roramos@udec.cl
Chile	LCPN-ME	Daniel Cárcamo M.	dacarcam@udec.cl
Colombia	SIC	Alexander Martínez L.	amartinez@correo.sic.gov.co
Costa Rica	ICE	Harold Sanchez	hsanchez@ice.go.cr
Ecuador	CMEE	Julio Cesar Montaluisa	molaju1966@hotmail.com
Mexico	CENAM	René D. Carranza	rcarranz@cenam.mx
Mexico	CENAM	Sergio Campos Montiel	acampos@cenam.mx
Mexico	CENAM	Marco Antonio Rodriguez	mrodrigu@cenam.mx
Panama	CENAMEP AIP	Carlos Espinosa	cespinosa@cenamep.org.pa
Paraguay	INTN	Jorge L. Parra R.	jparra@intn.gov.py
Trinidad - Tobago	TTBS	Eshwar Ramrattan	eshwar.ramrattan@gmail.com
Uruguay	UTE	Daniel Slomovitz	DSlomovitz@ute.com.uy
USA	NIST	Rand Elmquist	elmquist@nist.gov
Germany	PTB	Ulf Hillner	Ulf.Hillner@ptb.de
Germany	PTB	W. Guilherme K. Ihlenfeld	guilherme.ihlenfeld@ptb.de

1. SIM EM MWG Annual Meeting - Introduction

Welcome and introduction of the participants

The meeting commenced at 9:00 am with a welcome by the chairman followed by self introductions of the attendees from the various countries represented.

The agenda was changed: Rand Elmquist (NIST) proposed to make a presentation on an idea on CMC review data base conceived recently together with some colleagues who are IT developers.

The agenda was approved by all participants.

Lucas Di Lillo (INTI) volunteered to take the minutes for this meeting.

2. PTB Energy Project

This section contains the conclusions reached during the meeting concerning the project (report by Ulf Hillner (PTB)). The main objectives were

- to inform members of the SIM EM MWG on the project proposal and PTB technical cooperation,
- to know about the degree of interest of the members to engage in this project,
- to validate and further develop the ideas for activities within the scope of the project

The session was structured as follows:

2.1 Introduction

As part of the introduction the participants reported some basic characteristics of their institutes.

	Institution with no. of staff working in Electricity				
Country	**Name**	**NMI**	**DI**	**Other**	**CMCs**
Argentina	INTI	25			c. 300
Brazil	INMETRO	50			c. 300
Canada	NRC	20			x
Chile	LCPN-ME		2		(under review)
Colombia	SIC	4			
Costa Rica	ICE		4		57
Ecuador	CMEE			8	
México	CENAM	22			x
Panamá	CENAMEP	3			1
Paraguay	INTN	3			

Trinidad & Tobago	TTBS		3	
Uruguay	UTE		x	X
U.S.A.	NIST	20		X
Germany	PTB	120		X

2.2 Presentation

A presentation was made by Ulf Hillner on PTB International Technical Cooperation and background information on the project proposal regarding Quality infrastructure for Renewable Energies and Energy Efficiency in Latin America and the Caribbean.

2.3 Results of the Workshop in May

Lucas Di Lillo (INTI) gave a summary of results on behalf of Héctor Laíz (INTI) who is the SIM coordinator for the preparation and implementation of the project. The workshop documentation is available on the web (https://www.ptb.de/lac/index.php?id=5379).

2.4 Discussion: Way forward?

In a first step general questions were dealt with based on the information given. In a second step two groups were formed to develop concrete ideas for activities in two of the identified priority areas.

1 - General aspects

Nobody presented any principal objections or doubts regarding the proposal. In a general way interest to work on this project was expressed by participants. It was recognized that this exchange of information and ideas was to provide the SIM coordinator in the project steering committee with guidance and orientation with regard to activities that the working group considers of interest.

Activities that can be supported by the project include training activities, workshops, consultancies, intercomparisons. Purchase of equipment for individual institutions are considered to be beyond the scope of the project. Other cases like the support for participation in scientific congresses would need to be evaluated on a case-by-case basis.

2 - Working Groups

Based on the ideas generated by SIM representatives in the May workshop at Inmetro, the working group split up in two subgroups to work out details for possible activities which were then presented and discussed with the whole working group.

Each subgroup discussed three questions:

1 – do the proposed lines of action cover the major and relevant issues or is there a need to add something?

2 – what activities are needed to implement the lines of action?

3 – what contributions to the implementation of that activities are possible from WG members?

In general terms, the lines of action identified in May were considered to contain all the main elements necessary. In the case of “Grids” the first line of action was amended by the working group to contain the aspect of traceability.

The results of the discussions are summarized in the following tables, one for each priority area (grids, household appliances).

There was no time to discuss the third line of action in each priority area.

GRIDS

Line of Action	Activity		Contributions		Subjects
Improvement of the competences for traditional energy meter verification and traceability	Survey of the needs or Capability (Multiple Choice of alternatives)	Identify minimum capacity needed			
	training & consulting		CENAM: Training on Basics of national standard selection	Need for physical measurement system training for development	Power and energy
			INTI: Training on Basics of test bench of energy meters		Energy
			NRC: Training		
	peer reviews				
Improvement of the technical competence for measurements of transmission and distribution of energy (power quality, phasors, transformers)	Seminar, Training		INMETRO,NIST, NRC, PTB	How to develop measurement systems	Digital Sampling algorithms
				Phase Measurement Unit (PMU)	Development of transducers (dividers and shunts) for power quality
	Comparisons: bilateral on power quality				
Improvement of the technical competences in new technologies of intelligent energy meters (software & communications, hardware)	Seminar, Training		Was not discussed		

HOUSEHOLD APPLIANCES

Line of action	Activity	Contribution
Improvement of the regional traceability framework for the magnitudes required by the tests which are necessary for labeling the energy efficiency of the household appliances	Identify needs: Survey to NMIs regarding needs in energy efficiency, electromagnetic compatibility, electric safety, flicker, vampire power	INTI: Training in energy efficiency Electromagnetic compatibility Electric safety
	Training in metrological traceability (options on how to structure), procedures (elaboration and harmonized application)	
Improvement of the regional traceability of the measurements dedicated to the improvement of the energy efficiency (for instance thermal isolation)	It was noted that a definition of the relevant magnitudes for the second line of action would be needed in order to be able to define any possible activity in the context of this SIM EM MWG.	
increase Awareness with Government	Seminars	Was not discussed

It was concluded that it would be necessary to have some information on the needs of SIM members well before the November meeting (by Oct. 21), in order to have time to draft concepts for the trainings, René Carranza (CENAM) volunteered to develop a survey proposal which was then discussed by a small group after the meeting. This survey will be submitted to the SIM EM MWG chair Gregory Kyriazis for distribution to the WG members and to Héctor Laiz for distribution to all the SIM members via the SIM secretariat in order to capture the demands for the magnitudes apart from electricity and magnetism. Concerning household appliances and their traceability, Lucas Di Lillo will talk at INTI with Liliana Fraigi to know which type of tests is necessary to do.

3. General Issues

3.1 Matters arising from the last CCEM meeting

At the last Consultative Committee on Electricity and Magnetism (CCEM) meeting held in Paris in 2011, it was decided that the RMOs should discuss their procedures for reviewing Electricity and Magnetism CMCs towards a future possible harmonization. Based on such request SIM EM MWG elaborated two documents:

SIM MWG-1 #01 *SIM TECHNICAL REVIEW PROCESS FOR ELECTRICITY AND MAGNETISM CALIBRATION AND MEASUREMENT CAPABILITY* - approved by SIM EM MWG in February 2011.
SIM MWG-1 #01 PROCESO DE REVISIÓN TÉCNICA SIM PARA CAPACIDADES DE CALIBRACIÓN Y MEDICIÓN EN ELECTRICIDAD Y MAGNETISMO - approved by SIM EM MWG in February 2011.
The documents have been submitted for publication in SIM web page.

3.2 Matters related to SIM

A few weeks ago, SIM Technical Committee Chair, Claudia Santo, drafted a document condensing information from several SIM MWGs on how they conduct the CMC review process. Documents like this have been presented this spring by all RMO chairs, in the JCRB meeting in Paris as a subsidy to the decision on whether a JCRB Workshop on CMC Review should take place in the near future.

The document issued by SIM Technical Committee contains flowcharts summarizing the process. SIM EM MWG chairperson suggested that the two SIM documents listed above be modified by insertion of flowcharts.

3.3 EURAMET Reflection on MRA Processes

The MRA processes (CMC review and comparisons) represent an important workload for the technical committees in the RMOs. The experience with recent CMC reviews shows that the CMC processes are becoming more and more difficult to handle:

- The number of entries steadily increases.
- It is difficult to review all entries properly and to ensure their validity over time.
- For an external customer it is difficult to compare services published in the KCDB and to choose. For this purpose, the data base entries are often not comparable enough.

EURAMET issued a paper in February 2011 with this motivation criticizing the process and suggesting possible roots for improvement. The Consultative Committee on Electricity and Magnetism Working Group on Coordination of Regional Metrology Organizations (CCEM WGRMO) accepted the contribution and issued the following recommendations

---

Recommendations of the CCEM WGRMO task group on how to streamline the CMC review process

Implementation of data base tools for the handling of the entries

. The review is carried out via web interface using a dedicated section of the CMC database.
. Access rights are given depending on the role of the reviewers.
. All reviewers are working on the same data (no merging of multiple file versions anymore).
. Whenever possible, the format and the allowed range of values of the entries should be predefined and fixed (e.g. fixed relation between service category, description of the service and allowed range of the measurand).

This would lead to a drastic reduction of the workload for the reviewers, the TC chairs and the KCDB manager.

Strict deadlines

. Announcement of review by RMO: maximum of four weeks after submission of CMC set.
. Review by RMO: maximum of four months between announcement of review and sending of review report.
. If a reviewer cannot accept the submitted entry on the basis of the information available, he/she should contact the submitting NMI within three weeks after the start of the review. A maximum of three weeks is allowed for the first reaction of the submitting NMI to requests of the reviewer. Once the contact is established and the first positions are given, further iterations of the process should take less time (typically less than two weeks per iteration). In any case, the time allocated to the whole review process should not be exceeded.

Scope of Inter-RMO review

. Restrict review to new and improved services (reduced uncertainty, wider scope).
. Encourage cooperation among the RMOs in sharing the load for the inter-RMO review.
. Include technical peer review reports when available with the CMC submission and consideration by the reviewing RMO

3.4 NIST idea on CMC Review Process

Rand Elmquist (NIST) made a presentation on an idea conceived recently together with some colleagues who are IT developers. They are considering working to design a web version of the CMC database to help support the BIPM and reduce the effort that goes into reviews by the RMOs. This comes as a result of a discussion at the CCEM meeting in March, in Paris, where Ms. Claudine Thomas (BIPM) spoke about the difficulty of maintaining the CMC tables, and the possibility of producing a web-based version in the future. This idea is being discussed this spring in the JCRB meeting in the broader context of a reevaluation of the CMC process.

The idea is to base a CMC web portal accessible from a browser, which is based on a highly configurable database. It would be straightforward to set up the CMC entries, but reviewing takes a little more work for them. This is based on the database and interface that they use for measurement data storage and access, there in their NIST Division. Below are some of the basic features.

· All CMCs for every NMI would be viewable through the browser, and searchable, for example it could display only those CMCs for a given RMO or NMI, those that are under review, or those that are under review in a particular measurement area like DC voltage.
· The reviewer would click on a data field and input their comment to show in that field, rather than off at the end of the row as in the old EXCEL spreadsheets.
· The existing compact form of the uncertainty matrices would remain where needed, and clicking a link in the data field allows the reviewer to view them.
· Links are provided to relevant reports supporting the CMC entry from the KCDB database.
· Review comments are viewable only by the current reviewer, author of the CMC, and the BIPM staff.
· The final CMC table would be accessible to the general public in the same format, but without any access to data entry.

In summary, the main idea is to make a data base similar to the database Rand uses in his Lab. In this database all the information concerning the CMC can be seen by anyone in the world. Additionally this new format can be used by the reviewers in order that any reviewer can see other reviewer´s comments in order to avoid lots of files being exchanged around the world. According to this information the new proposal can be presented in the next JCRB meeting.

There were several points made by SIM EM MWG:

- SIM members would support a trial version working within SIM as a way of reviewing CMCs;
- It should be managed and updated by BIPM staff, certainly not NIST;
- The SIM EM MWG is willing to voice its interest in the proposal to the BIPM when NIST is ready to submit it.

3.5 Funding for SIM Activities

3.5.1 2011 SIM EM MWG meeting

As the current SIM / OAS project was finished in 2011, SIM was unable to partially fund the participation in this meeting. SIM is submitting a new project to OAS but we need to wait until OAS approves the project.

Physikalisch-Technische Bundesanstalt (PTB) partially funded the participation in this meeting by providing flight tickets to seven SIM members. In general terms PTB would not be able to offer full financial support for the working group members. But considering the importance of the working group and its relation to the project PTB discussed during their workshop in May at Inmetro about the future cooperation in energy, they considered a partial financing of participants through the provision of flight tickets. To be able to do this and to soundly justify it they would need to have met a couple of conditions:
- be able to participate in the working group meeting and have an additional item of about half a day in the working group meeting agenda to discuss the results obtained during our May workshop;
- participants eligible for support would need to participate in the working group meeting and the capacity building activity during Metrologia 2011 and they would need to contribute to the preparation of the planning process of the energy project in a way which still needs to be defined.

3.5.2 2012 SIM EM MWG meeting

Rand Elmquist (NIST) informed that there will be NIST travel grants to attend CPEM 2012 and the 2012 SIM EM MWG meeting to be held in Washington, U.S.A. The information had been distributed last year to SIM members. The grants can be accessed at http://www.icpem.org/2012/grants.html and at http://www.icpem.org/2012/career.html
The deadline for submitting the application forms is January 13th. For this support, first consideration will be given to applicants from SIM institutions who submit a summary paper and wish to present a technical paper. Second consideration will be for applicants from SIM institutions that have been under-represented at previous CPEM conferences. Third consideration will be given to applicants from outside of SIM institutions but within the geographical regions of SIM.

Ulf Hillner (PTB) would like to know if SIM can organize during CPEM a training event that can be realized together with another activity related to the PTB Project. In that case PTB can provide partial funding. The SIM EM MWG chairperson has traditionally organized two-hour meetings during CPEM but holding the meeting in a day before the conference could be a possibility. The decision must be taken by CPEM 2012 Organizing Committee. The chairperson will check that. Ulf Hillner said that if it becomes necessary to stay more time to discuss the PTB project, PTB could also provide partial funding for that. But this still needs to be confirmed.

3.5.3 2013 SIM EM MWG meeting

It is expected that OAS will have approved the SIM project by 2012 so that hopefully there could be partial funding for participants in the 2013 SIM EMG meeting to be held together in Buenos Aires with the 10th International Congress on Electrical Metrology (X SEMETRO). The event is being organized by INTI.

Action agreed	Responsible	Date
Elaborate survey on NMI measurement demands	René Carranza and Ulf Hillner	Beginning October
Distribute survey on NMI measurement demands	Chairperson	October 10
Distribute information on NIST travel grants to attend CPEM 2012	Chairperson	October 30
Contact CPEM 2012 Organizing Committee to schedule the next meeting	Chairperson	November 30
Updating of SIM EM CMC Review documents to include flowcharts	Chairperson	May, 2012

3. SIM.EM-K5 Electric Power Comparison

Pilot - CENAM
Report by René Carranza

Due to its high stability, the RD-22-311 is being used to ensure the link between the SIM.EM-K5 and the CCEM-K5. Thus, this standard is being sent to either those NMIs who did take part in the CCEM-K5 or to those NMIs whose declared CMCs, reported at the KCDB, show measurement uncertainties below ± 50 µW/VA for the calibration services of power meters.

Measurements to be done by CENAM, NIST, NRC, Inmetro, UTE, and INTI.

The laboratories which do not satisfy the requirements for receiving the RD-22-311 standard will receive the RD-23-432 standard.

In this case, measurements to be done by LCPN-ME, SNM-INDECOPI, SIC, CENAM, ICE, CENAMEP AIP.

Rene Carranza (CENAM) made a presentation on the comparison. He presented the comparison measuring points to the participants and he said that the link to the CCEM comparison (53 Hz) will be made through the results at 50 Hz. He also showed the current status of the schedule.

Current status:

At this time the traveling standard RD-22-311 is at CENAM. So far, USA, Canada and Brazil have already taken part in this comparison. Uruguay and Argentina are the following and final participants.
On the other hand, CENAM needs to make measurements for a week with the traveling standards RD-22-311 and RD-23-432 in order to check the RD-23-432 status. When the measurements had been finished we will ready to send the traveling standard RD-22-311 to the next participant Uruguay.

The only participants that remain to measure are UTE and INTI. Ecuador will be waiting until CENAM checks the stability of the travelling standard. UTE will measure in October and INTI during November. The Draft A will be issued in February. René Carranza (CENAM) will prepare a paper to be presented at the CPEM in January. The authors will be all the participants.

4. SIM.EM-S7 Electric Energy Comparison

Pilot - CENAM
Report by René Carranza

Considering the high stability of the RD-22-311, it will be used to ensure the link between the SIM.EM-S7 and the SIM.EM-S2. Thus, this standard will be sent to either those NMIs who did take part in the SIM.EM.S2 or to those NMIs whose declared CMCs, reported at the KCDB, show measurement uncertainties below ± 50 µWh/VAh for the calibration services of energy meters.

Measurements to be done by CENAM, NIST, NRC, Inmetro, UTE and INTI.

The laboratories which do not satisfy the requirements for receiving the RD-22-311 standard will receive the RD-23-432 standard.

In this case, measurements to be done by LCPN-ME, SNM-INDECOPI, SIC, CENAM, ICE, CENAMEP AIP, and CMEE.

This inter-comparison is to run in parallel with the power comparison commented above.

Current status:

The traveling standard RD-23-432 is back from Ecuador. Unfortunately Ecuador could not make her measurements due to waste of time with customs and when the traveling standard was cleared, their standard had to be calibrated on that date. CENAM needs to make measurements for a week with the traveling standards RD-22-311 and RD-23-432 in order to check their behavior.

Action agreed	Responsible	Date
CENAM to make measurements to check traveling standards	René Carranza	October 18
UTE to make measurements	Daniel Slomovitz	November 10
INTI to make measurements	Lucas Di Lillo	December 10
Technical paper submitted to CPEM 2012	René Carranza	January 10
Draft A distributed to participants	René Carranza	February 28

6. SIM.EM-K12 AC-DC Current Transfer Comparison

Pilot - INTI
Report by Lucas Di Lillo

Measurements to be done by INTI, UTE, NRC, NIST, CENAM, SIC, INMETRO and NIS (Egypt). The latter was added after approval by SIM EM MWG in July 2011 of a request made to Lucas Di Lillo by Dr. Eng. Mamdouh Halawa, the head of electrical measurements in NIS, Egypt.

This comparison is to be done at two values, 10 mA and 5 A, using a shunt and thermal converters all manufactured by INTI. A data logger is being used to measure temperature and humidity during testing and transportation of the standards.

Lucas Di Lillo (INTI) made a presentation on the comparison.

Current status:

The travelling standard was at NRC and Peter Filipski detected that the input connector of the shunt was damaged. That´s why the pilot decided the standard should return to INTI. INTI fixed the problem, made new measurements and (as the pilot results were the same as before) the shunt was sent again to NRC.

When the standard arrived to CENAM, Sara Campos informed Lucas Di Lillo that the input connector of the TVC had a strange mark. They concluded that this will not affect the behavior of the standard and they decided to continue with the comparison.

Sara Campos (CENAM) sent the standard to Costa Rica and it is still in customs. Unfortunately, Harold Sánchez (ICE) has not had the correct cables to measure the output of the thermocouple. He is going to buy them. They cannot measure now. Also SIC´s multimeter is under calibration and so they cannot measure now.

As a result the pilot decided to send the standard to INMETRO and after that, INMETRO is going to send the standard again to INTI. After INTI make the measurements and, if ICE and SIC solve the abovementioned problems the standard will go to ICE, SIC and then again to INTI and finally to NIS.

INTI is waiting some information from ICE to complete the dates in the schedule.

Action agreed	Responsible	Date
ICE to provide information to complete the dates in the schedule	Harold Sánchez	November 30
SIC to provide information to complete the dates in the schedule	Alexander Martínez	November 30
New schedule to be distributed to participants	Lucas Di Lillo	To be defined

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

Pilot - NIST
Report by Rand Elmquist (on behalf of Andrew Koffman)

Measurements finished by NIST, CENAM, ICE, NRC, INTI, Inmetro, UTE.
Traveling standards at NIST.
Draft B elaborated and distributed to participants for comments in September 2011.

Rand Elmquist (NIST) made a presentation on the comparison. He explained that the draft is finished with all the statistical analysis. He also showed Nien-fan Zhang´s paper on data analysis. Lucas Di Lillo (INTI) would like to know if it is possible to include in the final report a graph with the new results including the corrective actions. Rand said that the comparison took lot of time and, in case of doing all the reports again the comparison will suffer a new delay. Lucas explained that the idea of a comparison is to know how good the results of a given NMI are. In case of corrective actions such a graph should be included in the report. SIM EM MWG chairperson remarked that according to MRA rules the graphs should portray the results provided by NMIs during the comparison and not the ones reached after corrective actions have been implemented.

Current status:

Draft B elaborated and distributed to participants for comments in September 2011.

Four laboratories took corrective actions. They do not affect the comparison.

The linkage to the CCEM-K4 was provided using the CCEM-K4 data from both NIST and NRC. The CRVs for the SIM comparisons were produced using only NIST data, since NIST provided the only independent values.

Four of the seven labs have undertaken corrective actions. These do not affect the CRV on any of the ranges since only NIST values were used to calculate the CRV.

Action agreed	Responsible	Date
Participants to send comments on Draft B	Comparison participants	October 30
Final Report issued	Andrew Koffman	November 30
Final Report approved	Comparison participants	December 30
Technical paper submitted to CPEM 2012	Andrew Koffman	January 10
Submission of Final Report to chairperson	Andrew Koffman	January 30
Final Report published in KCDB	Chairperson	February 28

8. SIM.EM-S5 Digital Multimeter Comparison

Pilot - NIST
Report by Rand Elmquist and Harold Sánchez (on behalf of Mark Parker now retired from NIST)

Current status:
Measurements finished by NORAMET (only NIST participated as pilot), CAMET (ICE, CENAMEP AIP), CARIMET (TTBS), ANDIMET (SNM-INDECOPI, CMEE, SIC) and SURAMET (INTI, UTE, LCPN-ME, Inmetro)
6 (six) traveling standards distributed to sub-regions
Draft A elaborated and distributed to participants for comments.

6 (six) DMMs purchased with OAS resources for SIM.EM-S5 (only four were used in the comparison) have been distributed by NIST to the three pivot laboratories from SURAMET, ANDIMET and CAMET, namely, INTI, ICE and INDECOPI. Each NMI received 2 (two) DMMs and will be responsible for coordinating sub-regional comparisons in the future.

SURAMET - INTI took custody of a HP3458 and a Datron 4950.
Hewlett-Packard 3458A s/n 2823A15128 US$4000
Datron 4950 s/n 33002 US$3000 with model 4953 AC/DC shunt, s/n 32869 value US$250
Contact: Lucas Di Lillo

CAMET - ICE took custody of a HP3458 and a Datron 4950.
Hewlett-Packard 3458A s/n 2823A15147 US$4000
Datron 4950 s/n 28746 US$3000
Contact: Harold Sanchez

ANDIMET - INDECOPI took custody of two Keithley 2002.
Keithley 2002 s/n 0626300 value $2000
Keithley 2002 s/n 0626306 value $2000
Contact: Henry Diaz

Harold Sánchez (ICE) asked Rand Elmquist (NIST) if it is possible for NIST to send a calibration report for the DMMs but Rand explained that Mark Parker is now retired and they do not have calibrations of these DMMs.

Harold Sánchez (ICE) elaborated the Draft A report and distributed it in August to participants for comments. Some participants then provided comments to improve the document.

According to the MRA rules, supplementary comparisons shall only be carried out by the RMOs. There are only few examples for supplementary comparisons organized by CCs, from the early phases of the MRA. CCEM has only organized two. Since in general there will be no equivalent CC supplementary comparison, it would not be possible to establish a link. Normally, supplementary RMO comparisons are "standalone" comparisons, which are carried out for particular purposes, but they are not linked to other comparisons. If a RMO comparison should be linked to an existing CC key comparison, also the RMO comparison should be "key".

Nien-Fan Zhang (NIST) elaborated a EM-S5 Draft B analysis. It is similar to Harold Sanchez's analysis method with a few changes. A couple of questions have been discussed in Natal:

-- There is a minor covariance issue for the results of SIC and UTE with the other labs in Loop 4. While NIST, INTI, and INMETRO are independent, both of those labs get traceability within SIM. May we ignore this issue? Nien-Fan made a sample calculation and confirmed that it is actually a minor issue.

-- To give pairwise D.O.E. values for all eleven labs there will have to be nine tables, each with 11 x 11 terms. Considering the lack of a CCEM comparison for DMMs, is that necessary? Can we live with just the differences and uncertainties for each participant?

The SIM EM MWG answered YES to both questions.

Rand Elmquist (NIST) will prepare a paper to be presented at the CPEM in January. The authors will be all the participants.

Action agreed	Responsible	Date
Participants to send comments on Draft B	Comparison participants	October 30
Final Report issued	Rand Elmquist	November 30
Final Report approved	Comparison participants	December 30
Technical paper submitted to CPEM 2012	Rand Elmquist	January 10
Submission of Final Report to chairperson	Rand Elmquist	January 30
Final Report published in KCDB	Chairperson	February 28

9. SIM.EM-K3 Inductance Comparison

Pilot - Inmetro
Report by Gregory Kyriazis (on behalf of Luiz Macoto Ogino)

Current status:
Measurements finished by INTI, Inmetro, ICE, CENAM, NIST, NRC and UTE.
All labs reported their values.
Draft A issued and distributed to participants for comments.

Several participants have commented the Draft A issued by Inmetro since the end of 2010. NRC is reluctant to agree to abandoning the whole measurement comparison because of the work involved so far, particularly on the part of INMETRO, but having looked again at the comparison data alongside the data from Inmetro´s in-house check standard, they would agree that it looks as if the shipped artifact underwent a "step" change at some (unknown) point during the comparison, probably after the NRC measurements. This leads them to conclude that from an NRC perspective pursuing the full analysis of this comparison further with the present data set is not a useful exercise. NRC therefore agrees with others that this comparison be abandoned.

Inmetro believes that it would be best to restart the comparison with a new standard inductor. They are also in agreement that NIST cannot be the link to CCEM-K3 with the calibration system employed in the SIM comparison. They suggest that a country with a lower uncertainty to participate in a bilateral comparison with an European NMI, or to invite an European NMI to participate of the new round of measurements. Unfortunately, Inmetro doesn't have any more standards that could be used in the new comparison.

CENAM further suggested that In future SIM comparisons it will be necessary establish that:
1. Those laboratories that serve as link to CCEM should participate using the same measurement system and uncertainty used in the Key Comparison, or a better one with validated results.
2. In case of conflict or controversy, a bilateral comparison must be realized between a participant of the comparison and a participant of the CCEM Comparison. Also the criteria to choose the participants of this bilateral comparison should be established.
During the review of the comparison protocol, CENAM recommended to use two inductors instead of only one. This is a weak aspect of the comparison. In future SIM comparisons the use of more than one standard should be strongly considered to minimize situations like the one faced now.

The motion to abandon the comparison was voted and approved by the SIM EM MWG.

Rand Elmquist (NIST) informed that Andrew Koffman has an inductance standard and is looking for another one to start a new run of the comparison.

CENAM would like to pilot the next SIM Inductance comparison subject to the availability of sound travelling artifacts, and CENAM will confirm this offering at the upcoming CPEM 2012 in Washington DC.

Daniel Slomovitz (UTE) suggested that all uncertainties results in the comparisons be reported with $k = 2$.

Action agreed	Responsible	Date
Abandonment of current SIM.EM-K3	SIM members	September 26
CENAM to arrange traveling standards	René Carranza and Andrew Koffman	November 30
Inform about CENAM´s proposal to pilot next SIM.EM-K3	Chairperson	July 07

11. New and Proposed Comparisons

SIM.EM-S8 Comparison of current ratios using instrument transformers
Measurement ratios: 5 A, 10 A, 50 A, 100 A, 500 A, 1000 A to 5 A.
Currents for each ratio: 1%, 5%, 20%, 100% and 120% of nominal current (In).
Frequency: 50 Hz or 60 Hz or both.
Pilot: UTE
Participants: UTE, Inmetro, SIC, NRC and INTI.
Status: Protocol distributed

UTE prepared a draft protocol and distributed it. It has been already circulated for approval.

Countries which expressed interest include Brazil, Colombia, Canada and Argentina.

The comparison start is delayed because UTE had some problems with the traveling standard. They will keep us informed when the problem is solved.

Daniel Slomovitz (UTE) will check the conditions for regarding this comparison a key comparison.

Action agreed	Responsible	Date
Problems with the traveling standard to be solved	Daniel Slomovitz	To be defined
Conditions for regarding this comparison a key comparison	Daniel Slomovitz and Gregory Kyriazis	November 30

Pilot Study Current shunts and low-valued resistors
Test points: 1 mΩ, 10 mΩ and 100 mΩ and 100 mW power.
Pilot lab: CENAM
Participants: not defined yet.
Status: Proposed by CENAM

At the SIM EM MWG meeting at CPEM 2010, a support group was proposed and the need for an oil bath and appropriate scaling for this work was pointed out. It was suggested that two resistors at 1mΩ be considered. It was again recommended that a draft protocol be produced and submitted for review prior to approval. This would then be circulated for approval.

The status of the pilot study of high current shunts is currently at stand by. Felipe Hernandez (CENAM) has not had enough time to complete the protocol and related studies for this comparison. It is expected to have more experimental results by the middle of year 2012. Felipe would like to make a presentation of the status of this pilot study during the upcoming CPEM 2012.

SIM.EM.RF-K19.CL Comparison on RF Attenuation
Test points: 10 dB, 20 dB and 30 dB (30MHz, 1 GHz and 10 GHz)
Pilot lab: INTI
Participants: ICE, CENAM, INTI, NIST and NRC
Status: Proposed by INTI

Lucas Di Lillo (INTI) informed that INTI can only pilot one comparison on RF this time. They are going to start a new one on RF only after they finish with the comparison on S parameters.

SIM.EM-K4.b, SIM.EM-S4.b, SIM.EM-S3.b Capacitance
Participants: NIST and ICE
Status: To be started after SIM.EM-K4, SIM.EM-S4, SIM.EM-S3 draft B is published

A Bilateral Comparison between NIST and ICE has already been incorporated to SIM.EM-K4, SIM.EM-S4, SIM.EM-S3 Draft B. This helped ICE in elaborating the corrective actions added to that report.

SIM.EM.RF-K8 Comparison on Calibration factor of type-N thermistor mounts
Test points: to be defined
Pilot lab: ICE
Participants: ICE, CENAM, INTI, NIST and NRC
Status: Proposed

Harold Sánchez (ICE) informed that they will need two traveling standards to ensure the completion of the comparison exercise. He informed they had a delay in the purchase of a VNA and training but they expect to solve those needs by 2012.

Ronald Ginley (NIST) recently received the Type N Microwave Power standards proposed to be used in the comparison piloted by ICE. Numerous attempts to measure one of the M1110s (SN 2902) resulted in very noisy measurements with high short term standard deviations. Further investigation revealed a loose center conductor on the type N RF interface. The center conductor has somehow loosened from the bead. SN 2903 appears normal and measures well.

NIST is sending the unit to be fixed at TEGAM.

In the 2010 meeting it was proposed that a coordinating group be formulated to manage the comparison including CENAM and INTI. The Proposal is to be drafted and submitted with NIST intended to start and end the round of measurements.

The discussion of this comparison has been postponed to the next meeting.

Action agreed	Responsible	Date
NIST to make measurements on the traveling standards	Ronald Ginley	December 15
ICE to draft and submit again the comparison protocol for approval	Harold Sánchez, Lucas Di Lillo and Israel Garcia	To be defined

SIM.RF-K5b.CL Scattering Coefficients by Broad-Band Methods
2 GHz - 18 GHz - Type N Connector
Test points:
Pilot lab: INTI
Participants: ICE, CENAM, INTI, NIST and NRC
Status: Protocol distributed

Scattering parameters of Type N connector devices selected for this comparison will be measured from 2 GHz to 18 GHz (inclusive) in 1 GHz steps. For one-port devices (matched and mismatched loads) the measurand is the complex-valued reflection coefficient S11. The VSWR 1.0 (matched) load and VSWR 2.0 (mismatched) load were chosen to perform reection measurements with low and high magnitude values. When measuring two-port devices (3 dB and 20

dB attenuators) the measurands are the four complex-valued S-parameters (S11, S21, S12 and S22). The values of 3 dB and 20 dB were chosen to cover transmission measurements with high and low magnitude values.

The analysis of the results will be done only for S11 (for one-port devices) and S21 (for two-port devices) in 2 GHz, 9 GHz and 18 GHz to reduce the amount of data to be analyzed for the comparison. This three frequencies were chosen to cover the low, medium and high frequency range.

All the participants agreed to start the comparison in 2012. The chairperson will convey all SIM members about the comparison start. If all the participants agree, the registration form will be sent to the KCDB. INTI, as the pilot lab, will send the schedule in a few days.

Action agreed	Responsible	Date
All SIM members to be informed about the comparison start in 2012	Chairperson	October 30
INTI to distribute the schedule to comparison participants	Lucas Di Lillo	October 30
INTI to prepare the registration form	Lucas Di Lillo	November 30
Registration form and protocol to be published in the KCDB	Chairperson	December 15

CCEM.EM-K2 Key comparison on 10 M□ and 1 G□ resistances
Participants: CENAM, NIST and NRC representing SIM

At the CCEM meeting earlier this year, the forthcoming Key Comparison of 10 Mohm and 1 Gohm resistors was discussed. It is intended that this be a repeat of K2 carried out some years ago but now with better accuracy and precision as many laboratories have improved their instrumentation and methods in the meantime.

NRC have very kindly volunteered to support the running of this comparison and they are currently evaluating the travelling standards and drafting the protocol which will be based on the more recently completed EUROMET.EM-K2 exercise.

There is now a need to decide on the list of participants. In order that the comparison is delivered in a timely manner, they expect to have between 10 and 12 participants in addition to NRC and this should be spread amongst the RMOs. In EURAMET, they will ensure that appropriate linkage is provided with their recent K2.

All SIM members have been invited by the chairperson to participate but only CENAM and NIST responded by July 25. It was agreed that three countries would suffice to represent SIM in the comparison as representatives from five RMOs are expected to participate.

NIST: For 10 MΩ they will use a high resistance CCC with an uncertainty estimate of 0.3 μΩ/Ω (k=2). For 1 GΩ they will use a high resistance CCC and an active-arm bridge, with combined uncertainty estimated to be 3 μΩ/Ω (k=2). The contact person for this comparison is Dean Jarrett who is the leader of the high resistance dissemination services at NIST (dean.jarrett@nist.gov).

CENAM: For 10 MΩ they have a high resistance CCC and a MIL 6000B commercial bridge, the uncertainty they can reach is less than 1 μΩ/Ω (k=2). For 1 GΩ they have a high resistance CCC and a modified Wheatstone bridge, the uncertainty they can reach is about 12 μΩ/Ω (k=2). The contact person for this comparison is Felipe Hernandez who is the chief of the Resistance Laboratory of CENAM (fhernand@cenam.mx).

12. SIM and inter-regional CMC reviews

SIM NMI CMCs
CMC SIM.EM.04.2010 - published in the KCDB

Participation of SIM reviewers in inter-regional reviews
EURAMET.EM.7.2010 - approved by SIM and published in the KCDB
APMP.EM.7.2011 – under review by SIM

Proposals for new CMCs in the region
CMC CENAM (on service category 7) – submitted to interregional review
CMC CENAM (on service category 11) – under review by SIM
CMC INDECOPI – review pending

The CMC CENAM (on service category 7) has been included in SIM.EM.05.2011 and submitted for interregional review. INDECOPI requested more time for calibrating their standards and updating their CMC. They will then resubmit their CMC for review by SIM.

CMC CENAM (on service category 11) will have to wait till 2012 to be submitted for interregional review. As has been agreed in our 2010 meeting, there is one SIM EM CMC review cycle per annum and a window from April to October has been defined within which the chairperson would be submitting SIM CMCs once a year for interregional review.

List of SIM EM CMC Reviewers

The list of SIM reviewers has been updated as below.

Categories		Primary reviewer	Secondary reviewer
1.	DC voltage	Yi-hua Tang (NIST)	David Avilés (CENAM)
2.	Resistance	Rand Elmquist (NIST)	Felipe Hernandez (CENAM)
3.	DC current	Regis Landim (Inmetro)	Sara Campos (CENAM)
4.	Impedance	Marcel Coté (NRC)	Andrew Koffman (NIST)
5.	Ac voltage	Lucas Di Lillo (INTI)	
6.	Ac current	Lucas Di Lillo (INTI)	
7.	Power	Daniel Slomovitz (UTE)	Lucas Di Lillo (INTI)
8.	High voltage and current	Rejean Arseneau (NRC)	Ademir França (Inmetro)
9.	Other DC and low frequency		
10.	E&M fields	Perry Wilson (NIST)	
11.	Radio frequency	Perry Wilson (NIST)	
12.	Measurements on materials		

We are grateful to Peter Filipski (NRC) for his role as SIM reviewer through the last years and we welcome Lucas Di Lillo (INTI) for replacing him in this position.

As can be seen there are vacant places in the table. We kindly request SIM members to nominate volunteers for those places. We need in special secondary reviewers that would accompany present reviews and replace current reviewers in the future.

Action agreed	Responsible	Date
SIM.EM.5.2011 to be submitted for publication in the KCDB	Chairperson	October 1
APMP.EM.7.2011 to be reviewed by SIM	Chairperson	October 30
Secondary reviewers to be nominated	Chairperson	November 30
CENAM CMC (on service category 11) to be reviewed by SIM	Perry Wilson	December 05
INDECOPI to submit CMC for SIM review	Henry Diaz	To be defined

13. Election of new SIM EM MWG Chair (for the period 2011-2014)

Gregory Kyriazis (Inmetro) has been reelected for another period as chair of the SIM Electricity and Magnetism Metrology Working Group (SIM EM MWG) till 2014.

13. Next SIM EM MWG Meeting

Several proposals for future meeting dates were received:

2012 - CPEM 2012 (01-06 July), in Washington DC, USA,
2013 - X SEMETRO (25-27 September) in Buenos Aires, Argentina
2014 - CPEM 2014 (03-08 August) in Rio de Janeiro, Brazil.

In our last 2010 meeting, Peter Filipski (NRC) had proposed an Electrical Measurement Workshop to be held in 2013, for 4 to 5 days. This proposition by NRC involves hands-on training in Josephson voltage, Electronic kilogram, High Voltage, Power, Capacitance, Bridges, and Quantum Hall. However, NRC decided to suspend the proposed SIM Electrical Standards Workshop in the form they have envisioned previously. This does not mean that they are abandoning the idea. They will try to see if they can pursue this initiative in another form, and maybe with another source of funding.

The 2012 SIM EM MWG meeting will be held at CPEM 2012 in Washington DC, USA. There will be financial support to attend this meeting. For this support, first consideration will be given to applicants from SIM institutions who submit a summary paper and wish to present a technical paper. Second consideration will be for applicants from SIM institutions that have been under-represented at previous CPEM conferences. Third consideration will be given to applicants from outside of SIM institutions but within the geographical regions of SIM.

The 2013 SIM EM MWG meeting will be held at X SEMETRO in Buenos Aires, Argentina. The *III Training and Development on Electrical Metrology* could perhaps be held immediately before the congress. This still needs to be defined. Yi-hua Tang (NIST) manifested interest in participating as lecturer. It is expected that OAS will have approved SIM project by 2012 so that financial support may be available to SIM members to attend this meeting.

The 2014 SIM EM MWG meeting will be held at CPEM 2014 in Rio de Janeiro, Brazil.

The SIM EM MWG meeting ended at 18:00 p.m.

We thank Metrologia 2011 Organizing Committee for hosting the meeting in the conference venue.

Action agreed	Responsible	Date
Submission of technical papers to CPEM 2012	SIM representatives	January 13, 2012
Submission of application forms for travel grants to CPEM 2012	SIM representatives	January 13, 2012
Presentation of technical papers at CPEM 2012	SIM representatives	July 01-06, 2012

20110926
Gregory Kyriazis
Chair, SIM EM MWG
gakyriazis@inmetro.gov.br