Bureau international des poids et mesures

Director's Report on the Activity and Management of the International Bureau of Weights and Measures

(1 January 2014 – 31 December 2014)

BIPM Director's Report 2014

This BIPM Director's Report describes the activity of the BIPM and is one of a set of three documents issued annually by the CIPM and the BIPM which collectively cover the formal reporting to Member States, the other two reports in the set being the:

- Report of the 103rd Meeting of the International Committee for Weights and Measures (March and November 2014), and the
- *Rapport annuel aux gouvernements des hautes parties contractantes sur la situation administrative et financière du Bureau international des poids et mesures 2014*.

Note on the use of the English text

To make its work more widely accessible the International Committee for Weights and Measures publishes an English version of these reports.

Readers should note that the official record is always that of the French text. This must be used when an authoritative reference is required or when there is doubt about the interpretation of the text.

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[1]The Caribbean Community (CARICOM) is an Associate on behalf of eleven of its Member States: Antigua and Barbuda, Barbados, Belize, Dominica, Grenada, Guyana, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Suriname, and Trinidad and Tobago.

Director's Report on the Activity and Management of the International Bureau of Weights and Measures

(1 January 2014 – 31 December 2014)

1. INTRODUCTION

1.1. General introduction and overview of 2014

The major event for the BIPM during 2014 was the 25th meeting of the CGPM. Every meeting of the CGPM marks a milestone for the BIPM, it is the meeting at which progress with the work of the BIPM is presented to the Member States and at which future plans are agreed.

The Conference agreed five resolutions (which can be accessed from the BIPM website). In this summary I would like to focus on some highlights. The first of these is the agreement of a Resolution on the revision of the SI. Although the resolution does not state a particular date for the adoption of new definitions, the discussion at the conference recognized the importance of a roadmap endorsed by both the CCU and the CCM which indicates the steps needed to achieve a re-definition in 2018.

The BIPM is playing its part in preparing for re-definition by carrying out several of the actions agreed on the roadmap. One of the most important of these steps is the extraordinary campaign of calibration with the IPK, which is described in the report from the Mass Department included here.

Another initiative launched by the 25th CGPM was the review of the CIPM Mutual Recognition Arrangement (MRA). After fifteen years of successful operation, it was agreed that there is a need to review its implementation and operation. This will go beyond the improvements being made within the existing framework that include the increasingly strategic approach to the planning of comparisons and other steps to streamline the processes. The review will include a workshop in 2015 that will engage in a broad discussion about the CIPM MRA establishing views on what works well, and what needs to be improved regarding its implementation. It will involve the directors of the National Metrology Institutes as well as representatives from the Member States, the RMOs and relevant stakeholders.

Finally, the future funding ("dotation") of the BIPM was discussed by the CGPM. A Programme of technical and coordination activities at the BIPM for 2016-2019 was proposed by the CIPM and agreed by the Member States. Additionally, the CIPM tabled a proposal for a programme of work at the BIPM specifically aimed at strengthening the world-wide metrology infrastructure by building the necessary human and institutional components in those Member States that do not have a well-developed metrology infrastructure. The objectives of the proposal were widely supported and the CGPM included in its resolution on the budget of the BIPM the request that "Member States, as well as international organizations, private organizations and foundations to maintain the provision of additional voluntary support of all kinds to support specific BIPM mission-related activities, particularly those that facilitate participation in the activities of the BIPM by those countries without well-developed metrology infrastructure". This request further reinforces the opportunities available to the BIPM by working collaboratively to deliver its mission; indeed, in 2014 the BIPM hosted 12 secondments and internships.

As I look at what I consider to have been a strong endorsement for the work of the BIPM from the 25th CGPM, I recognize that the long-term sustainability of the BIPM depends on it being seen to be an efficient and effective organization that delivers a relevant and affordable mandate and is therefore a partner of choice for collaborative activities with the National Metrology Institutes, the Member States, as well as international organizations, and private organizations.

2. LABORATORY WORK AT THE BIPM

To fulfil its mission to ensure and promote the global comparability of measurements, the BIPM operates laboratories in the fields of mass, time, electricity, ionizing radiation and chemistry. All of the laboratory work addresses one or more of the agreed objectives for the BIPM's laboratories, which are:

- To establish and maintain appropriate reference standards for use as the basis of a limited number of key international comparisons at the highest level.
- To coordinate international comparisons of national measurement standards through the Consultative Committees of the CIPM; taking the role of coordinating laboratory for selected comparisons of the highest priority and undertaking the scientific work necessary to enable this to be done.
- To provide selected calibrations for Member States.

The following sections provide highlights of the scientific work and achievements at the BIPM during 2014.

2.1. Mass

In December 2013 the Mass Department started a campaign of calibrations (*Extraordinary Calibrations*) against the International Prototype of the Kilogram (IPK) in anticipation of the planned redefinition of the kilogram. This campaign will meet one of the prerequisites for the redefinition of the kilogram requested by the Consultative Committee for Mass and Related Quantities (CCM)[1]. It will enable the mass standards used in the watt balance and X-ray crystal density (XRCD) experiments, which will contribute to fixing the numerical value of the Planck constant, as well as the BIPM working standards, to be compared as directly as possible with the IPK. In the first phase of the campaign, the six official copies of the IPK and the BIPM working standards have been compared with the IPK for the first time since the 3rd Periodic Verification (3rd PV, 1988-1992). The results show that the differences in mass between the IPK and the official copies have changed on average by only 1 μg since the 3rd PV. These results do not confirm the trend observed during the 2nd and 3rd PVs by which the masses of the six official copies diverged from the mass of the IPK. All of the BIPM working standards have been calibrated with respect to the IPK and all were found to have lower masses than those established when they were calibrated during the 3rd PV. As a consequence, the BIPM's 'as-maintained' mass unit has been found to be offset by 35 μg with respect to the IPK.

To understand how this offset of 35 μg in 2014 has evolved over time, extensive mathematical modelling has been carried out. The results of all mass comparisons between the BIPM working standards carried out since the 3rd PV have been used as input data. Different deterministic models were tested against these data and the one that describes the data most satisfactorily has been identified. The phenomena included in the model are: the mass increase of a standard after cleaning and washing, and mass changes proportional to the number of weighings in the two comparators used most often during this time. As boundary conditions, the model assumes that the mass of the IPK is exactly 1 kg after cleaning and washing, in 1992 and in 2014. This model allows retrospective calculation of revised mass values for previous calibrations. The uncertainty of the revised mass values has been estimated to be 3 μg. The NMIs participating in accurate determinations of the Planck or the Avogadro constant have been

[1] Milton M.J.T., Davis R., Fletcher N., Towards a new SI: a review of progress made since 2011, *Metrologia*, (2014), **51**, R21

informed of the revised mass values for previous mass calibrations. This will allow them to recalculate their results, if necessary. The second phase of the *Extraordinary Calibrations*, consisting of calibrations of transfer standards from these NMIs started in December 2014 and will be completed in February 2015.

Preparations for a new version of the BIPM watt balance are actively under way with the specific objective of reducing the type B uncertainty due to misalignment. The new apparatus will comprise several new and improved measurement facilities. Some of them have already been assembled and tested *in situ*, most importantly a dynamic alignment mechanism for the correction of the coil trajectory. Its performance has been successfully validated under real working conditions. Alignment techniques for the coil and the magnetic field continue to be refined. Development of a new interferometer has advanced well. It is based on space-separated heterodyning techniques to allow for small non-linear error and high phase resolution. In order to facilitate the alignment of the interferometer, a new open support structure allowing easy access to the watt balance apparatus has been designed. In addition to being rigid and stable, the design has been refined using finite element analysis to avoid low frequency resonance peaks, especially those present in the environment. The Josephson voltage standard for current measurement has been successfully tested in the watt balance.

In 2011, the CGPM encouraged the BIPM to develop "a pool of reference standards to facilitate the dissemination of the unit of mass when redefined" (Resolution 1 (2011)). Since then, the Mass Department has been assembling a new Ensemble of 12 Reference Mass Standards and four stacks of disks. The storage network for the Ensemble of Reference Mass Standards (ERMS) has undergone several improvements in 2014. The gas flow has been reduced and is now uniform within the different gas lines. New mass holders for the standards stored in gas allow easier manipulation in the glove box and are safer for the standards. New holders have been designed for the stacks, which allow the transfer to the mass comparator while keeping them in their storage medium. The first standards will be placed in their containers in early 2015.

Four new mass prototypes and one stack of eight discs have been fabricated during 2014. The four mass prototypes have been calibrated and, together with an already existing stack, have been characterized for their vacuum-to-air transfer behaviour. Three more prototypes are being fabricated. The department has determined the masses of the two re-polished ^{28}Si spheres AVO-S5 and AVO-S8, in air and in vacuum. These results have contributed to a new determination of the Avogadro constant with the relative uncertainty of 2 parts in 10^8. A study was undertaken to determine the mass of the chemisorbed water layer present on the surface of a natural silicon sphere. The mean chemical adsorption coefficient obtained by two different methods was 0.026 µg.cm^{-2} with a standard uncertainty of 0.012 µg.cm^{-2}. The BIPM results confirm those obtained by the NMIJ/AIST, Japan, which had measured the adsorption isotherms on SiO_2/Si(100) plane surfaces. The Mass Department has published the final report on the CCM comparison, CCM.M-K4, of stainless steel masses.

2.2. Time

A major achievement in the Time Department in 2014 was the implementation of a new algorithm for the regular calculation of Coordinated Universal Time (UTC). This algorithm is based on a parabolic model for the prediction of the participating clocks' frequency, and a weighting procedure which uses the clock predictability as the criteria. The time scale computed with the new algorithm has an improved stability of about 20 % in both the short and long term.

Time transfer methods used for clock comparison are the major component in the uncertainty of [UTC-UTC(k)] in the key comparison CCTF-K001.UTC. Improving time transfer with the study and implementation of new methods has been a substantial part of the work programme of the Department, with the target of reducing the statistical uncertainty of time transfer from the best value of 0.3 ns that is

presently achieved for 46 % of time links, and also to enhance the accuracy of time transfer with more refined and frequent calibrations.

Coordination with the Regional Metrology Organizations (RMOs) for the calibration of time transfer links and equipment in UTC contributing laboratories was a major theme for the department in 2014. The BIPM revised the guidelines on the procedures to be followed in the regional calibrations; a scheme fixes the responsibilities of the BIPM for the calibration of a set of selected laboratories and the RMOs for the calibration of the others. The measurements that are the responsibility of the BIPM are close to being concluded. At the end of the first round of the process, all time links in UTC will be calibrated, and the u_B value characterizing the links and impacting on the uncertainty of [*UTC* - *UTC*(*k*)] is expected to decrease by a factor of 2.

Five new caesium fountains have been incorporated in 2014 to improve the frequency accuracy of International Atomic Time (TAI) following approval from the relevant Consultative Committee for Time and Frequency (CCTF) Working Group. Twelve primary frequency standards, including ten caesium fountains, and one secondary representation of the second contributed to TAI in 2014, with an average of five to six caesium fountains reporting measurements each month. The increasing number of measurements reported for these standards reinforces the accuracy estimation of TAI, which is in the low 10^{-16}.

BIPM *Circular T* continues to be published monthly, giving traceability to the International System of Units (SI) second via UTC to its local realizations in national laboratories. It is the most frequent key comparison, with one evaluation of the key comparison reference value UTC and the degrees of equivalence [*UTC* - *UTC*(*k*)] every five days for the 73 participants that together contributed data from more than 450 atomic clocks at the end of 2014 compared to 400 in 2013.

Regular publication of rapid UTC (UTCr) continued in 2014, providing a weekly solution that has a peak to peak difference with the final UTC published in *Circular T* that has remained within the interval -3 ns to +2 ns. This rapid solution supports the quality of the representations of UTC in national laboratories and the steering of the Global Navigation Satellite Systems' times to local representations of UTC.

2.3. Electricity

A first uncertainty budget has been established for the calculable capacitor, which includes the results of a theoretical model of the frequency dependence. The present alignment accuracy of the capacitor's electrode bars limits the relative uncertainty of determinations of the von Klitzing constant to about 1 part in 10^7. A number of measurements involving the calculable capacitor and the dedicated coaxial ac-bridge have been carried out to investigate possible systematic errors and noise sources. These investigations allowed the elimination of several noise sources from the measurement chain which has improved the measurement repeatability to 1 part in 10^8 or better. Two causes of systematic errors have been detected in the calculable capacitor. One of them is related to a mechanical instability of the electrode bars and the second to an instability of the interferometer laser, which has recently been solved. These difficulties have delayed the planned determination of the von Klitzing constant at the 10^{-7} level, which is now scheduled for early 2015. This will be followed by a careful re-alignment of the electrode bars with a new alignment probe which is at present being fabricated in the BIPM workshop. The ultimate goal remains a determination of the von Klitzing constant at the 10^{-8} level.

A Josephson Voltage Standard (JVS) dedicated to the measurement of the current sent to the coil of the BIPM watt balance experiment has been assembled, tested and delivered. It was demonstrated that the array voltage remained quantized and that the performance of the array did not suffer from the noise level of the watt balance environment. It has been successfully implemented on the watt balance and

demonstrated for the first time that the stability of the current source needed to be improved as this was the limiting factor.

The BIPM series of onsite quantum Hall comparisons (BIPM.EM-K12) restarted with a successful visit to the PTB, Germany, in November 2013[2]. This comparison highlighted a limiting factor for 1 Ω measurements, which has been the subject of further study in 2014 in collaboration with the PTB. The effect of Peltier heating in a range of different 1 Ω standards has now been comprehensively characterized, with the results submitted for publication. With this improved knowledge it should be possible to minimize these effects in future comparisons, and ensure comparability of 1 Ω measurements to the level of around 10 nΩ/Ω. (The effect is less significant for higher value resistors, and comparisons of 100 Ω and 10 kΩ standards against the quantum Hall reference are possible at uncertainties approaching 1 nΩ/Ω, as seen in the PTB comparison). The comparison series will continue with two onsite visits planned for 2015.

The very low frequency (1 Hz or below) room temperature current comparator bridge technology that the BIPM uses for onsite resistance comparisons forms the basis of a EURAMET research project on next generation quantum Hall reference systems based on graphene. The BIPM has been collaborating with the PTB and the MIKES, Finland, in tests of new resistance bridges that can give primary standards level accuracy without the need for liquid helium. Initial tests have shown successful ratio measurements using MIKES-built current comparators and the existing BIPM electronics. This technology, combined with the graphene devices is now in development and promises simpler, more robust primary standards for resistance.

2.4. Ionizing radiation

The project to develop an absorbed-dose standard for medium-energy x-rays made significant progress in 2014. The transfer standards constructed at the BIPM have been measured in air and in the new water-phantom arrangement over the range of x-ray energies. Corresponding Monte Carlo calculations of the relative response of the chambers under these conditions indicate that the absorbed dose is likely to be determined to well within the target uncertainty of 1 %.

The Ionizing Radiation Department carried out the seventh and eighth comparisons in the series BIPM.RI(I)-K6 for absorbed dose to water in high-energy photon beams, with the NPL, UK, and the VSL, the Netherlands, in the 6 MV, 10 MV and 25 MV beams of the NPL. The BIPM used a remote-controlled motorized monitoring and shutter system for the first time, to reliably track and correct for intrinsic intensity variations in the beams. The new design is compact and showed a high reproducibility in the positioning of the shutter. Being controlled remotely, the system avoids the need for staff to enter the radiation area between irradiations, which saves time and improves radiation protection for the operator.

The accumulated data from the BIPM.RI(I)-K6 comparison series were used for a re-determination of the value for W_{air}, the mean energy required to create an ion pair in air, with a world-wide impact on primary ionometric dosimetry measurements[3].

The comparison series BIPM.RI(I)-K8 for reference air kerma rate for HDR ^{192}Ir brachytherapy sources was re-launched: a new protocol was adopted, the results of the three previous comparisons were

[2] Goebel R., *et al*, Final report on the on-going comparison BIPM.EM-K12: Comparison of quantum Hall effect resistance standards of the PTB and the BIPM, *Metrologia* (2014) **51** 01011

[3] Burns D.T., Picard S., Kessler C., Roger P., Use of the BIPM calorimetric and ionometric standards in megavoltage photon beams to determine W_{air} and I_c, *Physics in Medicine and Biology* (2014) **59** 1353–1365

re-analysed and the corresponding comparison reports were produced and published. Two new comparisons with the NRC, Canada, and the LNE-LNHB, France, were carried out.

In total, sixteen dosimetry comparisons and thirteen calibrations of national secondary standards were made, which are underpinned by a significant effort in equipment calibration and maintenance. In addition, eleven comparison reports were submitted for publication.

Within the radionuclides measurements programme, the *Système International de Référence* (SIR) received 16 ampoules of 11 different radionuclides from seven laboratories, all oriented to generate equivalence values in the ongoing BIPM key comparison BIPM.RI(II)-K1. Measurements of ^{222}Rn, a radioactive gas with a short half-life ($T_{1/2}$ = 3.823 5 d, u = 0.000 3 d), contributed to a co-authored article on geometry and type of containers. Monitoring of ^{222}Rn has been implemented to study possible correlations of the background on SIR measurements.

A significant milestone was reached in 2014 with the effective use of the SIRTI to extend the SIR to ^{18}F ($T_{1/2}$ = 1.8 h), one of the most frequently used radionuclides in positron emission tomography (PET), through a new BIPM.RI(II)-K4.F-18 ongoing comparison, onsite at the NMIs' premises. The new specific protocol was established and the link SIRTI-SIR was measured for ^{18}F using both a commercial solution and a solution from the LNE-LNHB. The validation was made at the NPL by comparing the SIRTI result and the NPL SIR result from 2003. This new ongoing comparison series started with comparisons at the VNIIM (Russian Federation), the NPL and the ENEA-INMRI (Italy).

In parallel, the BIPM.RI(II)-K4.Tc-99m ($T_{1/2}$ = 6.0 h) comparison using the SIRTI continued with the VNIIM and the ENEA-INMRI participating in 2014. It is remarkable that, in spite of being transported around the world, the SIRTI has shown a very high reproducibility since 2007, with a relative standard deviation of 2×10^{-4} for the count rate of the ^{94}Nb reference source measured world-wide.

Another significant step concerned the effective start in November 2014 of the trial exercise for the extension of the SIR to beta emitters, with liquid scintillation measurements of ^{3}H, ^{14}C, ^{55}Fe and ^{63}Ni in different scintillators, volumes and counters and the participation of 14 NMI/DIs. The trial exercise will last 5-7 months and will serve to establish the procedures for a new ongoing, 'on demand' key comparison that will allow NMIs to obtain equivalence rapidly for beta emitters without the need for large-scale time-consuming comparisons.

In total, eighteen radionuclide activity comparisons were undertaken, and update reports of six BIPM.RI(II)-K1 comparisons and one BIPM.RI(II)-K4 comparison were submitted for publication in the *Metrologia Technical Supplement* covering ^{131}I, ^{133}Ba, ^{152}Eu, ^{177}Lu, ^{166m}Ho and ^{99m}Tc, and including the links from APMP.RI(II)-K2.I-131, COOMET.RI(II)-K2.Eu-152, CCRI(II)-K2.Lu-177 and EURAMET.RI(II)-K2.Ho-166m comparisons.

In summary, thirty-four comparisons, thirteen calibrations and seventeen comparison reports were generated by the BIPM in 2014. Additionally, four CCRI and five RMO comparison reports were reviewed and published.

2.5. Chemistry

In the field of gas metrology, the BIPM continued to coordinate comparisons of standards for greenhouse gases and air quality monitoring in 2014. In the area of greenhouse gases and their precursors, the final report of CCQM-K82 on methane in air at ambient levels was published and the results were presented at the *European Geophysical Union General Assembly*. A paper demonstrating equivalence between standards made in whole and synthetic air and measured by cavity ring-down spectroscopy (CRDS) and gas chromatography – flame ionization detector (GC-FID) for atmospheric monitoring applications was

submitted to *Analytical Chemistry* in November 2014. A new vacuum Fourier transform infrared (FTIR) spectroscope was acquired and validated in preparation for the comparison CCQM-K120 on carbon dioxide in air standards. Standards chosen to span both the target amount fraction and isotope ratio ranges have been obtained through collaborative work with partner NMIs (NIST and NPL). A new methodology to deduce the isotopic shift $\delta^{13}C$ in the CO_2/air mixtures by FTIR has been developed during the secondment of Dr Marta Doval Minarro from the NPL. A new system to measure carbon dioxide amount fractions with traceability to the BIPM pressure standards has also been installed in a new laboratory. The system makes use of cryogenic separation of carbon dioxide from its air matrix and accurate measurements of pressure, temperature and volume. Corrections for the presence of N_2O will be made based on gas chromatography – electron capture detector (GC-ECD) measurements, with the funds for the purchase of a system donated from the KRISS, Republic of Korea. The system will also underpin future key comparisons on nitrous oxide standards.

In the area of air quality gas standard comparisons, the ongoing surface ozone reference standard comparison (BIPM.QM-K1) has continued with four laboratories participating in 2014, bringing the total number of participants to 21. Work on new ozone absorption cross-section measurements was completed, leading to the proposal of a new value of 11.27×10^{-18} cm^2 molecule^{-1} with an expanded relative uncertainty of 0.92 %. This is lower than the conventional value currently in use and measured by Hearn in 1961 with a relative difference of 1.8 %, with the consequence that historically reported ozone concentrations should be increased by 1.8 %. A paper describing the measurements was published online in *Atmospheric Measurement Techniques Discussions*[4]. The comparison CCQM-K90 on formaldehyde (HCHO) in nitrogen standards has started after the delivery of the transfer standards mixtures selected by the BIPM for their stability and the final validation of two different systems to dynamically generate HCHO, one by permeation from paraformaldehyde, the other by diffusion of trioxane. The development of a dynamic generation system for nitric acid in nitrogen standards was carried out during the secondment of Mrs Céline Pascale from the METAS, Switzerland. It was used to calibrate the FTIR spectrometer, reducing the relative uncertainty of measurements of nitric acid by a factor of three. This will reduce the uncertainty in the reference value for nitrogen dioxide standards in future key comparisons (CCQM-K74.2018).

The BIPM's organic programme forms an essential part of the CCQM Working Group on Organic Analysis' (OAWG) strategy for Core Competency comparisons. A white paper outlining an approach for the linkage of organic purity key comparison results to calibration and measurement capability (CMC) claims for organic analysis, which included an extensive compilation of the results by all NMIs that have participated in BIPM coordinated purity comparisons, was prepared. It has been accepted for implementation by the OAWG and the CCQM Working Group on Key Comparisons and CMC Quality (KCWG).

The BIPM's laboratory facilities for supporting purity key comparisons were augmented through the donation of a high field nuclear magnetic resonance (NMR) spectrometer from an instrument manufacturer. Obtaining the donation was the first outcome of the BIPM-NMIJ collaboration on the development of quantitative NMR (qNMR) for organic purity assignment which started in 2014. This was followed by training of BIPM staff at the NMIJ, Japan, and the NRC, Canada, and the installation and commissioning of the NMR instrument at the BIPM. In a lead up to this collaboration the BIPM participated successfully in the CCQM-P150 pilot study, coordinated by the NMIJ, on use of qNMR for a purity assignment of dimethyl sulfone with bis-3,5-triflurormethylbenzoic acid as the internal standard.

[4] Viallon J., Lee S., Moussay P., Tworek K., Petersen M., Wielgosz R.I., Accurate laser measurements of ozone absorption cross-sections in the Hartley band, *Atmos. Meas. Tech. Discuss*., (2014) 7, 8067-8100

The final report of the CCQM-K55.c [(L) Valine purity] key comparison was published in the key comparison database (KCDB) and the preparative work on samples for CCQM-K55.d [Folic acid purity] is continuing, with homogeneity and stability measurements under way. The normal phase-liquid chromatography-tandem mass spectrometry method with atmospheric pressure photoionization developed for the purity assessment of 17β-estradiol by the BIPM as part of CCQM-K55.a was published in *Analytical and Bioanalytical Chemistry*[5]. The BIPM has led an International Union of Pure and Applied Chemistry (IUPAC) working group, with members from 12 NMIs and two international organizations, with two meetings held in 2014 to draft technical guidelines on 'Methods for the SI Value Assignment of the Purity of Organic Compounds for use as Primary Reference Materials and Calibrators'. A draft report from this working group is expected in 2015, which will describe validated methods and achievable measurements uncertainties for organic primary calibrator material characterization. The implementation of these methods is expected to improve the comparability of analytical chemical measurements world-wide.

The BIPM's organic programme on large organic molecule purity continued with the start of the first CCQM key comparison (CCQM-K115/P55.2) on peptide purity (C-peptide (hCP)) coordinated by the BIPM in collaboration with the NIM, China, and supported by the secondments of Dr Ming Li and Dr Dewei Song. Preparatory work for the comparison included the successful completion of the cross-validation of different approaches for the purity mass fraction value assignment of a model decapeptide (Angiotensin I in collaboration with NIST) as well as insulin. Three external publications that are currently in preparation describe this work.

2.6. Comparisons

During 2014, there were a total of 35 comparisons coordinated by the BIPM involving 206 participations.

2.6.1. Mass

Comparison	Description	No. of NMI participations
CCM.M-K4	Comparison of 1 kg stainless steel mass standards, finalization of report	16

[5] Josephs R.D., Daireaux A., Choteau T., Westwood S., Wielgosz R.I., Normal phase-liquid chromatography-tandem mass spectrometry with atmospheric pressure photoionization for the purity assessment of 17β-estradiol, *Analytical and Bioanalytical Chemistry*, 1 Nov 2014,Springer Berlin Heidelberg

2.6.2. Time

The Time Department pilots the key comparison CCTF-K001.UTC, published through the monthly *Circular T*. In 2014, 12 key comparisons (one each month, with one degree of equivalence calculated every five days) were carried out with 73 participants.

Comparison	**Description**	**No. of NMI participations**
CCTF-K001.UTC	Calculation of the reference time scale UTC	73

2.6.3. Electricity

Comparison	**Description**	**No. of NMI participations**
BIPM.EM-K10	DC voltage, Josephson standards: (a) 1.018 V; (b) 10 V	2
BIPM.EM-K11	DC voltage, Zener diode: (a) 1.018 V; (b) 10 V	5
BIPM.EM-K12	Quantum Hall resistance standards and their scaling to other resistance values	1 (finalization of report)
BIPM.EM-K13	Comparison of resistance standards: (a) 1 W; (b) 10 kW	1
BIPM.EM-K14	Comparison of capacitance standards: (a) 10 pF; (b) 100 pF	3 (finalization of reports)
Total		**12**

2.6.4. Ionizing Radiation

The Ionizing Radiation Department undertook 35 bilateral ongoing comparisons in 2014.

Comparison	**Description**	**No. of NMI Participations**
BIPM.RI(I)-K1	Measurement of air kerma for Co-60 gamma-rays	1
BIPM.RI(I)-K2	Measurement of air kerma for low-energy x-rays	3
BIPM.RI(I)-K3	Measurement of air kerma for medium-energy x-rays	4
BIPM.RI(I)-K5	Measurement of air kerma for Cs-137 gamma-rays	2
BIPM.RI(I)-K6	Measurement of absorbed dose to water for high-energy beams	2 (onsite: NPL; VSL)
BIPM.RI(I)-K7	Measurement of air kerma in mammography beams	2
BIPM.RI(I)-K8	Measurement of reference air kerma rate for HDR Ir-192 brachytherapy sources	2 (onsite: NRC; LNE-LNHB)
BIPM.RI(II)-K1.Cs-134	Activity of radionuclides	1
BIPM.RI(II)-K1.Fe-59	Activity of radionuclides	1
BIPM.RI(II)-K1.Sr-89	Activity of radionuclides	1
BIPM.RI(II)-K1.Cs-137	Activity of radionuclides	1
BIPM.RI(II)-K1.Y-90	Activity of radionuclides	1
BIPM.RI(II)-K1.Ra-223	Activity of radionuclides	2
BIPM.RI(II)-K1.Rn-222	Activity of radionuclides	1
BIPM.RI(II)-K1.Lu-177	Activity of radionuclides	1
BIPM.RI(II)-K1.Na-22	Activity of radionuclides	1
BIPM.RI(II)-K1.Co-60	Activity of radionuclides	1
BIPM.RI(II)-K1.Ge-68	Activity of radionuclides	2
BIPM.RI(II)-K4.Tc-99m	Activity of radionuclides using the SIRTI	2 (onsite: VNIIM; ENEA-INMRI)
BIPM.RI(II)-K4.F-18	Activity of radionuclides using the SIRTI	3 (onsite: VNIIM, NPL, ENEA-INMRI)
Total		**34**

2.6.5. Chemistry

The seven key comparisons and associated pilot studies (all coordinated by the BIPM) on which the BIPM activities focused in 2014 are listed below. For clarity these have been divided into: those for which measurements were undertaken in 2014; those that are in the reporting phase; and those for which preparatory/validation work has been undertaken, with measurements planned for 2015/2016.

BIPM coordinated comparisons for which measurements were performed in 2014:

Comparison	**Description**	**Activity in 2014**	**No. of NMI participations**
BIPM.QM-K1	Ozone ambient level	Measurements completed and reports published or in preparation	4
CCQM-K90	Formaldehyde in nitrogen	First set of measurements on transfer standards started at the BIPM prior to dispatch to participants	8
CCQM-K115 (CCQM-P55.2)	C-peptide purity	Comparison samples dispatched to participants and measurement period started	14
Total			**26**

BIPM coordinated comparisons which are in the reporting phase in 2014:

Comparison	**Description**	**Activity in 2014**	**No. of NMI participations**
CCQM-K55.c	Purity analysis series: L-Valine	Report published in the KCDB database	19
CCQM-P117.c	Purity analysis series: L-Valine	Final report published in OAWG archive report file	10
CCQM-K82	Methane in air (ambient)	Report published in the KCDB database	16
Total			**45**

BIPM coordinated comparisons for which preparatory/validation work has started:

Comparison	Description	Activity in 2014	No. of NMI participations
CCQM-K55.d	Purity analysis series: Folic Acid	Method validation and homogeneity and stability measurements on material under way	
CCQM-K120.a CCQM-K120.b	CO_2 in air	Validation standards and facilities under development	

2.7. Calibrations

A total of 81 Certificates and 1 Study Note were issued in 2014. A complete list of certificates is provided in Appendix 1.

3. THE CIPM MRA

3.1. New signatories to the CIPM MRA

The following institutions signed the CIPM MRA during 2014:

- Central Organization for Standardization and Quality Control (COSQC), Iraq on 13 June 2014.
- Sudanese Standards and Metrology Organization (SSMO), Sudan on 26 June 2014.
- Institut luxembourgeois de la normalisation, de l'accréditation, de la sécurité et qualité des produits et services – Bureau Luxembourgeois de Métrologie (ILNAS), Luxembourg on 1 October 2014.
- Yemen Standardization, Metrology and Quality Control Organization (YSMO), Yemen on 17 November 2014.
- Directorate General for Specifications and Measurements (DGSM), Oman on 20 November 2014.

3.2. The BIPM key comparison database, KCDB

Bi-annual reports on the KCDB, a tutorial on the KCDB, and the outcome of a study entitled "Who visits the KCDB?" are available on the BIPM website at http://www.bipm.org/jsp/en/ViewKCDBReport.jsp.

3.2.1. Content of the KCDB

3.2.1.1. Key and supplementary comparisons

On 5 December 2014, the key and supplementary comparisons database covered 894 key comparisons (89 from the BIPM, 436 from the Consultative Committees (CCs), and 369 from RMOs) and 411 supplementary comparisons. A total of 30 new key comparisons and 37 new supplementary

comparisons were registered during 2014. Updated graphs of participants in key and supplementary comparisons can be found on the statistics page of the KCDB.

As of 5 December 2014, 78 of the 89 ongoing BIPM key comparisons had results published in the KCDB and the final reports of a further 480 CC and RMO key comparisons were approved and posted on the KCDB website, with corresponding tables of numbers and graphs entered in the database. A total of 2 300 graphs of equivalence were available in the KCDB on the same date.

The results of 239 RMO key comparisons have been published in the KCDB. Linkage has also been carried out for about 60 bilateral key comparisons subsequent to full-scale CC key comparisons; their results are included in the appropriate graphs of equivalence. The KCDB currently includes a dozen examples of more than seven key comparisons that are linked together, demonstrating the success of the system.

The final reports for 239 of the 411 supplementary comparisons registered in the KCDB had been posted by 5 December 2014; 62 % of the comparisons registered in the KCDB are complete. The final reports are generally published in the *Metrologia Technical Supplement*.

3.2.1.2. Calibration and Measurement Capabilities – CMCs

On 5 December 2014, the KCDB contained 23 964 CMCs: 14 175 in the field of General Physics, 4 022 in Ionizing Radiation, and 5 767 in Chemistry. The total number of CMCs has been reduced by about 500 when compared to the same period in 2013. This is the second decrease in the number of CMCs in eight years, even though approximately 600 new CMCs were approved and published during the last 12 months. This reduction is attributed to rationalization of the APMP's CMCs in Electricity and Magnetism (EM), following the same process described in the 2013 Director's Report for EURAMET's CMCs in EM.

The first sets of CMCs declared by the institutes of Georgia (nine CMCs in the field of thermometry) and of Estonia (four CMCs in the field of humidity) were posted in the KCDB on 20 March 2014 and 5 May 2014 respectively.

As of 5 December 2014 all but two of the Associates participating in the CIPM MRA had at least one of their metrology institutes listed as a participant in a key or a supplementary comparison, whereas only 22 of the 41 Associates had CMCs published in the KCDB.

As at 5 December 2014, 156 CMCs were temporarily removed from the KCDB, a number that is now stable and which is considered negligible when compared to the total number of CMCs in the KCDB.

3.3. Joint Committee of the Regional Metrology Organizations and the BIPM (JCRB)

The 32nd meeting of the JCRB was held at the BIPM on 26-27 March 2014. There was no meeting in the autumn of 2014 due to the workload associated with preparations for the 25th General Conference.

The JCRB has formulated a series of preparatory actions and recommendations for the planned review of the CIPM MRA. Comments from the CCs that were included in the CC strategy documents regarding the CIPM MRA have been collated and returned to the JCRB for consideration. Results from the CCQM questionnaire on the CMC process have been analysed. The KCDB questionnaire confirmed that the majority of users are from the metrology community although it noted that a significant number are external to this community, including commercial accreditation laboratories, testing laboratories, industrial companies and regulators.

EURAMET has proposed a range of ideas for consideration in preparation for the review of the CIPM MRA. These ideas are aimed at simplifying the system and improving its efficiency and have been included in a paper "Making the CIPM MRA sustainable: MRA Phase II". A generalized version of this paper will be produced in collaboration with the BIPM and will be made available to the other RMOs. The RMOs have been invited to submit their ideas on the challenges and practical ways forward for the CIPM MRA at the JCRB meeting in March 2015. A workshop is planned for October 2015 to engage in a broad discussion of the CIPM MRA with NMI Directors, Member State representatives, RMO representatives and other relevant stakeholders. A review committee will be set up at the workshop to finalise the review of the CIPM MRA.

4. INTERGOVERNMENTAL AND INTERNATIONAL ACTIVITIES AND PROMOTION OF THE METRE CONVENTION

4.1. New States Parties to the Metre Convention (Member States) and new Associates of the CGPM (Associates) in 2014

At the end of 2014, there were 55 States Parties to the Metre Convention and 41 Associates.

The Dominican Republic was excluded on 1st January 2015 due to its failure to meet the terms of the Rescheduling Agreement concluded in 2012.

The following became Associate States in 2014:

- The Grand Duchy of Luxembourg on 29 January 2014.
- The Republic of the Sudan on 6 June 2014.
- The Republic of Yemen on 21 July 2014.

4.2. Institutional collaboration with external organizations

The International Liaison and Communication Department of the BIPM has the role of promoting metrology to the scientific community, industry and the public. It undertakes this role through liaison activities with other intergovernmental organizations and international bodies and by participation in international forums. The BIPM has an ongoing relationship and interaction with some thirty international organizations and provides or shares information with these bodies relating to the SI and the international comparability of measurements. Collaborations are both institutional and technical and in 2014, a typical year, BIPM staff travelled on more than 120 separate occasions, amounting to more than one person year of time, to provide their expertise to such organizations and to the NMIs.

Key liaison activities are with intergovernmental organizations such as the World Health Organization (WHO), the International Atomic Energy Agency (IAEA), the World Meteorological Organization (WMO), the International Organization of Legal Metrology (OIML) and international bodies such as the International Organization for Standardization (ISO) and the International Laboratory Accreditation Cooperation (ILAC). Interaction varies from high-level discussions to participation in dedicated working groups but the objective remains the same: to promote the importance of measurement, the SI and the comparability of measurement and to ensure the appropriate use of metrology and the international infrastructure. Representatives of the ILAC, the ISO and the OIML presented their perspective of the

interactions with the BIPM at the 25th General Conference on Weights and Measures in November 2014 (see §5).

In November 2014, the BIPM was invited to make a presentation at the World Trade Organization (WTO) Technical Barriers to Trade (TBT) thematic session on the role of metrology in conformity assessment. This provided the BIPM with a unique opportunity to explain and reinforce the role and importance of the NMIs and RMOs, the SI and the CIPM MRA to the assembled world trade community.

In addition to the organizations named above, BIPM staff liaised with the Codex Alimentarius Commission, the International Astronomical Union (IAU), the International Commission on Radiation Units and Measurements (ICRU), the International Commission on Illumination (CIE), the International Earth Rotation and Reference Systems Service (IERS), the International Union of Pure and Applied Chemistry (IUPAC) and the World Anti-Doping Agency (WADA).

The BIPM contributes at a modest level in activities supporting developing countries' technical infrastructure by participating in meetings of the Network on Metrology, Accreditation and Standardization for Developing Countries (DCMAS Network). In October 2014 the BIPM lectured at the DCMAS Network/UNIDO AFRIMETS legal metrology school held in Tunisia which was attended by metrologists from across Africa.

World Metrology Day is an annual event held on 20 May to commemorate the signing of the Metre Convention in 1875. The project is delivered in collaboration with OIML, with the support of a different NMI each year. The theme in 2014 was '*Measurements and the global energy challenge*' and the poster was designed by the KRISS, the NMI for the Republic of Korea. Participation in 2014 was at record levels and World Metrology Day has become a widely-used opportunity for NMIs from both developed and developing countries to raise the profile of metrology nationally. In 2014 the poster was translated into more than 20 languages and over 30 events were organized world-wide. Planning is already under way for 2015; the theme will align with the UNESCO 2015 International Year of Light and Light-Based Technologies. The poster will be designed by The NMI of South Africa (NMISA), with the strapline of '*Measurements and Light*'.

4.3. Travel and Visitors

4.3.1. Travel

BIPM staff attended more than 45 conferences and meetings in 2014. This level of attendance is equivalent to approximately 241 working days and involved 23 members of the BIPM staff. Eight lectures were presented. For a full breakdown of staff travel by department in 2014 please see the Supplementary information on the dedicated Director's Report webpage http://www.bipm.org/en/publications/directors-report/.

Also in 2014, 28 members of the BIPM staff spent more than 324 working days on technical visits to 17 states.

4.3.2. Visitors

More than 95 visitors from 26 states spent a total of 138 days on technical visits to the BIPM in 2014. For a full breakdown of visitors to the BIPM by department in 2014 please see the Supplementary information on the dedicated Director's Report webpage http://www.bipm.org/en/publications/directors-report/.

Secondees, research fellows and guest workers are listed in §7.3.3.

4.4. Joint Committees

4.4.1. Joint Committee for Guides in Metrology (JCGM)

The JCGM met at the BIPM on 3 December 2014 for its annual plenary meeting. Reports of its Working Groups (WG1 on the GUM and WG2 on the VIM) were presented.

The main topic of the WG1 Report concerned the revision of the *Guide to the Expression of Uncertainty in Measurement* (GUM), which is being given the highest priority. The first Committee Draft of JCGM 100-revised: *Guide to uncertainty in measurement* and its companion JCGM 110: *Examples of uncertainty evaluations*, will be circulated among Member Organizations and NMIs. The first edition of JCGM 110 will contain a limited number of suitably revised examples, mostly taken from the current GUM and its Supplements. The CC Presidents and Executive Secretaries have been invited to submit real-life examples that can be included in subsequent updates of the document. In the future, GUM Supplements 1 and 2 will require revision to align them with the new GUM, for example, terminology and notation.

The WG1, in agreement with the BIPM, is organizing a workshop at the BIPM (15-16 June 2015) which will allow experts to openly discuss their different views. A number of lectures will be given by invited speakers and others will be selected from abstracts presented by attendees.

The 2014 activities of JCGM WG2 centered primarily on four key topics:

- Analysis of feedback from the JCGM Member Organizations on the "Proposed Modified JCGM WG2 Plan of Work". The ISO favoured development of annotations to VIM3 provided it does not significantly impede development of the VIM4. It suggested that the membership be reinforced with one expert in "organic" chemistry and biology, and one terminologist.
- Analysis of work by ISO/REMCO and IUPAC/IFCC on terminology for nominal properties. The WG2 concluded that there was not enough commonality concerning vocabulary in these communities to form the basis on which the WG2 can come to clear decisions on how to treat nominal properties in the VIM4.
- Finalization of the electronic product and the development of 25 annotations for inclusion in the Annotated VIM3 (now called "VIM Definitions with Informative Annotations"), which was posted on the BIPM website on 30 September 2014.
- Continuation of planning for the VIM4. The WG2 was finally able to give significant consideration to key aspects of the VIM4, such as the structure and underpinning principles. However, noting the relative immaturity of the topic of vocabulary for nominal properties compared to the topic of vocabulary for quantities, the WG2 decided that it is too early to finalize a structure for the VIM4 (e.g., a single document with two parts, or intertwining definitions in one part only).

Following discussion, the JCGM decided that updates of WG1 documents that concern only hyperlinks to new examples in JCGM 110, and updates of JCGM 110 to include new examples, will not require formal approval but simply communication to its Member Organizations. The JCGM also decided that minor editorial revisions of the GUM Supplements aimed at aligning them with the revised GUM will be submitted directly to the JCGM Member Organizations for final approval. This will avoid the need to circulate the Committee Drafts among the Member Organizations. The JCGM encouraged its Member Organizations to promote the online availability of the Annotated VIM3.

The JCGM also noted the intention of the WG2 to develop a Draft Outline of the VIM4 by the end of 2016, and a first Committee Draft of the VIM4 by the end of 2018.

4.4.2. Joint Committee for Traceability in Laboratory Medicine (JCTLM)

In February 2014, the WG1 Cycle 10 reference materials, and measurement methods, and WG2 Cycle 8 reference measurement laboratory services that had been approved by the Executive Committee during its 12th annual meeting in December 2013, were published in the JCTLM database.

As of December 2014 the JCTLM database contained:

- 319 available certified reference materials covering 11 categories of analytes. Of these reference materials, 33 are in List II, which includes reference materials value-assigned using internationally agreed protocols, and three are in List III, which covers reference materials with nominal properties.
- 167 reference measurement methods or procedures that represent about 80 different analytes in nine categories of analytes.
- 106 reference measurement services, delivered by ten reference laboratories and two NMIs in eight countries and which cover seven categories of analytes.

The WG1 Cycle 11 call for nominations of higher order reference materials and reference measurement methods or procedures, and the WG2 Cycle 9 call for nominations of reference measurement laboratory services were announced on the JCTLM website in February 2014, and email notifications were sent to about 350 potential contributors to the JCTLM. As of July 2014, 12 nominations for materials, 9 nominations for methods, and 31 nominations for services had been received and sent to Review Teams for evaluation.

The first issue of the JCTLM Database Newsletter was published in April 2014 and distributed to JCTLM contacts by e-mail. Positive feedback was received on this first issue as well as some requests to include external contributions to promote measurement result traceability in laboratory medicine in future issues.

The annual joint meeting of the JCTLM Working Groups 1 and 2 was held at the BIPM on 3 December, followed by the 13th meeting of the JCTLM Executive Committee on 4-5 December 2014. During its meeting the Executive Committee decided to establish a Working Group on Education and Promotion on Traceability that would come into force in 2015. It also decided to set up an *ad hoc* Working Group on JCTLM Governance to revise JCTLM procedures and propose the most appropriate structure and assignment of duties to the JCTLM Executive, WG Chairs and the Secretariat.

ISO TC 212 WG2 is currently revising two normative standards of particular importance to the JCTLM processes, notably ISO 17511 and ISO 15195. The BIPM, as a liaison organization to ISO TC 212, has taken an active role in this work.

5. MEETINGS IN 2014

A full list of meetings organized by the BIPM in 2014 is given in Appendix 2.

25th meeting of the General Conference on Weights and Measures

18-20 November 2014

The 25th meeting of the General Conference on Weights and Measures (CGPM) was held in Versailles, France, from 18 to 20 November 2014 and was chaired by Prof. Taquet, the President of the French

Académie des Sciences. It was attended by 167 delegates from the governments of 46 of the BIPM's Member States and observers from 20 Associate States and Economies of the CGPM. In addition, there were six representatives from the OIML, ILAC, ISO, the European Space Agency (ESA), the Versailles Project on Advanced Materials and Standards (VAMAS) and the European Commission. Three representatives from the Republic of Azerbaijan (which became an Associate of the CGPM on 1 January 2015) were invited to attend the CGPM meeting as observers.

The BIPM Director and Dr Inglis, President of the CIPM, gave presentations highlighting the work accomplished since the 24th CGPM (2011), the achievements of the BIPM, the long-term strategy for the BIPM and the proposed work programme for the years 2016 to 2019. Other presentations were made by the Presidents of the ten CIPM Consultative Committees.

Representatives from the OIML, ILAC and ISO presented the work of their organizations and their collaborative ventures with the BIPM. Four invited speakers gave talks on: Stable and accurate measurements to quantify the causes of global climate change (Dr James Butler, NOAA); The global context of food safety (Dr Julia Doherty, USTR); Building a world-wide metrology: the challenge in emerging economies (Mr Ndwakhulu Mukhufhi, NMISA); and The measurement of time (Prof. Christophe Salomon, CNRS/LKB).

Five resolutions that addressed scientific and institutional matters were adopted during the meeting:

On the future revision of the International System of Units, the SI

Resolution 1

The General Conference on Weights and Measures (CGPM), at its 25th meeting,

recalling

- Resolution 1 adopted by the CGPM at its 24th meeting (2011), which takes note of the intention of the International Committee for Weights and Measures (CIPM) to propose a revision of the SI that links the definitions of the kilogram, ampere, kelvin, and mole to exact numerical values of the Planck constant h, elementary charge e, Boltzmann constant k, and Avogadro constant N_A, respectively, and which revises the way the SI is defined including the wording of the definitions of the SI units for time, length, mass, electric current, thermodynamic temperature, amount of substance, and luminous intensity so that the reference constants on which the SI is based are clearly apparent,
- the many benefits summarized in Resolution 1 that will accrue to science, technology, industry, and commerce from such a revision, especially from linking the kilogram to an invariant of nature rather than to the mass of a material artefact, thereby ensuring its long-term stability,
- Resolution 7 adopted by the CGPM at its 21st meeting (1999), which encourages work at the National Metrology Institutes (NMIs) that can lead to such a redefinition of the kilogram,
- Resolution 12 adopted by the CGPM at its 23rd meeting (2007), which outlines the work that should be carried out by the NMIs, the International Bureau of Weights and Measures (BIPM), and the CIPM together with its Consultative Committees (CCs) that could enable the planned revision of the SI to be adopted by the CGPM,

considering that there has been significant progress in completing the necessary work, including

- the acquisition of relevant data and their analysis by the Committee on Data for Science and Technology (CODATA) to obtain the required values of h, e, k, and N_A,

- establishment by the BIPM of an ensemble of reference standards of mass to facilitate the dissemination of the unit of mass in the revised SI,
- the preparation of *mises-en-pratique* for the new definitions of the kilogram, ampere, kelvin, and mole,

noting that further work by the Consultative Committee for Units (CCU),the CIPM, the BIPM, the NMIs and the CCs should focus on

- awareness campaigns to alert user communities as well as the general public to the proposed revision of the SI,
- the preparation of the 9th edition of the SI Brochure that presents the revised SI in a way that can be understood by a diverse readership without compromising scientific rigour,

that despite this progress the data do not yet appear to be sufficiently robust for the CGPM to adopt the revised SI at its 25th meeting,

encourages

- continued effort in the NMIs, the BIPM, and academic institutions to obtain data relevant to the determination of h, e, k, and N_A with the requisite uncertainties,
- the NMIs to continue acting through the CCs to discuss and review this data,
- the CIPM to continue developing a plan to provide the path via the Consultative Committees and the CCU for implementing Resolution 1 adopted by the CGPM at its 24th meeting (2011), and
- continued effort by the CIPM, together with its Consultative Committees, the NMIs, the BIPM, and other organizations such as the International Organization of Legal Metrology (OIML), to complete all work necessary for the CGPM at its 26th meeting to adopt a resolution that would replace the current SI with the revised SI, provided the amount of data, their uncertainties, and level of consistency are deemed satisfactory.

On the election of the International Committee for Weights and Measures

Resolution 2

The General Conference on Weights and Measures (CGPM), at its 25th meeting,

considering

- the provisions of Articles 7, 8 and 9 of the Regulations Annexed to the Metre Convention on the election and composition of the International Committee for Weights and Measures (CIPM),
- the decision made by the CGPM at its 17th meeting (1983), upon recommendation of the *ad hoc* Working Group it had created at its 16th meeting (1979), that the CIPM should – in general – ensure that the candidate is acceptable to his or her government at the time of provisional election,
- Resolution 10 adopted by the CGPM at its 24th meeting (2011) on the role, mission, objectives, long-term strategy and governance of the International Bureau of Weights and Measures (BIPM), in which the CGPM invited the CIPM to establish an *ad hoc* Working Group charged with conducting a Review of the role, mission, objectives, long-term financial stability, strategic direction and governance of the BIPM, and to report to the CGPM at its 25th meeting on recommendations from the Review of the *ad hoc* Working Group, actions consequently taken by the CIPM and proposals for additional actions that require the approval of the CGPM,

- the findings and recommendations of the said *ad hoc* Working Group relating in particular to the election and composition of the CIPM,

welcomes

- the revision by the CIPM, at Session II of its 102nd meeting (October 2013), of the principles it follows in making elections, which had been adopted by the CIPM at its 94th meeting (2005),

noting

- Decision 103-08 of the CIPM, adopted by unanimity at Session I of its 103rd meeting (March 2014), on the resignation of all CIPM members to become effective from the start of Session I of the 104th meeting of the CIPM, scheduled for March 2015,

decides that

- beginning with the 25th meeting of the CGPM (2014), CIPM members shall be elected to fixed renewable terms,
- terms will begin at the first CIPM meeting to take place no later than six months after the CGPM meeting at which they are elected, and will end at the beginning of the CIPM meeting that follows the next meeting of the CGPM,
- a Committee for CIPM Election is set up in order to assist the CIPM and the CGPM in the election of CIPM members, being elected and operating in conformity with a procedure to be adopted by the Committee,
- the Committee for CIPM Election shall be composed of nine representatives, each from a different Member State with maximum, intermediary and minimum contributions, with appropriate geographic representation, elected by the CGPM by majority vote, as well as the CIPM President and CIPM Secretary; and that it shall be chaired by one of the Member States' representatives,
- the CGPM shall proceed at each of its meetings to the election of the nine Member States' representatives of the Committee for CIPM Election,

invites

- Member States to participate actively in the CIPM election process.

On the Pension and Provident Fund of the BIPM

Resolution 3

The General Conference on Weights and Measures (CGPM), at its 25th meeting,

recalling

- that the CGPM at its 3rd meeting (1901) established a fund for pensions for the benefit of BIPM staff members,
- article 15 paragraph 2 of the Regulations annexed to the Metre Convention, which states, inter alia, that "[a]n annual levy in favour of the Pension Fund may be made from the total fees received by the Bureau",
- that the CGPM at its 24th meeting (2011) has adopted Resolution 10 on the role, mission, objectives, long-term strategy and governance of the BIPM which invited the CIPM to establish an *ad hoc* Working Group to conduct a Review of *inter alia* the long-term financial stability of the BIPM,

recognizing

- that the CIPM established a Standing Sub-Committee on the BIPM Pension and Provident Fund and Health Insurance in 2012,
- the importance of a sustainable pension fund as a mechanism for the BIPM to attract, retain and motivate competent staff,
- the need for the CIPM together with the BIPM to manage the BIPM's budget and finances to meet its financial obligations towards the BIPM Pension and Provident Fund within the dotation agreed by the Member States,
- that the CIPM has brought increased transparency to the accounts and financial statements of the BIPM Pension and Provident Fund through the adoption of the International Public Sector Accounting Standards (IPSAS),

welcomes

- the measures already taken by the CIPM towards ensuring the long-term financial stability of the BIPM Pension and Provident Fund, especially the amendments that were adopted by the CIPM in 2009 and that entered into force from 1 January 2010, including raising the retirement age and increasing the BIPM staff contribution,
- the work carried out to review and analyze the current assets and liabilities of the BIPM Pension and Provident Fund since the 24th meeting of the CGPM (2011) by the CIPM Sub-Committee on the BIPM Pension and Provident Fund and Health Insurance,

re-affirms

- the decision made at its 10th meeting (1954) to charge the CIPM with the administration of the BIPM Pension and Provident Fund,

invites the CIPM to

- implement its plans to provide sustainability for the BIPM Pension and Provident Fund whilst continuing to examine the longer term liability issue,
- inform Member States about the outcome of actuarial studies on the assets and liabilities of the BIPM Pension and Provident Fund in its regular financial publications and at the next meeting of the General Conference.

Dotation of the BIPM for the years 2016 to 2019

Resolution 4

The General Conference on Weights and Measures (CGPM), at its 25th meeting,

considering

- the increased importance of the work of the International Bureau of Weights and Measures (BIPM) to international trade, industrial innovation, monitoring climate change, human health and medicine, food and forensic science in all Member States,
- the recognition of the BIPM as the scientifically expert intergovernmental organization in metrology and the added value and cost efficiency it provides to all Member States in technical and economic terms,
- the manner in which the BIPM is adopting best management practice and improving the efficiency of its operation,

noting

- that Resolution 7 (1979) adopted by the CGPM at its 16th meeting established a principle for the determination of the base dotation,
- Resolution 10 (2011) adopted by the CGPM at its 24th meeting on the role, mission, objectives, long-term strategy and governance of the BIPM, and the actions consequently taken and successfully implemented by the BIPM,
- the current world financial situation and the financial constraints Member States are subject to,
- the successful implementation by the BIPM of the recommendation made by the CGPM at its 24th meeting that additional voluntary support be sought to enable additional activities at the BIPM related to its mission,

thanks those National Metrology Institutes that have provided voluntary support of all kinds to the BIPM, in particular by way of secondment of staff to the BIPM,

decides that the annual dotation of the BIPM, as defined in Article 6, 1921, of the Regulations annexed to the Metre Convention, will be set in such a way that, for those States that are Parties to the Metre Convention at the time of the 25th meeting of the CGPM, it shall be:

11 980 000 euros in 2016
11 980 000 euros in 2017
11 980 000 euros in 2018
11 980 000 euros in 2019

urges

- Member States, as well as international organizations, private organizations and foundations to maintain the provision of additional voluntary support of all kinds to support specific BIPM mission-related activities, particularly those that facilitate participation in the activities of the BIPM by those countries without well-developed metrology infrastructure.

On the importance of the CIPM Mutual Recognition Arrangement

Resolution 5

The General Conference on Weights and Measures (CGPM), at its 25th meeting,

considering

- the relevance and importance of the CIPM MRA as expressed in particular by the CGPM in Resolution 6 (2003) adopted at its 22nd meeting and in Resolution 4 (2007) adopted at its 23rd meeting,
- the appreciation and support expressed by all interested parties for the CIPM MRA since its entry into force more than fifteen years ago,
- the positive social and economic impact of the CIPM MRA in providing for the mutual recognition of national measurement standards and of calibration and measurement certificates,

noting

- that after fifteen years of successful operation of the CIPM MRA, there is a need to review its implementation and operation,
- that the activities carried out under the CIPM MRA are of direct relevance to the role, mission and objectives of the International Bureau of Weights and Measures (BIPM),

- the unique and distinct role of the Regional Metrology Organizations (RMOs) within the activities of the CIPM MRA, through the Joint Committee of the Regional Metrology Organizations and the BIPM (JCRB) and for the Associates of the CGPM,
- the improvements being made within the existing framework including the strategic planning of comparisons and ongoing streamlining of processes,
- a workshop planned for 2015 to engage in a broad discussion of the CIPM MRA, involving: Directors of National Metrology Institutes, Member States representatives, representatives of RMOs and other relevant stakeholders concerning the benefits of the CIPM MRA, as well as establishing views on what works well, and what needs to be improved regarding its implementation,

invites

- the Consultative Committees and the JCRB to continue their ongoing efforts to streamline operations within the existing framework, and to prepare for and contribute to the wider review in 2015,
- the CIPM to establish a working group under the chairmanship of its President, with membership to be determined at the 2015 workshop, to conduct a review of the implementation and operation of the CIPM MRA,

reaffirms

- its recommendation that the principles of the CIPM MRA be included in intergovernmental agreements as appropriate,

encourages

- all signatories of the CIPM MRA to support the activities and work of the working group on the CIPM MRA.

6. PUBLICATIONS

BIPM publications for 2014 are listed in Appendix 3.

6.1. *Metrologia*

Metrologia is in good health, and has the highest impact factor amongst the related measurement journals. It celebrated its 50th year of publication in 2014, and with one volume published per year since its launch in 1965, one might have expected to see the publication of volume 50 of *Metrologia* in 2014. However, since two volumes of *Metrologia* were published in 1987 it is already at volume 51, which featured three special issues: on "Watt and joule balances, the Planck constant and the kilogram", "20th anniversary of the GUM", and "The 12th International Conference on New Developments and Applications in Optical Radiometry (NEWRAD 2014)".

The publishing partnership with IOP Publishing (IOPP) continues to work well and publication times are competitive. Submissions to the journal remain high.

6.2. Website

The BIPM website continues to be the BIPM's primary means of communication. It contains a wealth of information and in 2014 it played a key role in communicating important documents for the meeting of the CGPM (2014).

A new-look, completely re-structured version of the BIPM website was completed in September 2014. An important part of the redesign was the development of the BIPM's new graphic charter, and particularly the new logo, which was approved by the CIPM in March 2014. The new graphic design is now used in the BIPM's presentations, corporate posters, visiting cards, and letterheads.

The website's former bilingual "tunnel page" has been replaced by an automatic redirect to a home page in either English or French, with a switch available between the two. The revised structure of the website takes into account the broader context of international metrology, so the top-level "buttons" have been reformulated; also, to complement this traditional top-down menu a new technical menu has been introduced across the bottom of each page, providing access to domain-specific information for the ten metrology areas represented by the CIPM's Consultative Committees (CCs). The rollover menus, in addition to the introduction of "tab" formatting, facilitate navigation of the site; the menus will be further refined in a second step when the content management system is renewed.

The new website includes new content: particularly a dedicated area for the meeting of the CGPM (2014), an updated version of the 8th edition of the SI Brochure, an annotated version of the VIM3, and more information about the BIPM's liaison work, CC working groups, Member States, RMOs and the outputs of the JCRB, as well as the reports of all the meetings of the CIPM to date. The Notification of Contributions and the formal Annual Report are published on the website as soon as they become available. The "news" area of the website has been reworked, and from the beginning of 2015 the website will serve as the platform for publication of the BIPM's electronic newsletter.

7. DIRECTOR'S OFFICE AND GENERAL SERVICES

7.1. Finance, Budget and Procurement Office

The Finance, Budget and Procurement Office developed a funding model during 2014 for the BIPM Work Programme for the four years 2016-2019. One of the most challenging aspects in drafting the funding model was how to estimate future pension costs based on actuarial studies. Three scenarios were developed that took into account potential increases in the dotation of between 0 % and 2 % from 2016 to 2019 and the predicted impact of each on the BIPM and its work. The document "Highlights of progress made since the 24th CGPM (2011) and Notes supporting the proposed dotation 2016-2019" provides full details of the estimated budget, financial performance and financial position of the BIPM under the three different proposed scenarios for the dotation. Development of the long-term financial plan continued until it was presented to the 25th CGPM (2014). The department also collaborated with the CIPM Sub-Committee on the BIPM Pension and Provident Fund and Health Insurance throughout the year. The BIPM received a 'clean' auditor's report in 2014 for the first time. This represents a significant milestone in the full adoption of accrual accounting by the BIPM.

Details of the 2013 Financial statements are available in the "*Rapport annuel aux Gouvernements des Hautes parties contractantes sur la situation administrative et financière du Bureau International des Poids et Mesures*".

A summary of key financial metrics for 2013 can be found in the "BIPM Core data 2013".

7.2. Legal, Administration and Human Resources Office

The Legal, Administration and Human Resources Office oversees human resources, legal and other services and relations with the Host State's authorities, with Member States and Associates of the CGPM, and with other States, intergovernmental organizations and international bodies. The Office's work covers legal and administrative affairs and the negotiation and administrative management of contracts and agreements entered into by the BIPM.

Legal activities of the Legal, Administration and Human Resources Office include:

- Assistance to the Director on legal, administrative and human resources questions related to the BIPM and its activities and preparation of the elements necessary to allow his decision-making, in particular: law applicable to staff members of the BIPM; General international law, including privileges and immunities and any question on the interpretation and application of the BIPM constitutive and fundamental provisions; Agreements and contracts to which the BIPM is a party; and Procurement contracts.
- Provision of legal opinions necessary to ensure the legal certainty of the BIPM on institutional, procedural, administrative and human resources matters.
- Drafting of *notes verbales* and institutional correspondence of the BIPM, in particular with States and other intergovernmental organizations, and liaison with the latter's legal advisors and administrative authorities on legal and administrative matters.
- Contribution to the development of rules applicable to the BIPM and to its staff members (amendments to the RRI).
- Provision of support to the department directors and section heads on legal, administrative and human resources questions of the BIPM and its activities.
- Participation in the proofreading of statutory BIPM publications.

Administrative activities of the Legal, Administration and Human Resources Office include in particular: administrative relations and protocol with public institutions, such as ministries and embassies; Management of the customs operations; and Support to staff members in their administrative formalities in connection with the BIPM.

The Human Resources activities of the Legal, Administration and Human Resources Office include in particular: Implementation of the Regulations, Rules and Instructions applicable to the BIPM staff members (RRI); HR management of appointments, secondments and internships, of the organizational structure and job descriptions; leave entitlements, performance evaluation, advancement and promotion.

7.3. Staff[6]

7.3.1. Appointments

- Dr Pierre Gournay was appointed as a Physicist in the Electricity Department as of 1 April 2014.
- Mr Damien Bautista was appointed as a Technician in the Mass Department as of 1 July 2014.

[6] See Appendix 4 for a list of BIPM staff and an organigram.

- Dr Franck Bielsa was appointed as a Physicist in the Mass Department as of 15 July 2014.

7.3.2. Promotions and change of grade

From 1 January 2014:

- Ms Frédérique de Hargues, Secretary in the Director's Office/Secretariat, was promoted to Principal Secretary.
- Mr Pascal Lemartrier, Painter in the Workshop and Buildings Section, was promoted to Principal Painter.
- Mr Manuel Nonis, Principal Technician in the Ionizing Radiation Department was promoted to Metrologist Technician.
- Mr Benjamin Rolland, Technician in the Electricity Department was promoted to Assistant.

7.3.3. Consultants, secondments, research fellows and guest workers

- Dr Richard Davis had his consultancy contract extended until 31 December 2014.
- Dr Ming Li, from the National Institute of Metrology (NIM, China), was on secondment in the Chemistry Department over two periods: from 1 May 2013 to 30 April 2014 and from 1 November 2014 to 31 October 2015.
- Dr Amale Kanj was on a post-doctoral contract with the BIPM and the Centre National d'Études Spatiales (CNES, France) in the Time Department over two periods: from 1 to 15 February and from 1 August to 31 December 2014.
- Ms Céline Pascale from the Federal Institute of Metrology (METAS, Switzerland) was on secondment in the Chemistry Department from 1 March to 31 July 2014.
- Dr Andrei Antohe from the Horia Hulubei National Institute for R&D in Physics and Nuclear Engineering (IFIN-HH, Romania), was on secondment in the Ionizing Radiation Department from 5 May to 31 July 2014.
- Dr Dewei Song from the National Institute of Metrology (NIM, China), was on secondment in the BIPM Chemistry Department from 1 June to 30 November 2014.
- Dr Wu Wenjun from the Chinese Academy of Sciences (CAS, China), began a secondment in the BIPM Time Department from 1 June 2014 to 2 June 2015.
- Dr Stuart Davidson from the National Physical Laboratory (NPL, UK) was on secondment in the Mass Department over two periods: from 16 June to 16 September and from 22 September to 31 October 2014.
- Dr Yunfeng Lu from the National Institute of Metrology (NIM, China) began a secondment in the Electricity Department from 1 September 2014 to 31 January 2015.
- Dr Marta Doval Miñarro from the National Physical Laboratory (NPL, UK), was on secondment in the Chemistry Department from 1 September to 30 November 2014.
- Dr Leonor Rodriguez Barquero, previously from the Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas (CIEMAT, Spain), began a consultancy in the Ionizing Radiation Department from 8 September 2014 to 6 March 2015.

- Dr Federica Parisi from the University of Turin (Italy) began an internship in the Time Department from 1 November 2014 to 6 February 2015.
- The secondment contract of Mr Chingis Kuanbayev from the Kazakhstan Institute of Metrology (RSE "KazInMetr") as Executive secretary of the JCRB was extended until 31 January 2015.

7.3.4. Departures

- Ms Cécile Goyon-Taillade, Assistant in the Mass Department, resigned on 28 February 2014.
- Mr Roland Goebel, Principal Physicist in the Electricity Department, retired on 30 April 2014.
- Dr Włodzimierz Lewandowski, Principal Physicist in the Time Department, retired on 31 May 2014.

7.4. Secretariat and Housekeeping Office

The Secretariat's activities are an essential part of the increasing coordination role of the BIPM. It has a major role in organizing and managing meetings at the BIPM. These meetings include those of the Consultative Committees and their Working Groups, as well as the meetings of the CIPM, CIPM bureau, Directors of NMIs and States Representatives, Joint Committees and workshops. In 2014, more than 1 300 attendees took part in meetings at the BIPM. See Appendix 2 for a full list of meetings held at the BIPM in 2014.

In addition to the meetings held on site, in 2014 the Secretariat and Housekeeping Office organized and managed the 25th meeting of the CGPM, which took place on 18-20 November at the Palais des Congrès in Versailles. Planning for this meeting started in 2013 and the organization involved a significant amount of work. As mentioned in §5, the CGPM meeting was attended by 167 delegates from the governments of 46 of the BIPM's Member States and observers from 20 Associate States and Economies of the CGPM. In addition, there were representatives from a number of organizations, invited speakers and other guests, taking the total number of attendees to more than 200.

The work of the Secretariat in preparing for the 25th meeting of the CGPM involved a diverse range of tasks from sending out the formal invitations to attend the CGPM meeting through to organizing the catering for the delegates. During the conference, the Secretariat ensured its smooth running through a significant amount of behind the scenes work. Many of the delegates expressed their appreciation for the professional and efficient organization of the CGPM meeting.

Another key role of the Secretariat is to provide secretarial and administrative support to all members of staff (e.g. support for travel, visa requests and registration for international symposia). Among its other responsibilities, the BIPM Secretariat and Housekeeping Office deals with the requests for use of the CIPM MRA logo and it is responsible for updating the central database which supplies data, such as contact details and the calendar of meetings, to the BIPM intranet and website.

The Secretariat circulates documents to Member States, Associates of the CGPM and NMI Directors. In addition it publishes working documents on dedicated restricted areas of the BIPM website for the CIPM, NMI Directors and States Representatives, and the Consultative Committees and Working Groups. It also maintains records of calibration certificates, sends the certificates to NMIs and issues the internal monthly "News" of events.

7.5. Safety, Quality and Grounds

The BIPM Quality Management System was reviewed in the yearly Quality Management System Review meeting on 2 October 2014. Revision 5.0 of the BIPM Quality Manual, in compliance with ISO/IEC 17025:2005 and the ISO Guide 34:2009 has been approved and implemented since March 2014. Regular internal audits in the 2014 cycle included a technical auditor from a different BIPM department to the one being audited. This resulted in a more thorough review of technical and scientific issues and has been very well received in all the audited areas. None of the internal audits or external onsite peer reviews that took place in 2014 resulted in any major non-conformities. Minor non-compliances and recommendations for improvement highlighted during the audits have already been addressed.

The BIPM Quality Management System was presented during the EURAMET TC Q meeting held in Cavtat, Croatia, in April 2014. The TC-Q issued the following statement of confidence in the BIPM QMS:

"TC-Q has sufficient confidence in the QMS of BIPM and its ability to fulfil the requirements of the CIPM MRA. This will be reported to the EURAMET Secretariat."

The BIPM Occupational Health and Safety Management System is based on the requirements of BS OHSAS 18001:2007. It was reviewed in the annual Occupational Health and Safety Management System Review meeting held on 2 October 2014. Revision 2 of both the English and French versions of the BIPM's Occupational Health and Safety Manual were published on 2 October 2013 and it has been fully applied throughout the BIPM.

Approximately 80 % of the existing boundary fence surrounding the BIPM site has been replaced with a 2.4 m high metallic wire fence as part of the improvements to site security. A proactive woodland management programme has started with some guidance from the *Parc de Saint Cloud* forestry experts. A programme of improvements and maintenance to roads, parking, trails and garden paths is now part of the annual budget.

Annexe 1 / Appendix 1

CERTIFICATS ET NOTES D'ÉTUDE / CERTIFICATES AND STUDY NOTES

Entre le 1er janvier 2014 et le 31 décembre 2014, 81 certificats et 1 note d'étude ont été délivrés. / In the period from 1 January 2014 to 31 December 2014, 81 Certificates and 1 Study Note were issued.

Certificats / Certificates

2014

1.	10 pF capacitance standard, Andeen-Hargerling model AH11A, No. 01289[1]	EIM, Grèce / Greece
2.	10 pF capacitance standard, Andeen-Hargerling model AH11A, No. 01290*	Id.
3.	100 pF capacitance standard, Andeen-Hargerling model AH11A, No. 01291*	Id.
4.	100 pF capacitance standard, Andeen-Hargerling model AH11A, No. 01292*	Id.
5.	1 pF capacitance standard, Andeen-Hargerling model AH11A, No. 01210*	INMETRO, Brésil / Brazil
6.	10 pF capacitance standard, Andeen-Hargerling model AH11A, No. 01209*	Id.
7.	100 pF capacitance standard, Andeen-Hargerling model AH11A, No. 01163*	Id.
8.	100 pF capacitance standard, Andeen-Hargerling model AH11A, No. 01622*	BIM, Bulgarie / Bulgaria
9.	100 pF capacitance standard, Andeen-Hargerling model AH11A, No. 01623*	Id.
10.	100 pF capacitance standard, Andeen-Hargerling model AH11A, No. 01625	Id.
11.	1 pF capacitance standard, Andeen-Hargerling model AH11A, No. 01245*	NMC, A*STAR, Singapour / Singapore
12.	10 pF capacitance standard, Andeen-Hargerling model AH11A, No. 01244*	Id.
13.	100 pF capacitance standard, Andeen-Hargerling model AH11A, No. 01240*	Id.
14.	10 pF capacitance standard, Andeen-Hargerling model AH11A, No. 01067*	CENAM, Mexique / Mexico
15.	10 pF capacitance standard, Andeen-Hargerling model AH11A, No. 01068*	Id.
16.	100 pF capacitance standard, Andeen-Hargerling model AH11A, No. 01070*	Id.
17.	100 pF capacitance standard, Andeen-Hargerling model AH11A, No. 01071*	Id.
18.	1 kg mass standard in stainless steel, No. 1950507*	LATU, Uruguay

* Les étalons marqués d'un astérisque ont déjà été étalonnés au BIPM. / Standards marked with an asterisk have been calibrated previously at the BIPM.

19.	1 kg mass standard in stainless steel, No. 116475	IPQ, Portugal
20.	1 kg mass standard in stainless steel, No. 116476	Id.
21.	1 kg mass standard in stainless steel, No. 116478	Id.
22.	1 kg mass standard, 3S2*	VSL, Pays-Bas / Netherlands
23.	1 kg mass standard, 4S2*	Id.
24.	1 kg mass prototype, No. 12*	Fédération de Russie / Russian Federation
25.	1 Ω resistance standard, ZIP type P321, No. 076124*	MKEH, Hongrie / Hungary
26.	1 Ω resistance standard, ZIP type P321, No. 470419*	Id.
27.	1 Ω resistance standard, Tinsley type 5658A, No. 17894/18	Id.
28.	1 Ω resistance standard, Tinsley type 5658A, No. 17894/19	Id.
29.	10 000 Ω resistance standard, ZIP type P331, No. 115021*	Id.
30.	10 000 Ω resistance standard, ESI type SR104, No. J201069130104*	DFM, Danemark / Denmark
31.	100 Ω resistance standard, TEGAM type SR102, No. A2011101SR102*	NMC, A*STAR, Singapour / Singapore
32.	1 Ω resistance standard, Leeds and Northrup type 4210, No. 1758735*	DMDM, Serbie / Serbia
33.	1 Ω resistance standard, Leeds and Northrup type 4210, No. 1758737*	Id.
34.	1 Ω resistance standard, Leeds and Northrup type 4210, No. 1755134*	Id.
35.	100 Ω resistance standard, Tinsley type 5685A, No. 8738/19*	Id.
36.	10 000 Ω resistance standard, Tinsley type 5685B, No. 270356*	Id.
37.	10 000 Ω resistance standard, Tinsley type 5685B, No. 15807/02	Id.
38.	Ionization chamber PTW 32002, No. 0220 in a ^{137}Cs gamma-ray beam	ENEA-INMRI, Italie / Italy
39.	Zener diode voltage standard, Fluke type 732B, No. 5740201*	SMD, Belgique / Belgium

40.	Zener diode voltage standard, Fluke type 732B, No. 6945016*	BIM, Bulgarie / Bulgaria
41.	1 Ω resistance standard, Tinsley 5685A, No. 279 903	CMI, République tchèque / Czech Republic
42.	100 Ω resistance standard, Tinsley 5685A, No. 274 557*	Id.
43.	1 pF capacitance standard, Andeen-Hagerling AH11A, No. 01832	GUM, Pologne / Poland
44.	10 pF capacitance standard, Andeen-Hagerling AH11A, No. 01025*	Id.
45.	10 pF capacitance standard, Andeen-Hagerling AH11A, No. 01026*	Id.
46.	10 pF capacitance standard, Andeen-Hagerling AH11A, No. 01027*	Id.
47.	100 pF capacitance standard, Andeen-Hagerling AH11A, No. 1507*	Id.
48.	Ionization chamber LS01, No. 115 in gamma-ray beams*	IAEA
49.	Ionization chamber HS01, No. 102 in gamma-ray beams*	Id.
50.	Ionization chamber LS10, No. 130 in gamma-ray beams*	Id.
51.	Ionization chamber Exradin A6, No. XQ090164 in gamma-ray beams	Id.
52.	Ozone analyzer Advanced Pollution Instrumentation 400, No. 823*	NMISA, Afrique du Sud / South Africa
53.	1 kg mass prototype, No. 102	NIST, États-Unis d'Amérique / United States of America
54.	1 kg mass prototype, No. 104	Id.
55.	1 kg mass prototype, No. 105	Id.
56.	10 pF capacitance standard, Andeen-Hagerling AH11A, No. 01305*	IPQ, Portugal
57.	1 pF capacitance standard, Andeen-Hagerling AH11A, No. 02002	NIS, Égypte / Egypt
58.	10 pF capacitance standard, Andeen-Hagerling AH11A, No. 02004	Id.
59.	100 pF capacitance standard, Andeen-Hagerling AH11A, No. 02006	Id.
60.	1 Ω resistance standard, ZIP type P321, No. 17103*	INM, Roumanie / Romania
61.	1 Ω resistance standard, ZIP type P321, No. 17112*	Id.

62.	10 000 Ω resistance standard, Fluke type 742A, No. 5 885 009*	Id.
63.	10 000 Ω resistance standard, Fluke type 742A, No. 5 885 010*	Id.
64.	1 Ω resistance standard, Leeds and Northrup type 4210, No. 1799595*	IPQ, Portugal
65.	10 000 Ω resistance standard, ESI type SR104, No. J207 119 030 104*	Id.
66.	10 pF capacitance standard, General Radio model 1408-9702, No. 111*	SMU, Slovaquie / Slovakia
67.	10 pF capacitance standard, General Radio model 1408-9702, No. 112*	Id.
68.	1 Ω resistance standard, Leeds and Northrup type 4210, No. 1859 009*	Id.
69.	1 Ω resistance standard, ZIP type P321, No. 222 039*	Id.
70.	1 Ω resistance standard, ZIP type P321, No. 144 487*	Id.
71.	10 000 Ω resistance standard, ZIP type P331, No. 148 058*	Id.
72.	10 000 Ω resistance standard, ESI type SR104, No. 648 042	Id.
73.	Ionization chamber PTW 23344, No. 620 in low-energy x-rays*	STUK, Finlande / Finland
74.	Ionization chamber PTW 23344, No. 620 in low-energy x-rays	Id.
75.	Ionization chamber NE 2561, No. 097 in medium-energy x-rays*	Id.
76.	Ionization chamber NE 2561, No. 097 in a ^{60}Co gamma-ray beam*	Id.
77.	1 Ω resistance standard, Guildline type 9330, No. 40731*	GUM, Pologne / Poland
78.	1 Ω resistance standard, Guildline type 9330, No. 41394*	Id.
79.	1 Ω resistance standard, ZIP type P321, No. 75 735*	Id.
80.	100 Ω resistance standard, ZIP type P331, No. 097292	Id.
81.	10 000 Ω resistance standard, Guildline type 9330, No. 40694*	Id.

Note d'étude / Study Notes

2014

1.	Electronic voltage standard, Fluke model 732B, No. 8195025	SMD, Belgique / Belgium

Annexe 2 / Appendix 2

RÉUNIONS ET PRÉSENTATIONS AU BIPM / MEETINGS AND PRESENTATIONS AT THE BIPM

Réunions organisées par le BIPM / Meetings organized by the BIPM

Les réunions suivantes se sont tenues au siège du BIPM entre le 1er janvier 2014 et le 31 décembre 2014. / The following meetings were held at the BIPM in 2014:

- Réunion du Groupe de travail du CCM sur les hautes pressions – 24 et 25 février / CCM Working Group on High Pressures (WGHP) – 24 to 25 February.
- Réunion du Groupe de travail du CCM sur les basses pressions – 25 février / CCM Working Group on Low Pressures (WGLP) – 25 February.
- Réunion du Sous-comité du CIPM sur la Caisse de retraite et de prévoyance du BIPM et l'assurance-maladie – 7 mars et 15 novembre / CIPM Sub-Committee on the BIPM Pension and Provident Fund and Health Insurance – 7 March and 15 November.
- Réunion du bureau du CIPM – 8 au 10 mars, ainsi que 25 octobre / Bureau of the CIPM meeting – 8 to 10 March and 25 October.
- Réunion du Sous-comité du CIPM sur les finances – 10 mars / CIPM Sub-Committee on Finance – 10 March.
- Réunion des présidents des Comités consultatifs – 11 mars / Meeting of Consultative Committee Presidents – 11 March.
- Première partie de la 103e session du CIPM – 12 et 13 mars / Session I of the 103rd meeting of the CIPM – 12 to 13 March.
- 32e réunion du JCRB – 26 et 27 mars / 32nd meeting of the JCRB – 26 to 27 March.
- Réunion du Groupe de travail de la Section II du CCRI sur les comparaisons clés – 1er et 2 avril, ainsi que 4 et 5 septembre / CCRI Key Comparisons Working Group (KCWG(II)) – 1 to 2 April and 4 to 5 September.
- Réunion du groupe de travail de l'IUPAC afin de rédiger des guides techniques sur le thème « Methods for the SI Value Assignment of the Purity of Organic Compounds for use as Primary Reference Materials and Calibrators » – 2 avril / IUPAC working group meeting to draft technical guidelines on 'Methods for the SI Value Assignment of the Purity of Organic Compounds for use as Primary Reference Materials and Calibrators' – 2 April.
- 19e réunion du CCQM et réunions de ses groupes de travail – 3 au 11 avril / The 19th meeting of the CCQM and meetings of the CCQM Working Groups – 3 to 11 April.
- 27e réunion du CCT et réunions de ses groupes de travail – 19 au 23 mai / The 27th meeting of the CCT and meetings of the CCT Working Groups – 19 to 23 May.
- Réunion du Groupe de travail 2 du JCGM sur le VIM – 4 au 6 juin, 1er et 2 décembre, ainsi que 4 décembre / JCGM-WG2 (VIM) meeting – 4 to 6 June, 1 to 2 December and 4 December.
- Réunion du Groupe de travail 1 du JCGM sur le GUM – 10 au 13 juin, ainsi que 29 septembre au 3 octobre / JCGM-WG1 (GUM) meeting – 10 to 13 June and 29 September to 3 October.
- 22e réunion du CCPR et réunions de ses groupes de travail – 15 au 19 septembre / The 22nd meeting of the CCPR and meetings of the CCPR Working Groups – 15 to 19 September.

- CODATA Task Group on Fundamental Constants – 3 et 4 novembre /3 to 4 November.
- Seconde partie de la 103e session du CIPM – 13 et 14 novembre / Session II of the 103rd meeting of the CIPM – 13 to 14 November.
- Réunion informelle sur le programme de travail du BIPM et la dotation correspondante – 7 novembre / Preparatory meeting on the BIPM Work Programme and associated budget – 17 November.
- 25e réunion de la CGPM –18 au 20 novembre** / 25th meeting of the CGPM – 18 to 20 November**.
- Réunion plénière du JCGM – 3 décembre / JCGM Plenary – 3 December.
- Réunion du Comité exécutif du JCTLM – 4 et 5 décembre / JCTLM Executive Committee – 4 to5 December.

Présentations données au siège du BIPM en 2014 / Presentations at the BIPM in 2014

- J. Faller (JILA), Precision measurement of the gravitational quantities *g* and G – 20 mars / 20 March.

** Réunion organisée à Versailles / Meeting held in Versailles, France.

Annexe 3 / Appendix 3

PUBLICATIONS

Publications du BIPM pour l'année 2014 / BIPM Publications 2014

- BIPM Core data 2013, 4 p. / 4 pp.
- *BIPM e-News* (juillet 2014 / July 2014).
- Comité consultatif de l'acoustique, des ultrasons et des vibrations, 9e session (2014), 24 p. / Consultative Committee for Acoustics, Ultrasound and Vibration, 9th meeting (2014), 24 pp.
- Comité consultatif pour la quantité de matière : métrologie en chimie, 20e session (2014), 31 p. / Consultative Committee for Amount of Substance: Metrology in Chemistry, 20th meeting (2014), 31 pp.
- Notification des parts contributives dues par les Gouvernements des Hautes Parties contractantes pour l'entretien du Bureau international des poids et mesures et des souscriptions des États et Entités économiques associés à la Conférence générale en 2014, 4 p. / 4 pp.
- Procès-verbaux du Comité international des poids et mesures, 102e session (2013), **81**, 188 p. / International Committee for Weights and Measures, 102nd meeting (2013), **81**, 188 pp.
- Rapport annuel aux Gouvernements des Hautes Parties contractantes sur la situation administrative et financière du Bureau international des poids et mesures en 2013, 138 p. / 138 pp.
- Rapport annuel du BIPM sur les activités du temps (2013), 124 p. / BIPM Annual Report on Time Activities (2013), 124 pp.
- Rapport du directeur sur l'activité et la gestion du Bureau international des poids et mesures (2013), **14**, 91 p. / Director's Report on the Activity and Management of the BIPM (2013), **14**, 91 pp.

Publications pour la 25e réunion de la CGPM / Publications for the 25th CGPM meeting

- BIPM Strategic Plan (2014), 20 p. / 20pp.
- Convocation de la Conférence générale des poids et mesures (25e réunion), 44 p. / Convocation of the General Conference on Weights and Measures (25th meeting), 44 pp.
- Principaux progrès réalisés depuis la 24e réunion de la CGPM (2011) et Notes à l'appui de la dotation proposée pour les années 2016 à 2019, 23 p. / Highlights of progress made since the 24th CGPM (2011) and Notes supporting the proposed dotation 2016-2019, 23 pp.
- Proposition pour un « Programme de visiteurs du BIPM pour les années 2016 à 2019 », 9 p. / Proposal for a "BIPM Visitor Programme 2016-2019", 9 pp.
- Rapport du président du CIPM sur les travaux accomplis depuis la 24e réunion de la CGPM, 15 p. / Report of the President of the CIPM on the work accomplished since the 24th meeting of the CGPM, 15 pp.

- Résolutions adoptées par la CGPM lors de sa 25e réunion (18-20 novembre 2014), 12 p. / Resolutions adopted by the CGPM at its 25th meeting (18-20 November 2014), 12 pp.
- Programme de travail du Bureau international des poids et mesures pour les années 2016 à 2019, 53 p. / Work programme of the International Bureau of Weights and Measures for the four years 2016-2019, 53 pp.

Publications scientifiques du BIPM pour l'année 2014 / BIPM scientific publications 2014

Masses / Mass

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Publications du BIPM

- Rapport annuel du BIPM sur les activités du temps 2013, **8**, 121 p. (rapport disponible uniquement sur la page internet http://www.bipm.org/en/bipm/tai/annual-report.html) / *BIPM Annual Report on Time Activities for 2013*, **8**, 121 pp., available only at http://www.bipm.org/en/bipm/tai/annual-report.html.
- *Circulaire T* (mensuelle), 8 p. / *Circular T* (monthly), 8 pp.
- *UTC rapide (UTCr)* (hebdomadaire), 1 p. / *Rapid* UTC (*UTCr*) (weekly), 1 pp.

Électricité / Electricity

Publications extérieures / External publications

- Burroughs C. J., Rüfenacht A., Waltrip B.C., Solve S., Dresselhaus P.D., Benz S.P., AC Waveform Source Referred to a Programmable Josephson Voltage Standard, *Proc. 2014 Conference on Precision Electromagnetic Measurements (CPEM)*, 2014, 736-737.
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- Fletcher N., Goebel, R., "A measurement chain for the determination of R_K using a calculable capacitor", *Digest CPEM 2014, 2014 Conference on Precision Electromagnetic Measurements*, pp.474-475.
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Rayonnements ionisants / Ionizing Radiation

Publications extérieures / External publications

- Alvarez J.T., de Pooter J.A., Andersen C., Aalbers A.H.L., Allisy-Roberts P.J., Kessler C., Comparison BIPM.RI(I)-K8 of high dose-rate Ir-192 brachytherapy standards for reference air kerma rate of the VSL and the BIPM, *Metrologia*, 2014, **51**, *Tech. Suppl.*, 06022.
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- Anton M., Allisy-Roberts P.-J., Kessler C., Burns D.T., A blind test of the alanine dosimetry secondary standard of the PTB conducted by the BIPM, *Metrologia*, 2014, **51**, *Tech. Suppl.*, 06001.
- Bailat C.J., *et al*., International comparison CCRI(II)-S7 on the analysis of uncertainty budgets for 4πβγ coincidence counting, *Metrologia*, 2014, **51**, *Tech. Suppl.*, 06018.
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- Kessler C., Burns D.T., Büermann L., Key comparison BIPM.RI(I)-K5 of the air-kerma standards of the PTB, Germany and the BIPM in ^{137}Cs gamma radiation, *Metrologia*, 2014, **51**, *Tech. Suppl.*, 06015.
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- Michotte C., Ratel G., Courte S., Caffari Y., Fréchou C., Thiam C., Brettner-Messler R., Maringer F.J., Update of the BIPM comparison BIPM.RI(II)-K1.Ba-133 of activity measurements of the radionuclide ^{133}Ba to include the 2009 result of the IRA (Switzerland) and the 2012 results of the LNE-LNHB (France) and BEV (Austria), *Metrologia*, 2014, **51**, *Tech. Suppl.*, 06017.
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- Picard S., *et al*., Key comparison BIPM.RI(I)-K6 of the standards for absorbed dose to water of the ARPANSA, Australia, and the BIPM in accelerator photon beams, *Metrologia*, 2014, **51**, *Tech. Suppl.*, 06006.

Chimie / Chemistry

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- Flores, E., *et al*., International comparison CCQM-K82: methane in air at ambient level (1800 to 2200) nmol/mol (2014) *Metrologia*, 2014, **52**, 08001.
- Viallon J., Moussay P., Idrees F., Wielgosz R., Lagler F., Final report of the ongoing key comparison BIPM.QM-K1: Ozone at ambient level, comparison with JRC (October 2013), *Metrologia*, 2014, **51**, *Tech. Suppl.*, 08006.
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- Viallon J., Moussay P., Idrees F., Wielgosz R., Sweeney B., Quincey P., Final report of the ongoing key comparison BIPM.QM-K1: Ozone at ambient level, comparison with NPL (May 2013), *Metrologia*, 2014, **51**, *Tech. Suppl.*, 08004.
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Publications diverses / Miscellaneous

Publications extérieures / External publications

- Arias E.F., Los Arcos J.-M., Stock M., Wielgosz R., Milton M., News from the BIPM laboratories - 2013, *Metrologia*, 2014, 51(1), 121-126.
- Davis R.S., Milton M.J.T., The assumption of the conservation of mass and its implications for present and future definitions of the kilogram and the mole, *Metrologia*, 2014, 51(3), 169-173.
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Annexe 4 / Appendix 4

LISTE DU PERSONNEL DU BUREAU INTERNATIONAL DES POIDS ET MESURES / STAFF OF THE INTERNATIONAL BUREAU OF WEIGHTS AND MEASURES

au 31 décembre 2014 / on 31 December 2014

Directeur / Director: M. Milton

Masses / Mass: A. Picard (M. Stock, directeur par interim / *interim* director)
P. Barat, D. Bautista, F. Bielsa, H. Fang, F. Idrees[1], A. Kiss, T. Lavergne, E. de Mirandés

Temps / Time: E.F. Arias
A. Harmegnies, Z. Jiang, H. Konaté, G. Panfilo, G. Petit, L. Robertsson, L. Tisserand

Électricité / Electricity: M. Stock
R. Chayramy, N.E. Fletcher, P. Gournay, A. Jaouen[2], B. Rolland, S. Solve

Rayonnements ionisants / Ionizing radiation: J.M. Los Arcos
D.T. Burns, S. Courte, C. Kessler, C. Michotte, M. Nonis, S. Picard, G. Ratel, P. Roger

Chimie / Chemistry: R.I. Wielgosz
T. Choteau, A. Daireaux, E. Flores Jardines, R.D. Josephs, P. Moussay, N. Stoppacher, J. Viallon, S.W. Westwood

Bureau du directeur / Director's Office

Juridique, Administration et Ressources humaines / Legal, Administration and Human Resources: S. Arlen
L. Dell'Oro

Finances, Budget et Achats / Finance, Budget and Procurement: I. Andernack
F. Ausset, D. Etter

Secrétariat et Entretien des locaux / Secretariat and housekeeping: C. Fellag Ariouet
A. Da Ponte, M.-J. Fernandes, F. de Hargues, A. Mendes de Matos, I. Neves

Relations internationales et communication / International Liaison and Communication: A.S. Henson
N. De Sousa Dias, S. Maniguet[1], J.R. Miles, C. Planche, R. Sitton, C. Thomas

Services informatiques / IT Services: R.I. Wielgosz
L. Le Mée, T. Nguyen

[1] Également à la chimie / Also Chemistry
[2] Sous le régime de l'invalidité / Under the invalidity scheme

Services généraux / General services

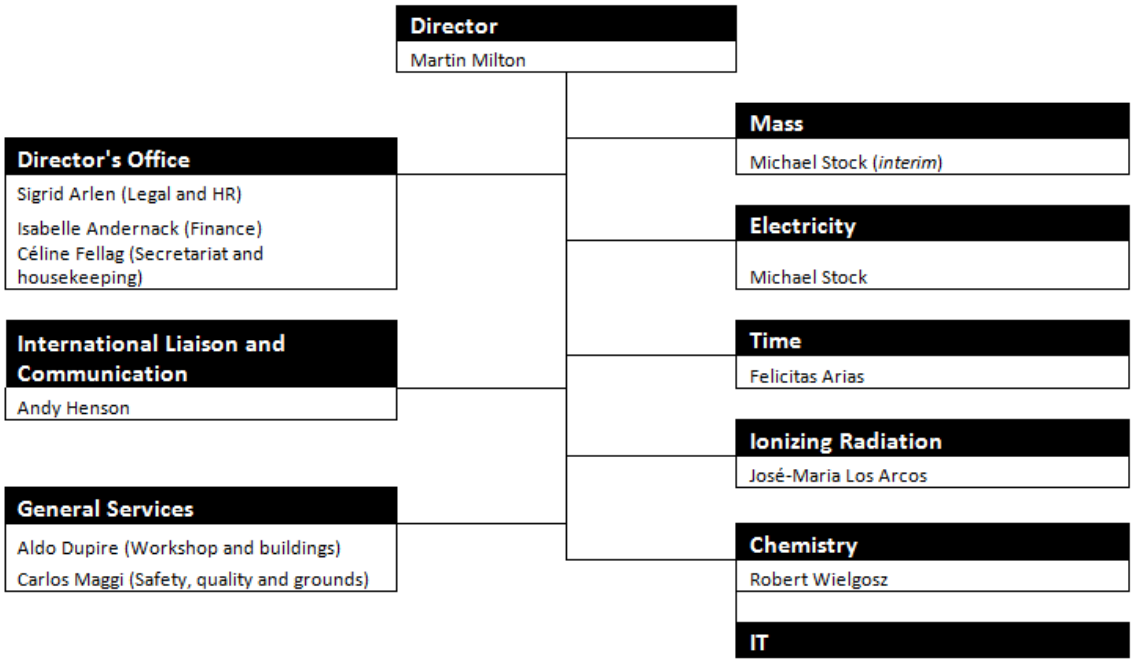
Sécurité, qualité et extérieurs / Safety, Quality and Grounds: C. Maggi
C. Dias Nunes, E. Dominguez[3], C. Neves, A. Zongo

Atelier de mécanique et entretien du site / Workshop and Buildings: A. Dupire
P. Benoit, F. Boyer, M. De Carvalho[4], P. Lemartrier, S. Segura, B. Vincent

Directeurs honoraires / Emeritus directors: T.J. Quinn, A.J. Wallard

Physicien chercheur principal honoraire / Honorary Principal Research Physicist: R.S. Davis

Organigramme du siège du BIPM / Organigram of the BIPM headquarters



[3] Également à l'atelier de mécanique et entretien du site / Also Workshop and Buildings
[4] Sous le régime de l'invalidité / Under the invalidity scheme

Annexe 5 / Appendix 5

LISTE DES SIGLES UTILISÉS DANS LE PRÉSENT VOLUME / ACRONYMS USED IN THE PRESENT VOLUME

AFRIMETS	Système intra-africain de métrologie/Inter-Africa Metrology System
AIEA	Agence internationale de l'énergie atomique
AMA	Agence mondiale antidopage
APMP	Asia-Pacific Metrology Programme
BIPM	Bureau international des poids et mesures/International Bureau of Weights and Measures
CAS	Chinese Academy of Sciences (Chine/China)
CC	Consultative Committee of the CIPM
CCAUV	Comité consultatif de l'acoustique, des ultrasons et des vibrations/Consultative Committee for Acoustics, Ultrasound and Vibration
CCEM	Comité consultatif d'électricité et magnétisme/Consultative Committee for Electricity and Magnetism
CCL	Comité consultatif des longueurs/Consultative Committee for Length
CCM	Comité consultatif pour la masse et les grandeurs apparentées/Consultative Committee for Mass and Related Quantities
CCPR	Comité consultatif de photométrie et radiométrie/Consultative Committee for Photometry and Radiometry
CCQM	Comité consultatif pour la quantité de matière : métrologie en chimie et biologie/Consultative Committee for Amount of Substance: Metrology in Chemistry and Biology
CCRI	Comité consultatif des rayonnements ionisants/Consultative Committee for Ionizing Radiation
CCRI(I)	CCRI Section I: x- and gamma rays, charged particles
CCRI(II)	CCRI Section II: Measurement of radionuclides
CCRI(III)	CCRI Section III : Neutron measurements
CCT	Comité consultatif de thermométrie/Consultative Committee for Thermometry
CCTF	Comité consultatif du temps et des fréquences/Consultative Committee for Time and Frequency
CCU	Comité consultatif des unités/Consultative Committee for Units
CGPM	Conférence générale des poids et mesures/General Conference on Weights and Measures
CIE	Commission internationale de l'éclairage/International Commission on Illumination
CIEMAT	*Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas* (Espagne/Spain)
CIPM	Comité international des poids et mesures/International Committee for Weights and Measures
CIPM MRA	CIPM Mutual Recognition Arrangement/Arrangement de reconnaissance mutuelle du CIPM

CMC	Calibration and Measurement Capability/Aptitude en matière de mesures et d'étalonnages
CNES	Centre national d'études spatiales (France)
CODATA	Committee on Data for Science and Technology
COOMET	Coopération métrologique entre les États d'Europe centrale/Euro-Asian Cooperation of National Metrological Institutions
COSQC	Central Organization for Standardization and Quality Control (Irak/Iraq)
CRDS	Cavity ring-down spectroscopy
DCMAS	Network on Metrology, Accreditation and Standardization for Developing Countries/Réseau de métrologie, d'accréditation et de normalisation pour les pays en développement
DGSM	Directorate General for Specifications and Measurements (Oman)
DI	Designated Institute
ENEA	*Agenzia nazionale per le nuove tecnologie, l'energia e lo sviluppo economico sostenibile* (Italie/Italy)
ERMS	Ensemble of Reference Mass Standards/ Ensemble d'étalons de masse de référence du BIPM
ESA	European Space Agency/Agence spatiale européenne
EURAMET	European Association of National Metrology Institutes
FTIR	Fourier transform infrared spectroscopy/Spectroscopie infrarouge à transformée de Fourier
GC-ECD	Gas chromatography – electron capture detector
GC-FID	Gas chromatography – flame ionization detector
GUM	Guide to the Expression of Uncertainty in Measurement/Guide pour l'expression de l'incertitude de mesure
HCHO	Formaldehyde
IAEA	International Atomic Energy Agency
IAU	International Astronomical Union
ICRU	International Commission on Radiation Units and Measurements
IERS	International Earth Rotation and Reference Systems Service/ Service international de la rotation terrestre et des systèmes de référence
IFCC	International Federation of Clinical Chemistry and Laboratory Medicine
IFIN-HH	"*Horia Halubei*" National Institute of Research and Development for Physics and Nuclear Engineering (Roumanie/Romania)
ILAC	International Laboratory Accreditation Cooperation
ILNAS	Institut luxembourgeois de la normalisation, de l'accréditation, de la sécurité et qualité des produits et services – Bureau luxembourgeois de Métrologie (Luxembourg)
IPK	International prototype of the kilogram
ISO	Organisation internationale de normalisation/International Organization for Standardization
IUPAC	International Union of Pure and Applied Chemistry
JCGM	Joint Committee for Guides in Metrology/Comité commun pour les guides en métrologie

JCRB	Joint Committee of the Regional Metrology Organizations and the BIPM/Comité mixte des organisations régionales de métrologie et du BIPM
JCTLM	Joint Committee for Traceability in Laboratory Medicine/Comité commun pour la traçabilité en médecine de laboratoire
JVS	Josephson Voltage Standards
KazInMetr RSE	Kazakh Institute of Metrology RSE (Kazakhstan)
KCDB	BIPM key comparison database/Base de données du BIPM sur les comparaisons clés
KCWG	Working Group on Key Comparisons and CMC Quality
KRISS	Korea Research Institute of Standards and Science (République de Corée/Republic of Korea)
LNE-LNHB	LNE Laboratoire national Henri Becquerel (France)
METAS	Institut fédéral de métrologie/Federal Institute of Metrology (Suisse/Switzerland)
MIKES	Finnish Metrological Institute (Finlande/Finland)
NIM	National Institute of Metrology (Chine/China)
NIST	National Institute of Standards and Technology (États-Unis d'Amérique/USA)
NMI	National Metrology Institute
NMIJ/AIST	National Metrology Institute of Japan/Advanced Industrial Science and Technology (Japon/Japan)
NMISA	National Metrology Institute of South Africa (Afrique du Sud/South Africa)
NMR	Nuclear magnetic resonance/Résonance magnétique nucléaire
NPL	National Physical Laboratory (Royaume-Uni/UK)
NRC	National Research Council (Canada)
OAWG	CCQM Working Group on Organic Analysis
OIML	Organisation internationale de métrologie légale/International Organization of Legal Metrology
OMC	Organisation mondiale du commerce
OMM	Organisation météorologique mondiale
OMS	Organisation mondiale de la santé
ONUDI	Organisation des Nations Unies pour le développement industriel
PET	Positron Emission Tomography
PTB	*Physikalisch-Technische Bundesanstalt* (Allemagne/Germany)
qNMR	Quantitative nuclear magnetic resonance/Résonance magnétique nucléaire quantitative
REMCO	ISO Committee on Reference Materials
RMO	Regional Metrology Organization
RRI	Regulations, Rules and Instructions applicable to the BIPM staff members
SI	Système international d'unités/International System of Units
SIR	Système international de référence pour les mesures d'activité d'émetteurs de rayonnement gamma/International Reference System for gamma-ray emitting radionuclides
SIRTI	Transfer Instrument of the SIR/Instrument de transfert du SIR
SRI	Statut, Règlement et Instructions applicables aux membres du personnel du BIPM
SSMO	Sudanese Standards and Metrology Organization (Soudan/Sudan)

TAI	Temps atomique international/ International Atomic Time
TBT	Technical Barriers to Trade
UAI	Union astronomique internationale
UNIDO	United Nations Industrial Development Organization
UTC	Temps universel coordonné/Coordinated Universal Time
UTCr	UTC rapide/Rapid UTC
VAMAS	Versailles Project on Advanced Materials and Standards
VIM	Vocabulaire international de métrologie – Concepts fondamentaux et généraux et termes associés (3e édition)/International Vocabulary of Metrology, Basic and General Concepts and Associated Terms (3rd edition)
VNIIM	D.I. Mendeleyev Institute for Metrology, Rostekhregulirovaniye of Russia (Fédération de Russie/Russian Federation)
VSL	Van Swinden Laboratorium (Pays-Bas/Netherlands)
WADA	World Anti-Doping Agency
WHO	World Health Organization
WMO	World Meteorological Organization
WTO	World Trade Organization
XRCD	X-ray crystal density
YSMO	Yemen Standardization, Metrology and Quality Control Organization (Yémen/Yemen)