Bureau International des Poids et Mesures

Consultative Committee for Amount of Substance: Metrology in Chemistry and Biology (CCQM)

Report of the 29th meeting
(25-26 April 2024)
to the International Committee for Weights and Measures

Comité international des poids et mesures

LIST OF MEMBERS OF THE CONSULTATIVE COMMITTEE FOR AMOUNT OF SUBSTANCE: METROLOGY IN CHEMISTRY AND BIOLOGY

as of 25 April 2024

President

Dr S.-R. Park, member of the International Committee for Weights and Measures also

Korea Research Institute of Standards and Science [KRISS], Daejeon

Executive Secretary

Dr R. Wielgosz, International Bureau of Weights and Measures [BIPM], Sèvres.

Members

Centro Nacional de Metrología [CENAM], Querétaro.

D.I. Mendeleyev Institute for Metrology, Rosstandart [VNIIM], St Petersburg.

Danish Fundamental Metrology A/S [DFM], Hørsholm.

Federal Institute for Materials Research and Testing/Bundesanstalt für Material-forschung und –prüfung [BAM] Berlin.

Federal Institute of Metrology METAS [METAS], Bern-Wabern.

Health Sciences Authority [HSA], Singapore.

Instituto Nacional de Metrologia, Qualidade e Tecnologia [INMETRO], Rio de Janeiro.

Korea Research Institute of Standards and Science [KRISS], Daejeon.

LGC Ltd [LGC], Teddington.

Laboratoire National de Métrologie et d'Essais [LNE], Paris.

National Institute of Metrological Research/Istituto Nazionale di Ricerca Metrologica [INRIM], Turin.

National Institute of Metrology [NIM], Beijing.

National Institute of Metrology (Thailand) [NIMT], Pathumthani

National Institute of Standards and Technology [NIST], Gaithersburg.

National Measurement Institute, Australia [NMIA], Lindfield.

National Metrology Institute of Japan, AIST [NMIJ/AIST], Tsukuba.

National Metrology Institute of South Africa [NMISA], Pretoria.

National Metrology Institute of Turkey /TÜBITAK Ulusal Metroloji Enstitüsü [UME], Gebze-Kocaeli.

National Physical Laboratory [NPL], Teddington.

National Research Council of Canada [NRC], Ottawa.

Physikalisch-Technische Bundesanstalt [PTB], Braunschweig.

RISE Research Institute of Sweden AB [RISE], Borås.

Slovak Institute of Metrology/Slovenský Metrologický Ústav [SMU], Bratislava.

VSL Dutch Metrology Institute [VSL], Delft.

The Director of the International Bureau of Weights and Measures [BIPM], Sèvres.

Observers

All-Russian Scientific Research Institute of Physical Technical Measurements, Rosstandart [VNIIFTRI], Moscow.

Bulgarian Institute of Metrology [BIM], Sofia.

Central Office of Measures [GUM], Warsaw.

Centro Español de Metrología [CEM], Madrid.

CSIR National Physical Laboratory of India [NPLI], New Delhi.

Government Laboratory [GL], Kowloon.

Government Office of the Capital City Budapest [BFKH], Budapest.

Instituto Nacional de Tecnología Industrial [INTI], San Martín, Prov. Buenos Aires.

Instituto Português da Qualidade [IPQ], Caparica.

Kenya Bureau of Standards [KEBS], Nairobi.

National Metrology Centre, Agency for Science, Technology and Research [NMC, A*STAR], Singapore.

National Physical Laboratory of Israel [INPL], Jerusalem.

State Enterprise "All-Ukrainian State Scientific and Production Center of Standardization, Metrology, Certification and Consumer' Rights Protection [SE "Ukrmetrteststandard"], Kiev

Liaisons

Cooperation on International Traceability in Analytical Chemistry [CITAC], Trappes.

European Commission – Joint Research Centre [JRC-Geel], Geel

International Atomic Energy Agency [IAEA], Vienna.

International Federation of Clinical Chemistry and Laboratory Medicine [IFCC], Milan.

International Organization for Standardization, Committee on Reference Materials [ISO REMCO], Geneva.

International Union of Pure and Applied Chemistry [IUPAC].

1. OPENING OF THE MEETING

The Consultative Committee for Amount of Substance: Metrology in Chemistry and Biology (CCQM) held its twenty ninth meeting at the International Bureau of Weights and Measures headquarters (BIPM), at Sèvres, and on-line, on 25 and 26 April 2024.

The following attended:

Members: M. Akgöz (UME), H. Andres (METAS), K. Arrhenius (RISE), T. Asakai (NMIJ/AIST), M. Bilsel (UME), J. Braybrook (LGC), P. Brewer (NPL), R.J.C. Brown (NPL), S.Z. Can (UME), J. Carney (NIST), K.H. Choi, B.-J. de Vos (NMISA), V. Delatour (LNE), F. Dewi (HAS), C. Divieto (INRIM), L. Dong (NIM), Z. Durisova (SMU), S. Ellison (LGC), C. Engelhard (BAM), M. Fernandes-Whaley (NMISA), P. Fisicaro (LNE), H. Goenaga Infante (LGC), C. Gonzalez (NIST), N. González Rojano (CENAM), J.A. Guardado Pérez (CENAM), K. Inagaki (NMIJ/AIST), M. Kato (NMIJ/AIST), Y.A. Kustikov (VNIIM), K.-S. Lee (KRISS), J.E. Lee (KRISS), M.N. Medeiros (INMETRO), J. Melanson (NRC), Z. Mester (NRC/IUPAC), M.J.T Milton (Director of the BIPM), S.Y. Ng (HSA), J. Noireaux (LNE), G. O'Connor (PTB), S.R. Park (President of the CCQM/CIPM/KRISS), C. Pascale (METAS), M. Pérez Urquiza (CENAM), J. Pillay (NMISA), C. Rimmer (NIST), J.M. Rodrigues Caixeiro (INMETRO), A.M. Rossi (INRIM), M. Sega (INRIM), K. Shearman (NIMT), D. Smeulders (NMIA), E. Sobina (UNIIM), R. Stosch (PTB), S. Taebunpakul (NIMT), L.L Tay (NRC), T.L Teo (HSA), M. Valkova (SMU), A. van der Veen (VSL), M. Vonsky (VNIIM), D. Wang (NIM), E. Yildirim (RISE), Q. Zhang (NIM).

Observers: Y. Cui (NMC, A*STAR), F. Dias (IPQ), J. Dumanska (GUM), T. Fernández Vicente (CEM), P.A. Gatti (INTI), F.M. Kai (NMC, A*STAR), B. Koleva (BIM), W.O. Lee (GL), D. Nagy (BFKH), Z.N. Nagyné Szilágyi (BFKH), N. Oganyan (VNIIFTRI), C. Palma (IH-LQPM), A. Petrenko (SE "Ukrmetrteststandard"), S. Prokunin (VNIIFTRI), M.M. Puelles (INTI), R. Quendera (IPQ), A. Rojo Esteban (CEM), H.K. Rotich (KEBS), N. Singh (NPLI), M. Strzelec (GUM), Y. Tarasenko (SE "Ukrmetrteststandard"), S. Tripathy (NPLI), W.F. Wong (GL).

Liaisons: A. Botha (ISO/TC334 Reference materials), F. Camin (IAEA), R. Koeber (JRC-Geel), T. Özben (IFCC).

Representatives from Member State invited to attend as Observer: C.E. Zapata Sanchez (UNAL-CALAIRE).

Guests: A.R. Al Askar (SASO-NMCC), M. Cleveland (NIST), C.M. Cobbaert (LUMC), B. Fu (NIM), W.-H. Fung (GL), J. Huggett (LGC), B.J. Kim (KRISS), J. Kucklick (NIST), S. Lee (KRISS), G. Miller (VCU) T. Näykki (MIKES-SYKE), S. Seitz (PTB), A. Shard (NPL), C. Swart (PTB), J. Vogl (BAM), M. Winchester (NIST), L. Wu (NIM).

Also present: M. Bedu (BIPM), R. Josephs (BIPM), P. Moussay (BIPM), R. Wielgosz (BIPM, Executive Secretary of the CCQM).

Tribute to Dr John Lyons

Dr Gonzalez gave a tribute to Dr Lyons (1931-2024) who was the director of the National Bureau of Standards (now NIST) from 1990 to 1993. Dr Lyons was elected to the CIPM in 1990 and his report at the 82nd CIPM meeting (September 1993) prompted the establishment of the CCQM. Dr Lyons proposed the first inter-laboratory comparison undertaken by the CCQM, focussing on isotope dilution mass spectrometry (IDMS) of heavy metals.

2. APPOINTMENT OF A RAPPORTEUR

Dr Wielgosz asked Dr Cleveland (NIST) to serve as Rapporteur. The meeting confirmed the appointment of Dr Cleveland as rapporteur. Dr Park thanked Dr Ellison for serving as Rapporteur for the 25th-28th CCQM Meetings.

3. APPROVAL OF THE AGENDA

Dr Park presented the proposed agenda (*CCQM/24-01*), which was adopted without change.

4. OPENING REMARKS OF THE CCQM PRESIDENT AND ACTIONS FROM THE 28TH MEETING OF THE CCQM

4.1 Opening remarks

Dr Park stated that there was much material to cover during the CCQM meetings and suggested participants should pre-read the documents on the CCQM Meeting website. Dr Park acknowledged the considerable effort made by members of the working groups.

4.2 Actions from the 28th meeting

Dr Wielgosz reviewed the actions from the 28th meeting of the CCQM. The list of actions agreed at the meeting was available separately as document CCQM/2023-63 and was appended to the Report of the 28th meeting of the CCQM. Most actions were complete and those that were outstanding were addressed in the meeting agenda.

5. REPORTS FROM CCQM TASK GROUPS

5.1 CCQM Task Group on Food Metrology: Progress Report (J. Melanson) [CCQM/24-30]

Dr Melanson gave an update on the CCQM Task Group on Food Metrology, with measurements related to food and food safety being one of the emerging needs for metrology identified by the CIPM.

The activities being undertaken by the TG include developing a document describing the CCQM strategy and work programme of 2021-2030 within the field of food safety and measurement, identification of gaps in measurement needs related to food and food safety, identification of unmet

stakeholder engagement opportunities, liaison with other CCs and identification of measurements related to food and food safety covered by these CCs.

Many CCQM WGs have identified food safety and measurement components within their current strategy documents (OAWG, PAWG, NAWG, CAWG, SAWG, IAWG, IRWG). There has also been interest from Consultative Committee for Thermometry (CCT) (humidity measurements) and Consultative Committee for Photometry and Radiometry (CCPR) (spectroscopic measurements).

The TG has had two meetings (February 2024 and April 2024). The next meeting is planned for June 2024 (internal to CCQM). There will be a larger workshop with external stakeholders in October 2024. The TG will start writing a report now, with a goal of completing the report by May 2025. The October 2024 virtual workshop is planned to cover identification of emerging measurement needs such as alternative sources of proteins, contaminants, and food authentication and country of origin determination. Potential external stakeholders include National food safety regulators, CODEX, AOAC international, and EU food reference laboratory network.

Dr Melanson noted that BERM 16 (1-4 June 2025) in Nova Scotia also may be a good forum for a half day workshop.

Regarding liaisons with other CCs, these were planned but had not formally been initiated so far. Dr Mester stated that the Consultative Committee for Ionizing Radiation (CCRI) should be included for activities related to sterilization. Dr Park reported that he would raise the issue of liaisons with other CC Presidents at the next CIPM meeting and request those with activities to nominate a contact point for their committee.

Dr Botha asked if it included food measurements in general (such as nutritional content) or just safety. Dr Melanson confirmed terms of reference of the task group covered food measurements which include food safety, but also other aspects such as food authentication, quality and nutritional value.

Dr Winchester said IAWG had responded to the questionnaire about what was currently in their strategy document but that the discussion now seemed to be what could be within the scope of the WG and asked if WGs needed to re-answer with that in mind. Dr Gonzalez asked about including PFAS and Dr Melanson said this would be within scope.

Dr Wielgosz said the TG terms of reference included both of short/medium term activities (considering current CCQM 2021-2030 strategy document) and longer term needs and gaps (what future new needs are foreseen beyond 2030 and new emerging areas not covered in the strategy when it was written but have since arisen).

5.2 CCQM Task Group on Metrology for Pandemic Preparedness: Progress Report (J. Braybrook) [*CCQM/24-31*]

Dr Braybrook reminded the CCQM that the TG originated as a follow up to the Roadmap for Metrology Readiness for Infectious Disease Pandemic Response. He reviewed the terms of reference of the TG, which included proposed comparison activities, documentation of standardization principles and development of knowledge transfer mechanisms. For the subgroup 1 activities, the fire drill comparison within the NAWG was completed in Q1 2024. A proposed PAWG exercise was discussed at the April 2024 meeting. Additionally, CAWG and EAWG have also expressed interest in running fire drill exercises within their WGs. For the other terms of reference for SG1, a paper was recently accepted by *Molecular Aspects of Medicine*, “Ensuring accuracy in the development and application of NAATs for

infectious disease". For SG2, eLearning modules focusing on development of nucleic acid reference material production are under development, with a planned release in the second half of 2024.

Dr Braybrook requested a 12-month extension to finish TG activities, and this was agreed by the CCQM.

5.3 CCQM Task Group on Metrology for Li-ion Batteries: Progress Report (S. Seitz) [*CCQM/24-33*]

CCT, Consultative Committee for Electricity and Magnetism (CCEM), and CCQM were involved in measurements related to Li-ion batteries. The main objective of the TG was to bring together these groups and discuss the measurands and metrological services related to Li-ion battery technology. A key activity of this TG is the organization of a stakeholder event to discuss measurands. The TG had two online meetings with participants from PTB, NPL and JRC (July 2023 and October 2023). The meetings reviewed former projects and developed a flyer to advertise the TG among the CCs. For the third meeting (March 2024), CCQM and CCEM were present with participants from PTB, NPL, JRC, VSL, CMI, INRIM, NIM, NMIJ, METAS, and BAM. At this meeting, the TG discussed having an online workshop, which would consist of two half-day sessions, bringing together stakeholders and international groups (for example ISO-TCs). The first focus was to identify the measurands. The currently identified measurands related to "state of health" of batteries include water content of the electrolyte, anode, cathode, separator; electrical impedance standards; dry electrode resistivity map; and leakage resistance.

Dr Braybrook asked if battery lifecycle and recycling would be included, and Dr Seitz replied that currently it was not included. Dr Shard invited Dr Seitz to talk to the SAWG, as they are often asked for surface analysis on batteries. Dr Milton asked what the measurands behind "state of health" were, Dr Seitz replied that it is a percentage of the battery capacity currently, compared to its original capacity.

Dr Wielgosz asked for clarification of the proposed CCT contribution and Dr Seitz replied that CCT could conduct temperature measurements of Li-ion batteries, especially during operation.

5.4 CCQM Nano- and Microplastics Measurements and Standards Task Group: Report and outcomes (J. Kucklick) [*CCQM/24-04*]

Dr Kucklick stated that plastic production was expected to double in the next 30 years. Microplastics are defined as 1 µm to 5 mm, nanoplastics are defined as 1 nm to 1 µm. Microplastics originate from the degradation of macroplastics and from industrial materials, personal care products and cleaning products. They are found in soil, air, water, plants, and animals. They can also transport and leach other substances. Microplastics can be characterized for count (particle number) and identity (type of plastic). The Nano- and Microplastics Measurements and Standards TG was formed after an April 2022 workshop. It aims to foster exchange among stakeholders and NMIs, assess the state of the art of microplastic measurement, identify priority needs within measurement infrastructure and align stakeholder needs with NMI efforts.

The TG plans to have a workshop in 2024. The TG conducted a survey regarding capabilities and current activities (distributed to NMIs). There were 33 responses, with 64 % reporting they were capable of microplastic measurements and 50 % stating they were capable of measuring nanoplastics. There is very limited activity producing RMs for microplastics and nanoplastics (only JRC, NIST, LGC currently). Respondents prioritized CCQM providing interlaboratory comparisons and guidance for nanoplastic and microplastic measurements. The end goal for the TG is to draft a CCQM roadmap for Nano- and Microplastics Measurements and Standards.

Dr Kucklick requested an extension for 1 year to convene and report the outcomes of a stakeholder's workshop and develop and a final TG report. This was approved.

Dr Kucklick stated that a more long-term cross cutting group may be useful. The original workshop had ~150 participants. Dr Wielgosz asked if the workshop would be online or in person; Dr Kucklick stated likely online.

It was noted that there is an International Atomic Energy Agency (IAEA) flagship project about microplastics, specifically regarding marine microplastics.

Dr Goenaga Infante noted that the results of CCQM-P222 CAWG study, which involved the counting of microbeads, are due in August, so that if the workshop is held later, these results can be incorporated.

5.5 Discussion on Task Group activities

Dr Wielgosz noted that there are currently four TGs at CCQM level, which have been formed because they are cross cutting. Additionally, there are many more TGs at the WG level. He noted that the resources required to operate these task groups, had in the most part been provided by the NMI members of CCQM and CCQM WGs that were willing to provide organizational support for these using online meeting and document sharing tools in addition to what could be provided by the BIPM Headquarters, and this had proved successful and manageable so far. One of the areas of evolving needs that had been identified by the CIPM was health and life sciences, and this was an area of considerable activity for the CCQM, where a Task Group could be envisaged when the activities on food measurements were completed, so as not to overburden CCQM members. Dr Park confirmed the CIPM interest, and requested CCQM WG Chairs to start to consider the future needs in this area that their WGs could contribute to.

6. CCQM WORKSHOPS AND SECTOR ENGAGEMENT

6.1 Update from the CIPM STG on Climate and Environment (R. Wielgosz) [*CCQM/24-34*]

A joint BIPM-WMO workshop titled, "Metrology for Climate Action" was held 26-30 September 2022, with over 1000 registered participants, and produced 128 recommendations on progressing metrology in this field. The workshop focused on metrology in support of the physical science basis of climate change and climate observations, as well as metrology as an integral component of operational systems to estimate greenhouse gas emissions based on accurate measurements and analyses. All presentations from the workshop are publicly available at www.bipmwmo22.org.

Dr Wielgosz gave an overview of the CIPM-STG-CENV (CIPM Sectorial Task Group on Climate Change and Environment). The group is currently composed of a core group of interdisciplinary members. The group has been working to identify groups (CC, WMO or other existing groups' existing committees, working groups or task teams) that can progress the 2022 workshop recommendations. The first stakeholder meeting will be held in September 2024 (hybrid meeting). The deadline for abstract submission is 31 May 2024 (www.bipm-cenv2024.org). CCQM is expected to be highly represented in this workshop.

Dr Wielgosz described the new WMO Global Greenhouse Gas Watch (GGGW) programme that had been launched in 2023, and which had received input from the metrology community. This programme will be able monitor greenhouse fluxes world-wide; it will require a more dense measurement network.

There are several CCQM TGs addressing BIPM-WMO 2022 recommendations. The EAWG has a TG related to seawater, the IRWG/GAWG has a TG on carbon dioxide and methane stable isotope ratios, GAWG has TGs on ozone, greenhouse gases, and advanced spectroscopy.

Dr Seitz commented that more interaction with the oceanography is needed; Dr Wielgosz replied that they are currently making good links in this area.

Dr Wielgosz stated that other CCs, such as CCPR, CCT, and CCRI also had relevant activities and would be contributing to the meeting.

6.2 CCQM Workshop on Digital and FAIR Chemical and Biological Reference Data and Certificates: Challenges and Opportunities (C. Gonzalez) [*CCQM/24-35*]

The objective of digitalization is to transform measurement services data to enable machine integration with data sources. This will allow enhanced collaboration and data sharing, expanded access to CRMs and improved data traceability and reducibility. The steering committee for this workshop has met 9 times. The workshop will be held on 9-12 September 2024. Currently, there are 16 different NMIs and standards organizations that will make presentations. The workshop will cover challenges with unique interoperable identifiers, digitalization of CRM certificates, and best practices in developing databases for chemistry/biology data that meet FAIR principles.

Invited panellists will provide 20-minute pre-recorded presentations. During the workshop, panellists will give a 5-minute overview summarizing the main points and then they will participate in discussions.

Dr Melanson asked what resources were required to maintain such a system; Dr Gonzalez responded that the systems initially require a lot of work to setup, but later they would be easier to maintain and reduce errors. Dr Wielgosz mentioned that the speakers would also include industry RM producers, in addition to NMIs. Dr Swart noted that PAWG had communicated with stakeholders in the clinical community who would like to use unique identifiers but there was trouble with defining the measurand.

Dr Gonzalez noted that one of the biggest barriers to adoption is getting agreement from all parties involved. Dr Mester stated that a large portion of the measurements are quite well defined, but that it may take a decade to see return on investment. Dr Park asked how NMIs should prepare and whether they will each be required to have their own platform; Dr Gonzalez replied that perhaps the BIPM Headquarters could host a repository of resources.

The CCQM approved Dr Gonzalez as the CCQM representative to the Forum on Metrology and Digitalization (FORUM-MD).

6.3 Update on CIPM digitalization initiatives (M. Milton) [*CCQM/24-36*]

The SI Digital Framework provides a fully digital representation of the SI; this will facilitate the use of digital certificates and the adoption of FAIR principles. A digital reference is a persistent identifier (PI or PID), which is a long-lasting reference to a document, file, web page, or other object (for example, DOI, ORCID ID).

This includes digital access to shared databases (for example, key comparison database, UTC database) and the BIPM digital references (for example, units, prefixes, defining constants, quantities, decisions, CMCs, measurement services categories). There are external digital references such as ROR, ORCID, InChI, and unit interoperability service (under development). The five-star deployment scheme for open data includes open licenses, machine readable files, open format files, use URIs, and linked open data.

Dr Wielgosz asked how digital references are being used in the physics part of the KCDB; Dr Milton replied that in the physics area, there are approximately 600 measurement service categories and 23,000 CMCs.

Dr Seitz asked if database could include derived units; Dr Milton replied that it already includes some derived units and may include additional derived units in the future; CCU leadership will look at this. Dr Swart asked if digitalized databases could self-update, so that if a CRM expires and CMCs are based on that, the database could communicate that.

6.4 20th May 1875 – Metre convention

The BIPM will celebrate the 150th anniversary of the signing of the metre convention on 19–22 May 2025. On 19 May, the BIPM will host a VIP reception. On 20 May, the UNESCO Headquarters in Paris will host an event with VIP speakers, video tributes, a panel discussion on the future of scientific multilateralism and the launch of the anniversary book. On 21-22 May, there will be an event at the Palais de Congrès de Versailles, highlighting themes from the CIPM strategy, climate, quantum and digital transformation, plus the "new second" and future of metrology technologies. This event will also include an open call for posters to all NMIs.

In addition to these events, the BIPM will publish a book covering the history of BIPM in 150 photographs, La Poste will release a special stamp, and there will be an end of the year event/workshop (December). A website will be launched soon to promote these events.

6.5 Future CCQM Workshop Topics

CCQM will contribute to the 150th anniversary of the metre convention celebrations and activities.

6.6 Report from the JCTLM (G. Miller) [*CCQM/24-37*]

Dr Miller outlined the structure and membership of the Joint Committee for Traceability in Laboratory Medicine (JCTLM), which has 77 member organizations from 20 countries. The JCTLM has review teams for different analytes; it maintains a database of reference materials, reference measurement procedures and reference laboratories that fulfil the ISO requirements. There has been a steady growth of the database over time, though more reference materials are still needed. In recent years, the number of nucleic acid reference materials has substantially increased. An automated online submission and review process is under development with a planned release in 2026. The nomination process will use a web form with required fields, online management and review, followed by online review by the DBWG and EC. Accepted nominations will be included in the database and non-accepted nominations will be able to be edited online for subsequent submission. There is a secondment position available for the development of the JCTLM database at the BIPM Headquarters; the position would last 6 months with a proposed start date of January 2025.

The JCTLM strategy group has recommended that JCTLM increase its visibility and creates a sustainable financial structure. To create the sustainable financial structure, JCTLM will create a tiered membership structure. The first tier would be the executive committee members and the second tier would be paid tier called “Member”. There would also be a free category called “Associate Member”.

The JCTLM has also developed a knowledge transfer group to improve the rate of acceptance for the first submission to the database. This group created a checklist of frequently observed non-compliances with suggestions on how to address these. The JCTLM will also create an eLearning module on the BIPM platform to help increase the number of successful submissions.

Dr Miller also covered shared challenges between JCTLM and CCQM, including a desire to align processes for NMIs/DIs, gaps between JCTLM listed RMPs/CRMs and references needed by the IVD community. He noted that the IFCC WG for Commutability and Metrological Traceability is developing recommendations for simplified commutability assessment of a replacement batch of a CRM.

Dr Wielgosz thanked IFCC for their continued support of the JCTLM and he said he believes the proposed model will be well received. Dr Wielgosz noted that the JCTLM database covers analytes that represent a very high volume of the clinical tests performed in the world, and the Strategy Group has indicated that this was a strong selling point of the database and should be promoted.

Dr Milton noted that the health activity (JCTLM) which already existed provided an excellent of linking to stakeholders and asked if there was a way to get the CIPM to better recognize this work. Dr Park agreed and said that was indeed a successful example of stakeholder interaction that could potentially be reproduced in other areas. Dr Wielgosz noted that the President of IFCC and CIPM are both members of the JCTLM executive committee.

6.7 Report from the IFCC (C. Cobbaert) [*CCQM/24-38*]

Dr Cobbaert presented an overview of the mission of IFCC SD, which is to advance the science of clinical chemistry and to apply it to the practice of clinical laboratory medicine. She detailed challenges that IFCC SD had encountered when attempting to get RMs, RMPs and RMSs adopted. Manufacturers often set their traceability to materials from decades ago. The current IFCC approach to standardization is committee-based standardization; other approaches include market-based standardization and government-based standardization. Dr Cobbaert stated that there is a need for a shared vision, effective governance, strengthening of collaboration between IFCC and measurement institutes, education about metrological traceability and standardization, and successful adoption of RMs/RMSs.

Dr Swart stated that PAWG is happy to work in collaboration with IFCC to measure higher order structure of protein materials. Dr Huggett asked about the best route for dealing with manufacturers refusing to reveal critical test attributes (for example, antigens, PCR primers). Dr Cobbaert suggested that the best route may be through regulators.

Dr Miller noted that we are challenged to provide necessary tools and resources to the IVD industry; meanwhile the IVD industry has difficulty meeting all the regulatory requirements. This issue was discussed at the 2021 JCTLM workshop and discussion with regulatory colleagues must continue.

Dr Wielgosz suggested that if we do have a TG involving health, this TG should consider the recommendations of the JCTLM 2021 workshop , when drawing up its terms of reference.

6.8 Future CCQM activities in support of Laboratory Medicine

Dr Park stated that NAWG, PAWG and CAWG chairs should think about how they can provide additional standardization to support the life sciences and health, as part of the CIPM initiative.

7. REPORTS FROM THE CCQM WORKING GROUPS

7.1 CCQM Working Group on Organic Analysis (CCQM-OAWG) (M. Fernandes-Whaley) [*CCQM/24-17*]

Dr Fernandes-Whaley thanked everyone who had contributed to the OAWG in the last year. The OAWG published four reports in the KCDB; there are currently two reports at Draft B and three at Draft A stage. One comparison is currently under way and three will start in 2025. The OAWG is broadly divided into three areas: sector focus (food, clinical environment), progressing measurement science to underpin organic analysis (qNMR, high resolution mass spec, UoM), and improved stakeholder engagement (ISO, JCTLM). OAWG has classified its comparisons to take into account analyte molar mass and polarity as well as the matrix. For the matrix, in the area of food analysis, they use the AOAC food triangle. By taking these factors into consideration, it is hoped they will cover the range of types of measurands of importance to the WG. The bulk of OAWG members currently perform measurements in support of the food sector. The majority of newly planned CRMs within OAWG member institutes are related to contaminants (74 %). CCQM-K180 measured metronidazole in pork muscle; Draft A from this study has been circulated to members. RMOs are also conducting additional comparisons in food. For the clinical sector, they also consider mass and polarity, and take into consideration medical impact level and harmonization level. OAWG is encouraging its members to create new materials rather than duplicating another NMI's materials. CCQM-K159 covers amino acids in plasma; Draft B is in progress. The OAWG has comparisons under way for the environmental sector (CCQM-K184).

OAWG held a workshop on Advances in Mass Spectroscopy and isotope dilution Mass Spectroscopy (IDMS), which led to a pilot study (track D) proposal, a published update of the dIMS technique and a workshop summary. OAWG has a variety of TGs within the WG covering strategic focus areas (food, clinical, environmental, advancing measurement science and knowledge transfer matrix measurements).

7.2 CCQM Working Group on Inorganic Analysis (CCQM-IAWG) (M. Winchester) [*CCQM/24-13*]

Dr Winchester gave a brief overview of IAWG. It was established in 1997 and the first comparison was CCQM-P1 (Pb in water). The first KC in IAWG was CCQM-K2 (Cd and Pb in Natural Water) in 1998. As of April 2024, IAWG had performed 74 KCs and 106 pilot studies. There are 69 official contact persons, with 40 member institutes in 33 countries. In November 2023, IAWG held a virtual meeting with 78 attendees. For now, the IAWG plans to hold its Q3/Q4 meeting as virtual only.

Dr Winchester stated that IAWG had recently adopted the NIST Decision Tree (https://decisiontree.nist.gov) for KCRV and DoE estimation. CCQM-K160: Platinum Group Elements in Automotive Catalysts was recently published using the decision tree.

IAWG is currently reviewing existing CMCs that are older. 1492 CMCs in the KCDB were approved in or before 2015. 169 of these CMC claims relate to metals and metal alloys, which require XRF. IAWG mainly uses ICP-MS and ICP-OES. Dr Winchester stated that IAWG will have to re-run KCs in this area if the 169 CMC claims are to remain in place.

IAWG is collaborating with CAWG and SAWG to advance particle metrology; there is a joint task group (IAWG/SAWG) on particle measurements. CCQM-P194 (number concentration of colloidal nanoparticles) has been completed; CCQM-K166/210 (nanoparticle number concentration in liquid suspension) is currently under way. Some IAWG members are also participating in the CAWG CCQM-P222 (particles for cell analysis). IAWG held a workshop on measurements of metalloproteins. IAWG is also working on enhancing SI traceability for inorganic analysis, with several KCs and PSs in this area.

Dr Winchester mentioned that the CIPM MRA (CIPM 2021: MRA-G-11, 4j) requires reporting of the degrees of freedom, which is not currently being done, but there is a tutorial from NIST on reporting degrees of freedom. CCQM-K161/P207 (anions in seawater) is currently in the Draft B stage; and three studies in the Draft A stage. Several other studies are also proposed (Non-metallic elements in Copper, Determination of Elements in Pork Powder, Elements in Particulate Matter, Mass Fraction Measurements in Crystallohydrates, Laser Ablation Analysis).

7.3 CCQM Working Group on Gas Analysis (CCQM-GAWG) (P. Brewer) [*CCQM/24-05*]

Dr Brewer noted that a workshop on CO_2 and CH_4 stable isotope ratio measurements was held in conjunction with the October 2023 GAWG meeting. The outcomes from this workshop will be used to inform the terms of reference for the new GAWG TG focused on these measurements. There was also a workshop on green hydrogen (for example, purity requirements for vehicles, challenges for adding hydrogen to national grid). In addition to the Q2/Q4 meetings, the GAWG has separate meetings to discuss comparison results. GAWG has recently spent time on strategic planning to find a system for archiving KCs (older than 15 years or replaced by more recent ones). In general, archived KCs cannot be used for CMCs, but there are two exceptions. GAWG has six TGs currently, with a seventh under way. The 50th GAWG meeting will be held at KRISS 21-24 October 2024.

Dr Park asked how the GAWG was able to manage such a large number of TGs; Dr Brewer replied that fortunately the GAWG had a large membership and that responsibilities for various TGs are shared amongst the members. Dr Wielgosz noted that the GAWG TGs had been quite successful, in part due to having well defined terms of reference, with achievable tasks in reasonable timeframes.

7.4 CCQM Working Group on Isotope Ratios (CCQM-IRWG) (Z. Mester) [*CCQM/24-16*]

Dr Mester gave an overview of the IRWG. The IRWG was established June 2018. IRWG has 39 representatives from 22 NMIs. The April 2024 meeting had 40 participants, with half in person. The objectives of the IRWG are to advance the science, improve comparability and engage stakeholders. The IRWG plans to have two workshops in the next 18 months to engage stakeholders: Intramolecular isotope ratio measurement using NMR, high resolution mass spectrometry (potentially in collaboration OAWG) and non-mass spectrometry based isotope ratio measurement of metals. The IRWG has run several studies including CCQM-P212 Coherence of $\delta^{13}C$ CRMs; CCQM-P213 Copper isotope ratio measurement in high purity materials, CCQM-P204, and CO_2 Isotope Ratios ($\delta^{13}C$ and $\delta^{18}O$) in pure CO_2, together with the GAWG as well as CCQM-P239, CO_2 Isotope Ratios ($\delta^{13}C$ and $\delta^{18}O$) in air that is currently in progress. CCQM-K182/P233 Li delta measurement will begin in 2024.

CCQM-K183/P234, application of gravimetric isotope mixtures for obtaining absolute isotope ratios of copper, is planned to launch in 2025. Further in the future, IRWG also has planned studies on Sr isotope ratios in cereal samples, carbon and nitrogen delta in organics, and compound specific carbon and nitrogen delta measurements in synthetic mixtures. The IRWG had a TG on quantities units and symbols, which was formed in 2022 and completed in 2023. A joint IRWG-GAWG TG on Stable Isotope Ratio Metrology for Atmospheric Source Apportionment of Greenhouse Gases was launched in October 2023.

The next meeting of the IRWG will be at KRISS in October 2024. The April 2025 meeting will be at the BIPM Headquarters and the October 2025 meeting will be at INRIM.

Dr Mester noted that IRWG would like to form a TG on the Isotope Delta Traceability Exception in the CIPM MRA. This TG would devise a process for the selection and upkeep of information on key/primary CRMs. Additionally, IRWG plans to form a CMC TG to develop guidance for the uniform comparable presentation of CMCs for the isotope ratio community.

Dr Mester asked CCQM to approve proposed the TG, to approve the study concepts and to note the necessary revision of Traceability Exception with timelines of 1-2 years. Dr Park confirmed the CCQM's approval of the new task group, noting that any proposed change to the traceability exception, should be presented to the CCQM, which could recommend its modification.

7.5 CCQM Working Group on Surface Analysis (CCQM-SAWG) (A. Shard) [*CCQM/24-15*]

Dr Shard stated that the main focus of the SAWG is technological materials at the nano and micro scale. A primary aim of the SAWG is the accurate measurement of the chemical composition and amount of substance in thin films, layers and coatings from atomic layers to 1 micrometre thickness to support the development of advanced technologies. SAWG often runs parallel studies with VAMAS. The materials used in the SAWG studies are very difficult to procure. As a result, SAWG must carefully consider how KCs will lead to CMC claims (focusing on wide scope claims). SAWG ran a joint study with IAWG, led by LGC (CCQM-K166/P210). CMC claims for K166 will cover particle tracking analysis (PTA), small-angle x-ray scattering (SAXS), single particle ICP-MS (spICP-MS),and scanning electron microscopy (SEM). CCQM-P229 Measurement of amount fractions in Pt_xNi_{1-x} alloy films was also recently completed; initial results look good and depending upon the method, CMCs for a wide range of metal alloy films could be supported, though some methods require RMs. SAWG is focused on obtaining the most relevant measurements for stakeholders, rather than the lowest uncertainty. SAWG also has an upcoming study, CCQM-P230 Measurement of surface elemental amount fraction in ionic liquids. SAWG also has a proposal for a new KC: mesoporous solids. Additionally, Dr Shard mentioned the joint IAWG/SAWG task group on particle metrology.

Dr Brown asked what the measurand was for Raman imaging. Dr Shard replied that they would first establish the ability to measure the composition of miscible polymer blend films using Raman imaging. Dr Brewer asked how well aligned gas absorption would be with GAWG plans; Dr Shard replied that gas absorption typically uses inert gases and does not examine reactivity (which would require another method).

7.6 CCQM Working Group on Protein Analysis (CCQM-PAWG) (C. Swart) [*CCQM/24-03*]

Dr Swart stated that PAWG reached capacity on meeting space for the April 2024 meeting, with onsite participation of members now on the increase. PAWG's scope is the development and validation of reference measurement procedures for purity assessment of high-purity peptide and protein materials suitable for calibration standards and (certified) reference materials, qualitative and quantitative analysis of peptides and proteins in complex biological matrices and biopharmaceuticals, and specialized measurements related to proteins. PAWG is currently updating their strategic plan document and will include food measurement as one of their focus areas. PAWG recently completed three studies: CCQM-K115.c, CCQM-K115.2018, CCQM-P216, and CCQM-P219. In 2024, PAWG plans to run a comparison for the measurement of amylase, lactate dehydrogenase and alanine aminotransferase. PAWG has three internal TGs: peptide and protein purity, peptides and proteins in complex matrices, and protein structure and activity. For the PAWG fire drill study, all laboratories will create their own calibration solutions and these solutions will be sent to a central laboratory for measurement. NRC has volunteered to be the pilot laboratory. PAWG is currently developing internal guidelines for CMC claims. Dr Botha asked about the IFCC-RELA scheme. Dr Swart explained that this is an interlaboratory comparison scheme for reference laboratories active in laboratory medicine. Dr Shard asked how often WGs were expected to conduct fire drill studies? Dr Braybrook replied that the purpose of the fire drill studies is to demonstrate capabilities of each of the WGs so that members could respond in an appropriate time frame in case of another pandemic.

7.7 CCQM Working Group on Cell Analysis (CCQM-CAWG) (J. Braybrook) [*CCQM/24-18*]

Dr Braybrook reviewed the Terms of Reference of the CAWG, along with recent meeting attendance numbers. The CAWG focuses on cell identification, cell quantification, and determination of cell activity and function. CAWG typically has 15 in-person participants with 20 online. CCQM-P217 and CCQM-P205 are in the Draft A report stage. CCQM-P222 results are expected in August 2024 and CCQM-P197 results are expected in May 2024. CAWG hopes to improve stakeholder interactions through focused WG and sub-group activities.

Dr Braybrook proposed a TG for gene delivery systems. This TG would potentially involve NAWG, PAWG, OAWG, IAWG, as well as CAWG. Dr Braybrook noted that one of the recommendations from the "Metrology for Viral systems as molecular tools" was the formation of a CCQM TG on viral vectors.

Dr Wielgosz recommended that the terms of reference for this proposed TG be finalized and circulated to the SPWG for further discussion.

Dr Winchester noted that IAWG is also starting to look at cells in addition to particles. Dr Goenaga Infante suggested a potential stakeholder for the proposed TG would be the European association for nanotherapeutics.

7.8 CCQM Working Group on Nucleic Acid Analysis (CCQM-NAWG) (J. Huggett) [*CCQM/24-21*]

The NAWG focuses on nucleic acid sequences, including modifications and abundance of these sequences. NAWG activities cover several sectors including climate and environment, health and life science, food safety and advanced manufacturing. Dr Huggett reviewed recent NAWG studies: CCQM-K86.d/P133.5 (Quantification and fractional abundance of genomic DNA extracted from a protein matrix), CCQM-K176/P218 (Breast cancer biomarker HER2 copy number variation (CNV)

measurement), CCQM-94.3 (Quantitative analysis of DNA methylation of a defined human genomic DNA region), CCQM-P231 (Species specific meat composition determination of DNA extracted from meat), CCQM-K181/P227 (SARS-CoV-2 RNA copy number quantification) and CCQM-P232 (Fire drill for rapid development of reference methods for PCR). Dr Huggett reviewed the current challenges in RNA measurements. The recently completed CCQM-P232 study measurand was the H5N1 sequence in a buffered solution; this virus is currently spreading in poultry and cattle. Dr Huggett stressed the importance of making the wider community aware of the capabilities of NMIs for nucleic acid measurement. In general, the diagnostic community tends to believe that RMs are not important for qualitative tests, yet clearly the analyte quantity will affect limit of detection, even for qualitative tests. He stated that diagnostics are critical for pandemic response and reference materials assure that diagnostics are working properly. The NAWG proposed several new studies requesting numbers, two KCs (Single Nucleotide Variation (SNV) and Small Deletion in Cancer Biomarker of PIK3CA and EGFR; Relative quantification of viral RNA from whole virus) and one PS (Quantification of RNA copy number in RNA lipid nanoparticles). Dr Huggett noted that NAWG is currently reviewing its strategy document and has prepared a survey to interact with RMOs regarding their potential programmes in nucleic acid analysis. The next meeting of the NAWG will take place at PTB in Berlin in October 2024.

7.9 CCQM Working Group on Electrochemical Analysis (CCQM-EAWG) (S. Seitz) [*CCQM/24-06*]

Dr Seitz noted that EAWG participation is still increasing. He reviewed recent studies conducted by the EAWG, covering pH, coulometry and conductivity. EAWG is asking for approval of two KCs (Tetroxlate and EDTA). There is considerable demand in industry for a higher pH buffer standard. NIST previously had an SRM but it was discontinued in 2016. PTB began a project with partners from industry; primary $Ca(OH)_2$ buffer measurements at PTB showed systematic differences and EAWG believes it would be appropriate to have a pilot study (~2025). Dr Seitz proposed a TG on bio-sensors and requested that participants contact him to discuss potential aims. EAWG has a TG on seawater pH and pH_T values. The aim of the TG is to establish metrological traceability for these measurements. EAWG ran a pilot study on seawater pH and the equivalence of the results was insufficient for the purpose. One major issue with seawater pH is that the Scripps institute is currently the only provider of reference materials but may discontinue these materials soon, due to a faculty retirement. Additionally, the pH measured and that calculated are inconsistent, so that is being investigated. Dr Swart said PAWG would be interested in participating in a TG about biosensors.

7.10 CCQM Working Group on Key Comparisons and CMC Quality (CCQM-KCWG) (A. Botha) [*CCQM/24-14*]

Dr Botha gave a review of CMC claims which peaked at 6632 and then briefly declined due to some NMIs/DIs withdrawing claims, as well as some NMIs making broader scope claims. Service categories were last reviewed in 2009 and are due to be updated; new categories for RNA and DNA solutions have been suggested. Notably, CCQM is the only CC with two uncertainty conventions. Dr Botha reviewed both conventions. Of the 551 newly submitted CMCs that were reviewed in the last cycle, the majority (352) were in the gases category. Dr Botha also suggested that it would be helpful if the database would allow a CMC to be associated with more than one WG.

Currently, there is only one opportunity to revise a CMC at the inter-regional review level; if further revisions are required, it must restart from the beginning. Dr Wielgosz reported that this had been discussed in detail during the KCWG meeting, noting that current practice was to continue review discussions outside of the KCDB system to reach agreement on inter-regional review of some CMCs. He asked if the process within the KCDB system could be modified. Dr Milton replied that this would be a question for the Joint Committee of the Regional Metrology Organizations and the BIPM (JCRB), which had been focussing on reducing the burden on the NMIs involved in CMC review, and that there would be concerns of making more work for the NMIs if multiple revisions are allowed.

Dr Botha reported that the KCWG had started to consider what the strategy should be for ensuring that CMCs are regularly reviewed in the future. One model that had been proposed was to review the CMCs that were supported by newly published comparisons in the year that the comparison result was published. Dr Wielgosz noted that CCQM was getting close to 7000 CMCs, and that if the goal was to have CMCs which were reviewed at least once in every 15 years period, then on average some 500 CMCs should be re-reviewed each year. He asked if the rate of publication of new comparison evidence would be enough for ensuring review of 500 CMCs per year? Another suggestion from the KCWG discussions was to simply grey out or delete CMCs over 15 years old that have not been re-reviewed. Such a policy was likely to lead to NMIs taking appropriate action to re-review CMCs they wished to maintain. Dr Milton stated that the CCQM is doing well relative to other CCs with regard to having a robust re-review system in place and any change in process should ensure that the quality of CMCs and their rereview was maintained.

Dr Swart asked if it would be possible to warn NMIs that their CMCs are greater than 15 years old, before deleting. Dr Winchester noted that the root problem is that there are possibly too many CMCs, as WGs cannot increase the number of comparisons run each year. Dr Park stated that more discussion would be needed before making a decision with regard to older CMC deletion.

7.11 BIPM Headquarters Programme on Metrology in Chemistry (R. Wielgosz) [*CCQM/24-49*]

Dr Wielgosz gave an overview of the BIPM Programme on Metrology in Chemistry, with the department having three different roles: liaison and coordination, comparison coordination, and knowledge transfer. The BIPM's status as an intergovernmental organization, allows links with other similar organizations (for example, Food and Agriculture Organization (FAO), World Health Organization (WHO)), and permitting promotion of metrology activities. The department has had over 80 visiting scientists in the last decade and has set up many joint technical projects. He described some technical highlights from the last year, including a BIPM a paper on a primary facility for CO_2 in air standard comparisons, a paper on quantification of SARS-CoV-2 monoclonal IgG mass fraction by ID-MS, and the publication of the first internal standard reference document for ^{19}F qNMR. This summer the BIPM will host its first qNMR Summer School from 24-28 June 2024 for twelve scientists from NMIs, and with the material available online as eLearning modules in July 2024.

Dr Wielgosz reported that BIPM coordinated CCQM comparisons (in support of GAWG, IRWG, OAWG, PAWG) are planned on a 4-year schedule, following the CCQM 2021-2030 strategy. He gave examples of some of the comparisons that the BIPM was currently coordinating. Preparations for CCQM-115.d (parathyroid hormone 1-84) had involved numerous teams (CDC, IFCC, NRC, LNE, NIBSC) involved in the development of reference methods and materials for this measurand, to ensure that the various activities were linked together. CCQM-P239 ($\delta^{13}C$ and $\delta^{18}O$ in CO_2 in Air) will clarify the current performance of reference measurement systems for atmospheric measurements. As part of

the CCQM-P204 exercise, the BIPM had developed pure CO_2 gas calibration materials for these measurements. There was a demand for these from NMIs, and the CCQM-IRWG had requested that the BIPM formalize the supply of such materials, until NMIs were able to supply these by themselves. As part of their knowledge transfer role, the BIPM had developed a number of eLearning modules (https://e-learning.bipm.org). Dr Wielgosz thanked the visiting scientists that had supported the BIPM headquarters programmes through secondments to the Department, with current opportunities for 2025-2026 described on the BIPM's webpages.

7.12 CCQM Task Group on Guidance for the estimation of a consensus KCRV (CCQM-TG-KCRV) (S. Ellison) [*CCQM/24-50*]

Dr Ellison reviewed the goals of this TG, which was to review and update CCQM guidance note CCQM/13-22 on estimation of a consensus KCRV and associated degrees of equivalence. The TG will make any necessary editorial corrections, update the bibliography, add new and improved statistical procedures, and include worked examples. Dr Ellison noted that KCRV selection is not a linear process. The principal factors affecting KCRV choice are bio/chemical measurement expertise, overdispersion/outliers, and asymmetry. There are currently two task group recommendations. The first recommendation is that the default model should allow for overdispersion because it is common. Additionally, the TG recommends KC reports should include a comment on any overdispersion, including its effect on possible CMC claims (useful to the KCWG). The KCRV has identified the main new issues, identified new tests, identified new graphical tools and received draft text for Section 6 (Choice of estimator). The next steps for the TG are integrating new material, adding an annex on graphical methods, and adding new Bayesian methods. The goal is to have an updated draft by the end of July 2024. After review and revision by the TG, CCQM will be provided the draft, hopefully by Q3/2024.

7.13 CCQM *ad hoc* Working Group on the Mole (CCQM-ah-WG-Mole) (R. Brown) [*CCQM/24-07*]

Dr Brown reminded the participants that the CCU/CCQM Workshop "The metrology of quantities which can be counted" was held in 2023 and the final report is available at https://doi.org/10.3390/metrology3030019. The outputs from that workshop have driven the WG activities during the past year. A CCU Focus Group on Counting and Number Quantities (FG-CNQ) has been formed; this group includes representatives from the CCQM. This FG has reviewed relevant parts of the SI Brochure where changes could improve understanding. The suggestions for these changes were approved by the CCU in April 2024 and will be recommended to the CIPM in June 2024. The process of reviewing the SI Brochure highlighted a discrepancy between the definitions of elementary entity in the SI Brochure and in the IUPAC Gold Book. The SI Brochure states that "an elementary entity may be an atom, a molecule, an ion, an electron, any other particle or specified group of particles." In contrast, the IUPAC Gold Book states that an elementary entity is "any countable object or event, but usually a molecule, an ion or a specified group of atoms." IUPAC has been contacted and a discussion is in progress. A new TG for Units and Quantities for Bioanalysis (TG-UQB) has been proposed. This TG will consult with the wider stakeholder community to identity key units and quantities relevant to CCQM that are commonly used in bioanalysis, review the literature to identify terms used, produce a guidance document and engage with ISO TC12 to publish the document as part of the ISO 80000 series. Additionally, Dr Brown stated that the *mise en pratique* for the

definition of the mole in the SI was last updated and it is now due for review. The terms of reference and the membership of the *ad hoc* WG on the mole will be reviewed during the coming year.

7.14 Approval of proposals for CCQM Comparisons [*CCQM/24-09*]

All submitted comparisons were approved.

8. CC GOVERNANCE AND OPERATIONAL ISSUES

8.1 CCQM Member Review and Applications

IPQ (Portugal) had applied to become a member of CCQM. Dr Botha led a team to review the application, which had recommended to the CCQM President that the application be supported. The CCQM confirmed its support of the application, which will now be forwarded to the CIPM for final decision in its meeting in June 2024.

8.2 Organizations in Liaison with CCQM

No new liaisons to report.

9. REPORTS FROM RMOS

Written reports were received from AFRIMETS [*CCQM/24-11*], APMP [*CCQM/24-24*], COOMET [*CCQM/24-25*], EURAMET [*CCQM/24-22*] and SIM [*CCQM/24-20*].

AFRIMETS – Dr Botha noted that AFRIMETS is running a comparison on pesticides in yellow plum. There is also a capacity building proficiency testing scheme organized towards method development and standardization involving cassava. In February 2024, there was a workshop discussing challenges and improvements related to the proficiency testing scheme. AFRIMETS received support from PTB to perform repeat rounds. This year there are also NMISA proficiency testing schemes for mycotoxins in feed, mycotoxins/pesticides in Macadamias, aflatoxins in peanut slurry, aflatoxins in milk powder, pesticides in avocado and pesticides in watermelon. AFRIMETS is also offering food safety testing courses aimed at NMIs/DIs and major national food monitoring/inspection laboratories.

APMP – Dr Kim stated that APMP had reviewed 107 CMCs in 2024. APMP has several focus groups covering climate change, food safety, and clean water. There is also a joint PT WG between APAC and APMP. APMP conducted a number of comparisons between 2019-2024. There are four new proposals for 2023. APMP is broadening its focus from COVID-19 to public health and currently drafting a document titled “APMP TCQM Strategy to Support Public Health.” APMP has planned a series of workshops on clinical chemistry to promote TCQM activities, including comparisons and knowledge transfer. The next TCQM chair, Dr Tang Lin Teo (HSA), has been elected and her term will begin 1December 2024.

COOMET – Dr Kustikov stated that COOMET has 24 NMIs from 19 Member States. The priority areas from COOMET are climate change and clean air, metrology in medicine, energy efficiency and

food safety. Dr Kustikov was recently elected as TC 1.8 Chairperson during the meeting in 2023. Dr Anna Kolobova was elected as the TC 1.8 Deputy Chairperson and Dr Alena Sobina was elected as the SC 1.8.3 Chairperson. Within COOMET, VNIIM is coordinating three comparisons and VNIIM-UNIIM are coordinating six comparisons. There are eight planned comparisons covering petroleum products, lithium carbonate, purity determination of metallic bismuth, moisture mass fraction in grain, moisture content in wood, aerosols, suspensions and powders and pH/pX of inorganic substances. The next meeting of TC 1.8 Physical Chemistry will be held October 2024 in Russia.

EURAMET – Dr Näykki stated that EURAMET has 35 NMIs and 75 DIs. In 2022, Ukraine and Georgia were accepted as corresponding applicants and they are continuing to be integrated into EURAMET. EURAMET recently released a new white paper called "Metrology for a strong Europe", which identifies four key areas from 2030-2040: green deal, competitive and resilient industry, health, and cohesion and infrastructure (https://www.euramet.org/about-euramet/metrology-for-a-stronger-europe-white-paper) EURAMET TC-MC recently held a three day meeting in the Netherlands. During the last cycle, 134 CMC claims were submitted. EURAMET aims to organize a summer school in 2025 focused on chemistry and bioanalysis. Dr Näykki acknowledged the work of the recently retired Dr Güttler in metrology in chemistry.

SIM – Dr Perez Urquiza reviewed some highlights from the SIM report. The last meeting of SIM was held online in August 2023 with 55 participants. SIM recently completed a number of comparisons in the areas of organic analysis, inorganic analysis, gas analysis, and nucleic acid analysis. Five studies had recently been published: ethanol in aqueous matrix, automotive emissions, natural gas, biogas and elements in natural water. SIM representatives recently participated in the workshop called "Making an impact on water quality for public health and safety" in March 2023 in Malaysia. There were 127 CMC submissions in the last cycle.

10. DISCUSSION AND QUESTIONS ON WRITTEN REPORTS FROM INTERNATIONAL ORGANIZATIONS IN LIAISON WITH THE CCQM

Reports had been received from the International Atomic Energy Agency [IAEA] *(CCQM/24-23*), the European Commission Joint Research Centre [JRC] (*CCQM/24-19*), the International Union of Pure and Applied Chemistry [IUPAC] (CCQM/24-27), ISO TC/334- Reference Materials (*CCQM/24-12*), Cooperation on International Traceability in Analytical Chemistry [CITAC] (*CCQM/24-10*), and the International Federation of Clinical Chemistry and Laboratory Medicine [IFCC] (*CCQM/24-38*). Dr Park invited representatives to comment briefly on their written reports.

International Atomic Energy Agency [IAEA] [*CCQM/24-23*]

Dr Carmin noted that IAEA had participated in both KC and P studies within the IAWG, OAWG, GAWG, IRWG. The IAEA is the custodian of carbon isotope delta scale, and consensus on the scale definitions was recahed at the 2024 IAEA Consultancy Meetings that took place in January 2024. IAEA had worked in collaboration with BIPM on CO_2 standards. Within IAEA project INT7020, a training centre had been established in Argentina. There are two other training centres under discussion in Singapore and Africa.

European Commission Joint Research Centre [JRC] [*CCQM/24-19*]

Dr Koeber stated that JRC had reorganized in 2016 and at that time, many of it CMCs were withdrawn. In 2021, JRC was reinstated as an associate of EURAMET, and they are currently working to reinstate some CMCs, though it will be significantly fewer CMCs than they had prior to 2016. JRC has members in various WGs, strong collaborations with IFCC, ISO TC 334, and JCTLM. They are continuing dissemination of RMs, focusing on *in vitro* diagnostics, food safety, food authenticity and environmental analysis. JRC will soon have a new RM for microplastics in water.

Dr Swart asked if JRC intend to obtain CMCs in protein and peptide analysis. Dr Koeber replied that JRC does intend to obtain CMCs in this area. Dr Mester asked if JRC will obtain CMCs in isotopes; Dr Koeber stated that JRC stopped activities in this area many years ago and they do not intend to resume these activities.

International Union of Pure and Applied Chemistry [IUPAC] [*CCQM/24-27*]

Dr Ellison highlighted some areas of interest from the written report. The IUPAC general assembly recently elected new officers and had reorganized its structure to put more emphasis on science. IUPAC have several diversity related activities, including a Global Women's Breakfast. There is a call for proposals for the top ten emerging technologies in chemistry. IUPAC also has several metrology related projects: IUPAC Brief Guide to Metrological Terms in Chemistry, IUPAC/CITAC Guide for interlaboratory comparison of nominal (qualitative) and ordinal (semi-quantitative) characteristics of a substance or material, and terminology and definitions of quantities related to isotopic analyses. Dr Ellison also mentioned two recent IUPAC publications.

ISO TC/334 - Reference Materials [*CCQM/24-12*]

Dr Botha reminded the participants of the structure of ISO/TC 334. The committee is in the process of transforming ISO Guides to ISO standards. ISO 33401 (previously ISO Guide 31) Reference Materials – contents of certificates, labels, accompanying documentation was recently published and several other projects are under way. There will be an online EURACHEM/CITAC workshop on 19 September 2024, "Production of Qualitative Reference Materials."

Cooperation on International Traceability in Analytical Chemistry [CITAC] [*CCQM/24-10*]

Dr Mester discussed the 2024 CITAC paper awards; the aim of the nomination is to highlight three important papers in the field of metrology in chemistry published in a peer reviewed journal. Since 2007, 43 papers have received the award. This year the winning papers are "Label-free quantification of host cell protein impurity in recombinant hemoglobin materials," "Clinically and industrially relevant incurred reference materials to improve analysis of food allergens, milk, egg, almond, hazelnut and walnut" and "Calibration model averaging in chemical analysis: a case study for the method of standard additions." The CITAC Best Paper Award live presentation will be broadcast on YouTube and Zoom in June 2024. The nomination deadline for the 2025 awards is 31 December 2024.

11. CCQM MEETINGS

11.1 CCQM WG meetings to be held in 2024

The IRWG and GAWG will meet 21-24 October 2024 at KRISS (Daejeon, South Korea). The NAWG, PAWG and CAWG will meet 7-11 October 2024 at PTB (Berlin, Germany). No other WGs were planning to meet in person for the remainder of 2024.

11.2 Dates CCQM meetings in 2025 and 2026

The 30th meeting of CCQM will be held in the week of 7-11 April 2025, at the BIPM Headquarters.

The 31st meeting of CCQM will be held in the week 13-17 April 2026, at the BIPM Headquarters.

12. CLOSING REMARKS FROM THE CCQM PRESIDENT

Dr Park noted that hybrid meetings are allowing better attendance and are running very smoothly now. He noted that all WGs are doing an excellent job following the CCQM strategic plan. He stated that there were some changes of WG chairs in the last year and the new chairs are doing an excellent job. He thanked the chairs and the members for their commitment. Dr Park also thanked the BIPM Director and BIPM staff.

Dr Milton said that he would pass on the appreciation to the BIPM staff. Dr Milton and Dr Park both wished everyone a safe journey home.

DECISIONS AND ACTIONS FROM THE 29TH MEETING OF THE CCQM

1. The CCQM **approved** the report of the 28th Meeting of the CCQM.
2. **Action:** CCQM President will ask other Consultative Committee Presidents to designate representatives to the CCQM Task Group on Food Metrology.
3. The CCQM **approved** a 12-month extension for the CCQM Task Group on Metrology for Pandemic Preparedness.
4. The CCQM **approved** a 12-month extension for the CCQM Nano- and Microplastics Measurements and Standards Task Group.
5. The CCQM **agree**d that Dr Gonzalez be made the CCQM representative of the CCQM to the Forum on Metrology and Digitalization (FORUM-MD).
6. **Action**: Dr Braybrook to provide draft terms of reference for a CCQM Task Group for gene delivery systems, for SPWG consideration.
7. **Action**: Working Groups Chairs interested in a potential Task Group on Bio-sensors should email Dr Seitz to discuss potential aims.
8. **Action**: Dr Brown to review terms of reference and members of the ad hoc WG on the mole
9. The CCQM supported IPQ's (Portugal) application to become a member of the CCQM. This matter will be tabled at the CIPM meeting in June 2024 for final decision.
10. The CCQM **approved** the following proposals for new Key Comparisons (KC) and stand-alone Pilot Studies (P) as presented in document CCQM/24-09:

    - EAWG: pH of a teraoxalate buffer (KC);
      Assay of EDTA (KC);
    - GAWG: Stack emission gases (repeat) (KC);
      SO_2 in air (KC);
    - IAWG Elements and anions in urban particular matter (KC);
      Elements in pork (KC);
    - NAWG: Quantification of particle size, RNA copy number, and RNA encapsulation in RNA LNPs (P);
      SNV/INDEL (KC);
      Relative quantification of viral RNA from whole virus (KC);
    - CAWG: Number concentration measurement of particles for cellular analysis (P);
      Membrane intact E.Coli (KC);
    - PAWG Measurement of the catalytic concentration of clinical enzymes (AMY LDH ALT) in serum (KC)
    - SAWG Specific adsorption, specific surface area, specific pore volume and pore diameter of nanoporous Al2O3(KC);

Any additional proposals for new comparisons should be submitted for SPWG review in the intervening period before the next CCQM Plenary meeting.