CCEM WGRMO Chair Report

March 2019

Dr Ilya Budovsky
Chair, CCEM-WGRMO

Bureau International des Poids et Mesures

Objectives of the WGRMO

- establish and maintain **lists of service categories**, and where necessary **rules for the preparation of CMC entries**;
- agree on detailed technical **review criteria**;
- develop **“lower limits” of uncertainties** for CMCs in those cases, where these are imposed by the characteristics of the device under test;
- provide **guidance on the range of CMCs** supported by particular KCs and SCs;
- identify areas where **additional KCs and SCs** are needed;
- coordinate the **sharing of the inter-RMO review** of new CMCs between the RMOs;
- coordinate the **review of existing CMCs** in the context of new results of KCs and SCs;
- **harmonize procedures and activities among the RMOs**; and
- strengthen the **cooperation between the RMOs**.

Members of the WGRMO

representatives of the RMOs;

chairpersons of WGLF and GT-RF;

the executive secretaries of the CCEM and the JCRB; and

the KCDB manager.

Informal meeting 7July 2018 – 23 attendees
March 2019 meeting – 26 attendees

Bureau International des Poids et Mesures

Agenda of CCEM WGRMO Meeting held on 26 March 2019

1. Introductions and welcome
2. Update from the last meeting (informal meeting on 7 July 2018)
3. CCEM WGRMO Chair's Report
4. CIPM MRA Review and update from JCRB
   a. Update from JCRB
   b. Overview of CIPM MRA Review and CCEM Input
   c. KCDB 2.0 - demonstration and discussion
   d. Criteria of acceptance of CMCs in Electricity and Magnetism
   e. Strategic planning of comparisons
5. Service Categories in Electricity and Magnetism
   a. Update on Categories 8 and 9
   b. Currency of EM service categories
   c. Proposals for new and updated service categories
   d. Periodic review of existing CMCs
6. News from RMOs
7. Terms of Reference for CCEM WGRMO
8. WGRMO Chair for 2019-2020
9. AOB
10. Close and Date of Next Meeting

CCEM WGRMO Chair's Report

Main Tasks:

1. Implement and lead the sampling strategy for Inter-RMO Reviews of Calibration and Measurement Capabilities (CMCs)
2. Oversee the transformation of Categories 8 and 9
3. Support the transition to KCDB 2.0
4. Support CCEM Input to the Review of CIPM Mutual Recognition Arrangement (CIPM MRA) http://www.bipm.org/en/cipm-mra-review/

Other Important Activities:

- Informal Meeting of WGRMO (Paris 7 July 2018)
  - CCEM Contribution to MRA Review
  - Update from the 4th Meeting of the Presidents of the Consultative Committees
  - CMC Service Categories in Electricity and Magnetism
  - Revision of categories 8 and 9
  - Proposals for any new and updated Service Categories

CCEM MRA Review

The CIPM MRA review made recommendations regarding:

1. Managing key comparisons.
2. Visibility of services and consistency of expression to be addressed in the web-based KCDB 2.0.
3. Dealing with the proliferation of CMCs.
4. Improve the efficiency of CMC review, using for example a risk-based approach, and harmonizing the evidence requirements.

http://www.bipm.org/en/cipm-mra-review/

CCEM MRA Review – Contributions from WGRMO

- CCEM had been the first consultative committee to introduce the risk-based strategy for CMC reviews, moving from 400% review to, according to agreed criteria, less than 100%.
- Simplification of existing CMCs to one entry per sub-sub category where possible, now mandatory for new CMC claims.
- New CMCs must follow the simplified CMC format - only one set of RMO CMCs at a time to be in the review process.
- Recasting categories 8 and 9 to better fit industry practice.
- *Electricity and Magnetism Supplementary Guide for the Submission of CMCs* version 5.0

Managing key comparisons

CCEM Response: Critical review of the CCEM Key Comparisons

- No new Key Quantities since 2002
- Repetition period slightly extended: 10 → 15 years
- Sharing of coordination work among multiple NMIs
  - CCEM-K5 on primary power is coordinated by CENAM, PTB, and VSL
- Implement scientific advances in the field: quantum standards
  - 100 Ω resistance and 10 V zener reference comparisons likely will not be organised anymore at CCEM level, given the on-site Josephson voltage and Quantum Hall resistance comparisons

  ⇒ CCEM community benefits from crucial role played by the BIPM
- Strategic Planning of Caparisons – to be discussed at this meeting

Web-based KCDB 2.0

The CCEM 2011 and subsequent meetings strongly recommended to transform the present KCDB

Nov. 2016 – Detailed description of CCEM and APMP TCEM review process provided to KCDB Administrator

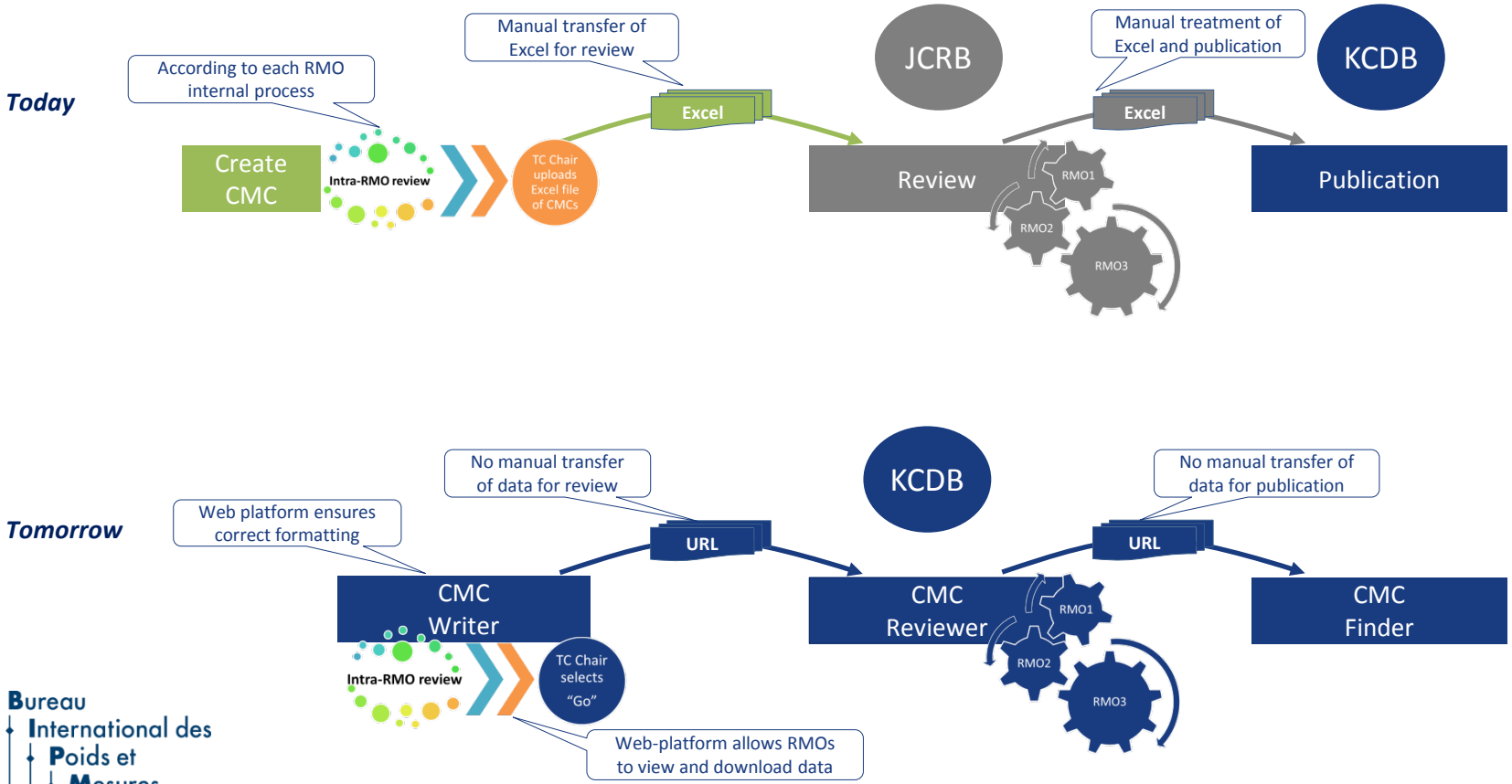
Mar 2017 – Requested s that KCDB 2.0 provides support for the affective nd efficient (risk-based) sampling strategy of inter-RMO reviews of CMCs employed by the CCEM WGRMO

2017-2019 - WGRMO Chair working with KCDB Administrator to solve issues as they arise.

Recommendations on KCDB

- Broad scope CMCs
- Harmonize units
- ‘Effective and efficient’ review (risk-based review)

KCDB 2.0 – *General concept*



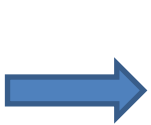
Bureau International des Poids et Mesures

Realisation of the KCDB 2.0

- KCDB 1.0 + JCRB restricted web + intra-regional + « Extra »
  - CMC platform
    - User accounts
  - Comparisons
  - Statistics
  - Numerical filter for CMCs
  - Implementation of Elasticsearch (to replace Exalead)
    - synonym finder (thesaurus)

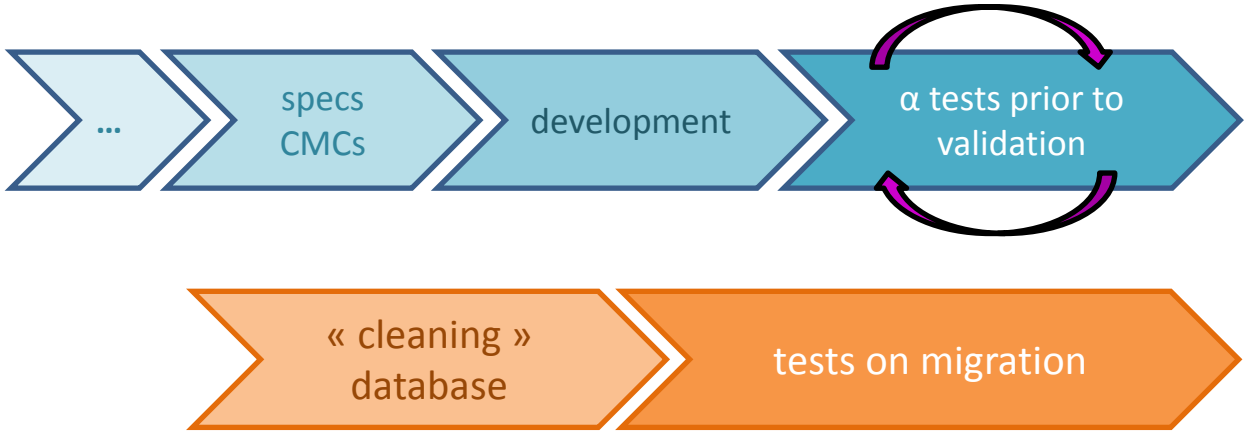
Realisation of the KCDB 2.0

- Migration of data
  - All tests are made on migrated data
  - Migration made via software that is refined successively
    - e.g. for uncertainty « 8 to 50 » will be separated
    - equations to be identified
    - solve issues for non-numerical information

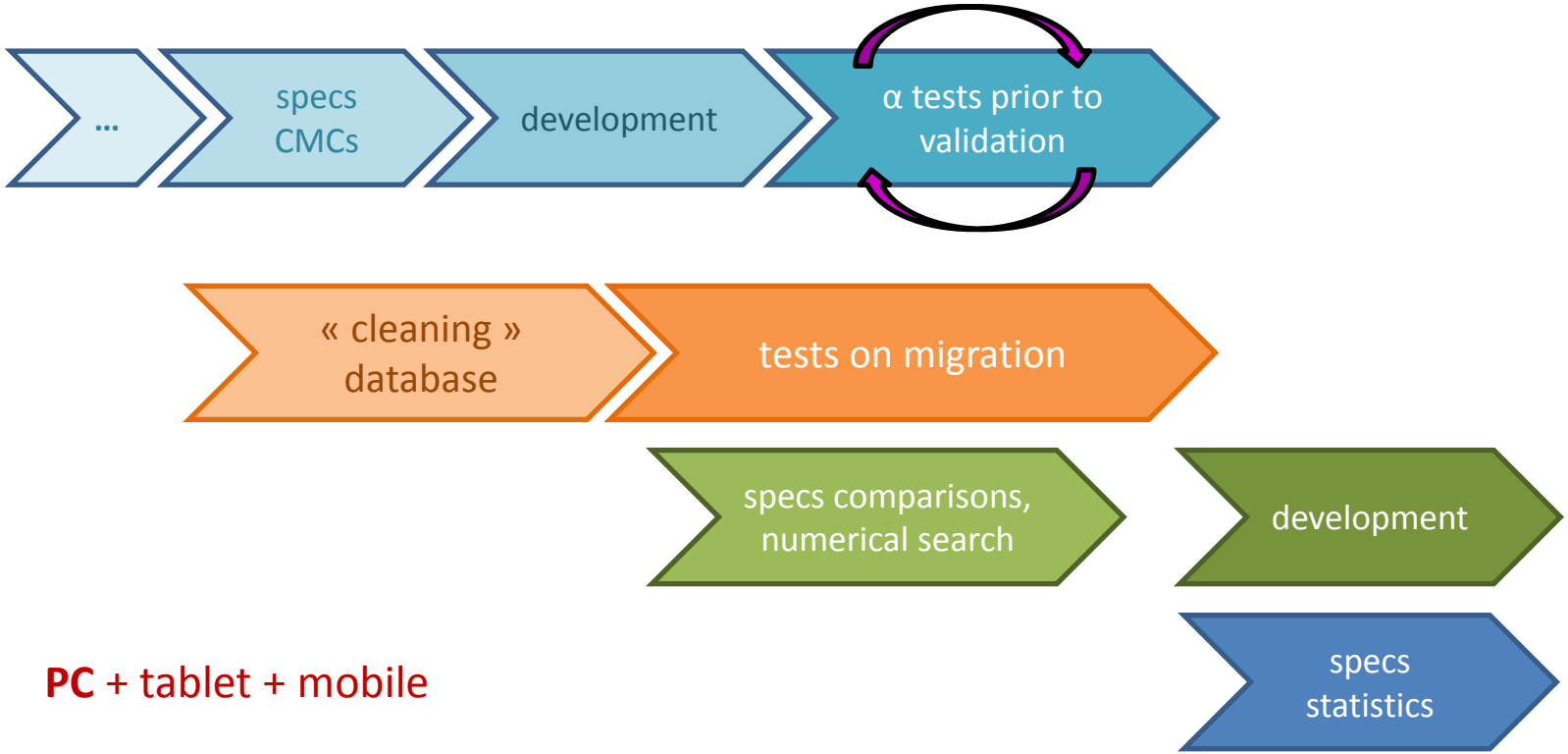
- New database SQL  
  - Merge 2 databases [CMC (PH, IR, QM) and Comparisons]

Realization of the KCDB 2.0

Realization of the KCDB 2.0

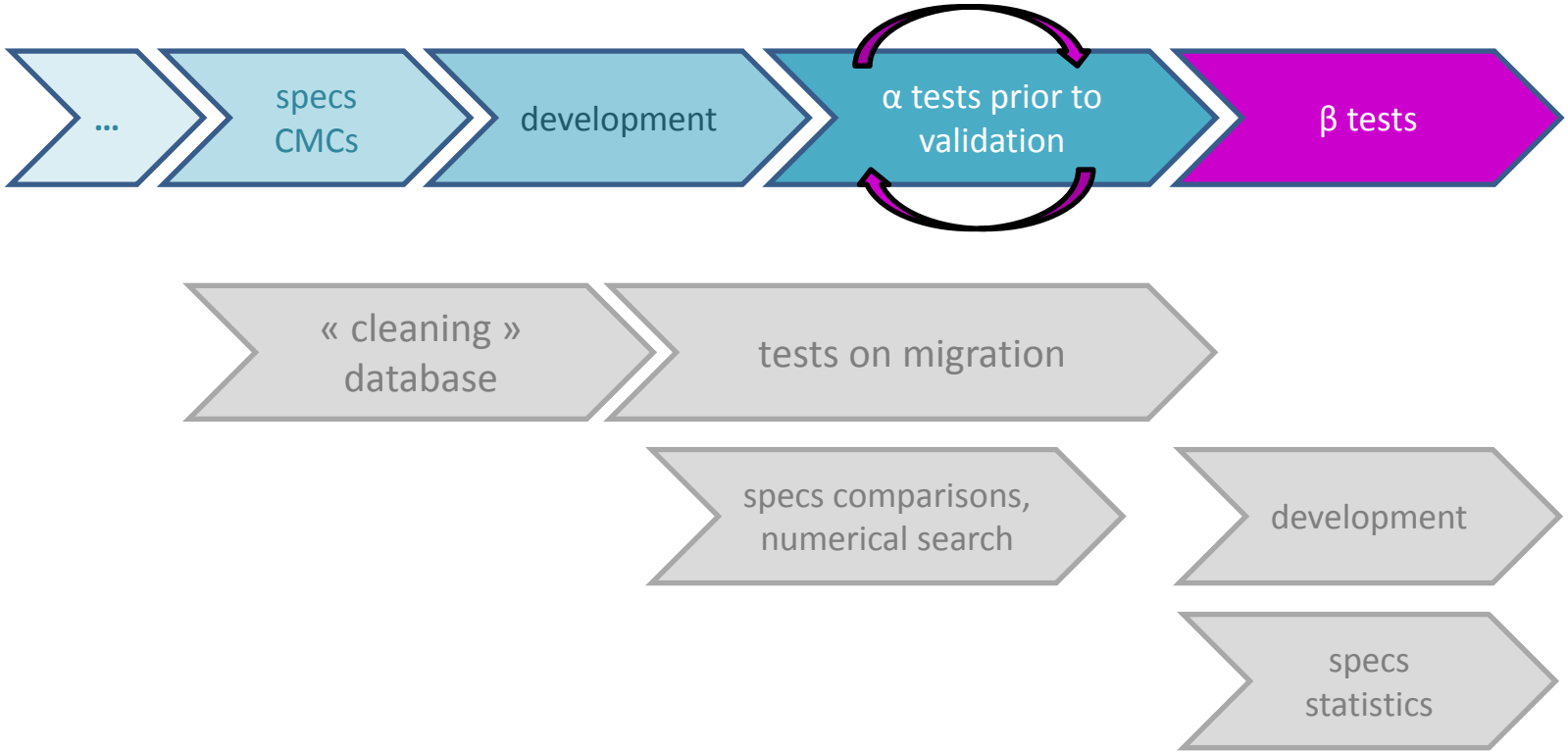


Realization of the KCDB 2.0

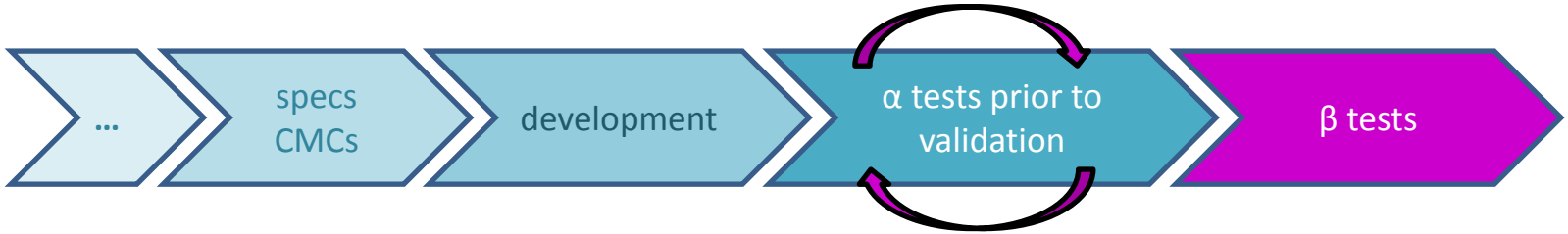


PC + tablet + mobile

Implementation of the KCDB 2.0



Implementation of the KCDB 2.0



CCT

CCQM

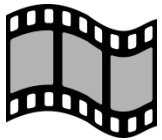
Tests with CCEM

CCRI

Action 2 - Susanne to approach WGRMO Chair and RMO TC Chairs when CCEM "beta" review of KCEB2.0 is required.

Implementation of the KCDB 2.0

Information

- Video clips 
- User manual 
- Demonstrations at Consultative Committee meetings

Implementation of the KCDB 2.0

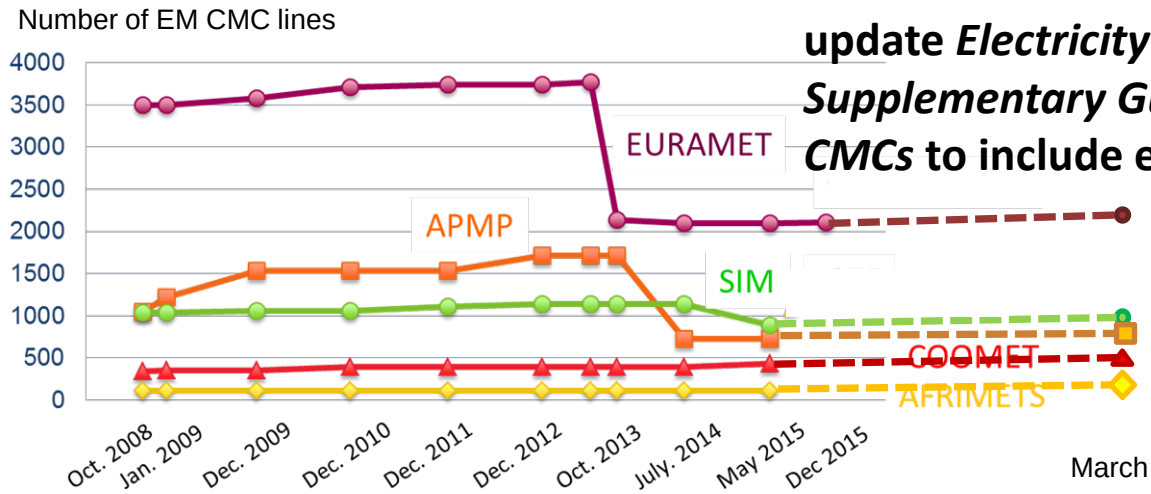
Decision 2 - RMOs to continue CMC review process as usual. However they should consult the KCDB coordinator before submitting CMCs for review to check for updated timing of KCDB2.0 introduction.

KCDB 1.0 → KCDB 2.0 Go Live

adding data to KCDB 1.0 → migration

JCRB web

Dealing with the proliferation of CMCs



March 2019

Action 1 - Michael and new WGRMO chair to update *Electricity and Magnetism Supplementary Guide for the Submission of CMCs* to include examples of matrices.

✓ Little growth in the number of CMC lines

RMO	May-15	Mar-19
AFRIMETS	114	122
APMP	728	796
COOMET	436	463
EURAMET	2096	2112
SIM	882	873
GULFMET	0	0
Total	4256	4366

Bureau International des Poids et Mesures

Improving the efficiency of CMC review

Sampling Strategy for Inter-RMO Review of CMCs:

- CCEM 2015 recommended to further reduce the volume of Inter-RMO reviews based on sampling

Prior to CCEM 2011:

Up to 400% review (Four RMOs each reviewing the entire set)

↓

Since CCEM 2011:

100% review (2-4 RMOs collectively reviewing the entire set)

↓

After CCEM 2015:

0 - 100% review (based on sampling)

Bureau International des Poids et Mesures

Improving the efficiency of CMC review

Sampling Strategy (continued):

CCEM 2015 Decision:

Upon submission of a CMC set, a proposal for the scope of Inter-RMO review is made by the Chair of WG-RMO or designate, based on agreed criteria such as:

- Magnitude of change
- History of previous reviews
- Coverage by on-site technical reviews
- Rotation
- High-level technical judgement

The final decision on the scope of review lies with RMOs.

Improving the efficiency of CMC review

Implementation of Sampling Strategy Example

EURAMET.EM.15.2018

No	Country (NMI)		Entries in category																									
	Contact		1		2		3		4		5		6		7		8		9		10		11		12		Sum		
			entry	matrix																									
AT	Austria (BEV)	new													8	2											8	2	AFRIMETS
	wolfgang.waldmann@bev.gv.at	improved													4												4	0	APMP
		minor ch.																									0	0	COOMET
		delete																									0	0	EURAMET
BE	Belgium (SMD)	new																									0	0	SIM
	dana.vlad@economie.fgov.be	improved	1	1																							1	1	GULFMET
		minor ch.																									0	0	
		delete																									0	0	
BG	Bulgaria (BIM)	new							1	1																	1	1	
	a.yovcheva@bim.government.bg	improved							2	2																	2	2	
		minor ch.																									0	0	
		delete																									0	0	
CH	Switzerland (METAS)	new							1	1	2	1	2	1			2						1				8	3	
	markus.zeier@metas.ch	improved									4	4											3	3			7	7	
		minor ch.																					3	2			3	2	
		delete																									0	0	
CZ	Czech Republic (CMI)	new																							1		1	0	
	jstreit@cmi.cz	improved							7	6	4	2									4	2	2	2			17	12	
		minor ch.																			2		1				3	0	
		delete																									0	0	

Bureau International des Poids et Mesures

Improving the efficiency of CMC review

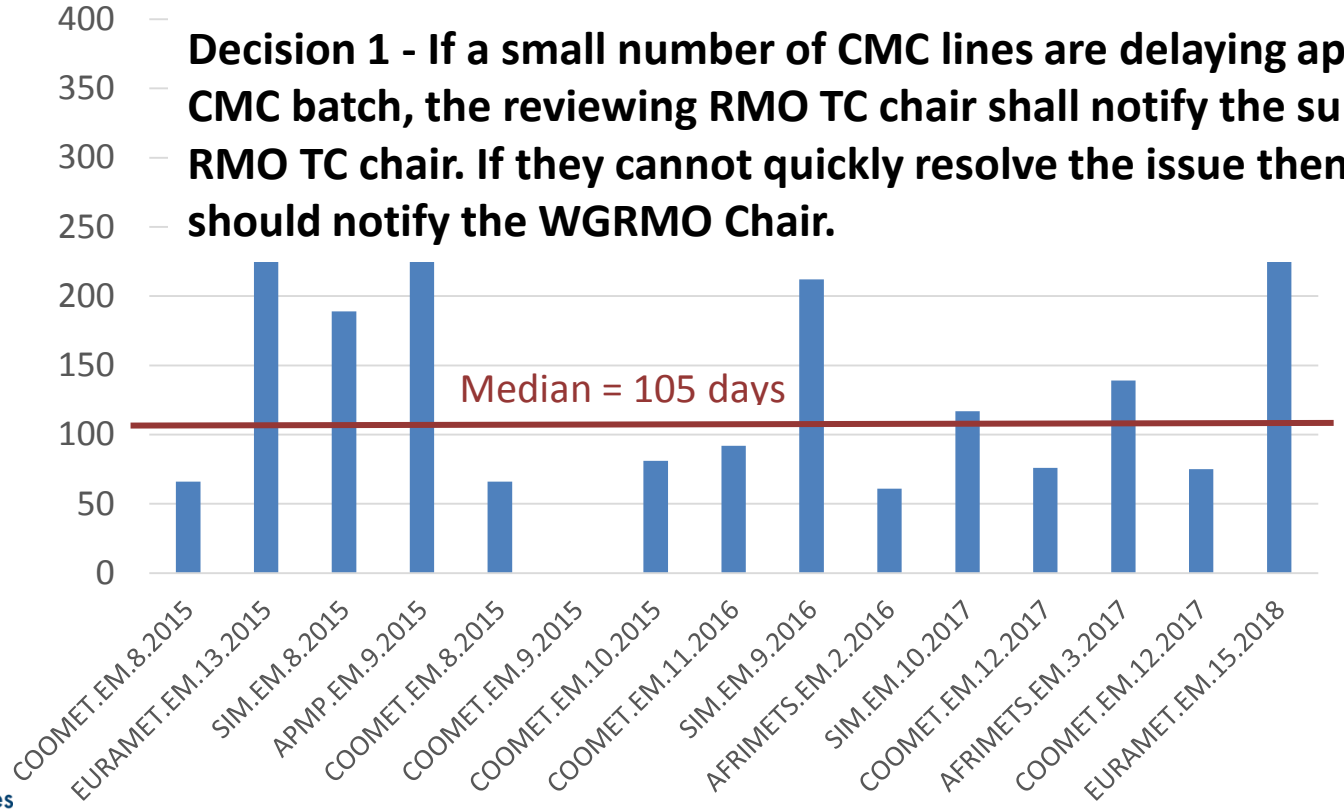
CMC Reviews in 2015-2019 - Implementation of Sampling Strategy

		AFRIMETS	APMP	COOMET	EURAMET	SIM	GULFMET	Notes
Sharing	AFRIMETS.EM.1.2013		No	Yes	Yes	No		1 lab only (NIS - Egypt)
	APMP.EM.7.2011	Yes		No	Yes	Yes		CMCs from 9 NMIs
	APMP.EM.8.2013	Yes		Yes	Yes	Yes		CMCs from 5 NMIs
	COOMET.EM.6.2013	Yes	Yes		No	No		1 NMI (Belarus - BelGim)
	COOMET.EM.7.2014	Yes	No		Yes	No		CMCs from 5 NMIs,
	EURAMET.EM.8.2012	No	Yes	Yes !		Yes		CMCs from 15 NMIs
	EURAMET.EM.12.2014	Yes	Yes	No		Yes		CMCs from 18 NMIs,
	SIM.EM.7.2014	Yes	No	Yes	No			1 NMI (INTI - Argentina)
Samling and Sharing	COOMET.EM.8.2015		Yes			Yes		2015-03-16 - 2015-05-21
	EURAMET.EM.13.2015	Yes	Yes			Yes		2015-08-31 - 2016-04-21
	SIM.EM.8.2015			Yes	Yes			2015-10-23 - 2016-04-29
	APMP.EM.9.2015			Yes		Yes		2015-12-21 - 2016-12-05
	COOMET.EM.8.2015		Yes			Yes		2015-03-16 - 2015-05-21
	COOMET.EM.9.2015							2015-12-21 - Re-submitted using matrices
	COOMET.EM.10.2015	Yes	Yes					2016-01-04 - 2016-03-25
	COOMET.EM.11.2016							2016-06-07 - 2016-09-07
	SIM.EM.9.2016		Yes	Yes	Yes		Yes	2016-10-04 - 2017-05-04
	AFRIMETS.EM.2.2016					Yes	Yes	2016-10-05 - 2016-12-05
	SIM.EM.10.2017				Yes			2017-02-03 - 2017-05-31
	COOMET.EM.12.2017					Yes	Yes	2017-04-05 - 2017-06-20
	AFRIMETS.EM.3.2017		Yes	Yes		Yes		2017-05-26 - 2017-10-12
	COOMET.EM.12.2017				Yes			2017-11-21 - 2018-02-04
	EURAMET.EM.15.2018	Yes	Yes	Yes		Yes	Yes	2018-04-20 - presented for approval 2019-02-13

Bureau International des Poids et Mesures

CMC Review Duration since the Introduction of Sampling and Sharing (days)

Decision 1 - If a small number of CMC lines are delaying approval of a CMC batch, the reviewing RMO TC chair shall notify the submitting RMO TC chair. If they cannot quickly resolve the issue then they should notify the WGRMO Chair.



Bureau International des Poids et Mesures

Improving the efficiency of CMC review

Sampling Strategy - Lessons Learnt

1. The sampling strategy is a good working compromise between fairness and simplicity.
2. Deciding on the CMCs to review requires high level of judgement.
3. No redundancy remains in the process – delays in submitting reviews mean that critical reviews are not completed in time.
4. Higher impact of review decisions.
5. Some CMC entries continue to be amended and a small number rejected as a result of the review. This indicates that the Inter-RMO review is still essential and the balance presently achieved by the CCEM is close to optimal.

Recasting Service Categories 8 and 9

2017 Decision 9: WGRMO agreed on the time line for the implementation for the revision of the high voltage CMCs in the KCDB:

- RMO will provide comments to the Ad hoc Working Group final draft within 2 months.
- The Ad Hoc Working Group will then produce the final version of service categories 8 and 9 in 2 months' time.
- The RMOs and NMIs are to approve the revised service categories in a month's time.
- The Ad Hoc Working Group will reformat the high voltage CMC entries for the NMIs and obtain their approval in 10 months' time for uploading to the KCDB.
- The migration of the existing high voltage service categories to the revised version is expected at the commencement of KCDB 2.0, due around July 2018**.**

Thank you to the Task Group:
Jari Hällström (VTT), Anders Bergman (RISE), Daniela Istrate (LNE), Yi Li (NMIA), Shao Haiming (NIM), Susanne Picard (BIPM), Ilya Budovsky (NMIA)

Bureau International des Poids et Mesures

Issues addressed at the 2019 Meeting

- Embrace KCDB2.0 – live demo at this meeting
- MRA Review Implementation – how are we travelling?
- Acceptance of CMCs – how many comparisons are needed?
- CMC Service Categories – how many CMCs and CMC categories are needed
- Periodic review of CMCs?
- New CMC categories
- New WGRMO Chair

How to support acceptance of CMCs?

CIPM MRA-D-04 :

CMCs submitted for review must be consistent with information from some or all of the following sources:

1. Results of key and supplementary comparisons
2. Documented results of past CC, RMO or other comparisons (including bilateral)
3. Knowledge of technical activities by other NMIs, including publications
4. On-site peer-assessment reports
5. Active participation in RMO projects
6. Other available knowledge and experience

The problem

In the absence of comparisons different decisions can be made by reviewers in similar circumstances.

Solutions:

- Strategic planning of comparisons – presentation from Euramet (Luca)

Analysis: past and ongoing

Category	Quantity	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
2	**DC resistance**																				
2.1	DC resistance standards and sources																				
2.1.1	low values (<= 1 Ω)																				
2.1.2	intermediate values (> 1 Ω to 1 MΩ)	BIPM.K12, K13				K10		K10		BIPM.K12, K13											
							S18														
2.1.3	high values (> 1 MΩ)	K2							K2					K2.1		K2.2012					
		S15											S32								
2.1.4	standards for high current																				
2.1.5	multiple ranges																				
2.1.6	temperature, power and pressure coefficients																				
2.2	DC resistance meters																				
2.2.1	low values (<= 1 Ω)																				
2.2.2	intermediate values (> 1 Ω to 1 GΩ)																				
2.2.3	high values (> 1 GΩ)																				
2.3	DC resistance ratios																				

Analysis – connection with CCEM strategic plan

Category	Quantity	< 19	CCEM/17-12 Strategic Document	
			Comparisons	Scheduled for
2 DC resistance				
2.1 DC resistance standards and sources				
2.1.1 low values (<= 1 Ω)				
2.1.2 intermediate values (> 1 Ω to 1 MΩ)		K1	CCEM-K1 1 ohm, 10 kohm	
2.1.3 high values (> 1 MΩ)			CCEM-K2 10 Mohm, 1 Gohm	
2.1.4 standards for high current				
2.1.5 multiple ranges				
2.1.6 temperature, power and pressure coefficients				
2.2 DC resistance meters				
2.2.1 low values (<= 1 Ω)				
2.2.2 intermediate values (> 1 Ω to 1 GΩ)				
2.2.3 high values (> 1 GΩ)				
2.3	DC resistance ratios			

Analysis – EURAMET needs

Category	Quantity	EURAMET TC-EM Comparison Strategy	
		EURAMET Plan for comparison	Analysis
2 DC resistance			
2.1 DC resistance standards and sources			
2.1.1	low values (<= 1 Ω)	No	Use BIPM.EM-K13.a for 1 ohm, technically not feasible for lower values (EUROMET.EM-S22 failed)
2.1.2	intermediate values (> 1 Ω to 1 MΩ)	No	Use BIPM.EM-K12, BIPM.EM-K13 (1 ohm, 10 kohm) (QUESTION: Would we need 100 ohm comparison?)
2.1.3	high values (> 1 MΩ)	2022	EURAMET.EM-K2
2.1.4	standards for high current	No	Technically not feasible (EUROMET.EM-S22 failed)
2.1.5	multiple ranges	No	
2.1.6	temperature, power and pressure coefficients	No	
2.2 DC resistance meters			
2.2.1	low values (<= 1 Ω)	No	From 2.1.1
2.2.2	intermediate values (> 1 Ω to 1 GΩ)	No	From 2.1.2
2.2.3	high values (> 1 GΩ)	No	From 2.1.3
2.3	DC resistance ratios	No	

What we are stating with this analysis

- Some CMC sub-sub-categories
  cannot have a comparisons for technical reasons

- The large part of CMC sub-sub-cat are not **in need** for a comparison
  - because they're covered by comparisons in other entries
  - because they're considered "easy" measurements
  - because the s.s.c is marginal
  - (because it's not realistic that anybody will organize it?)

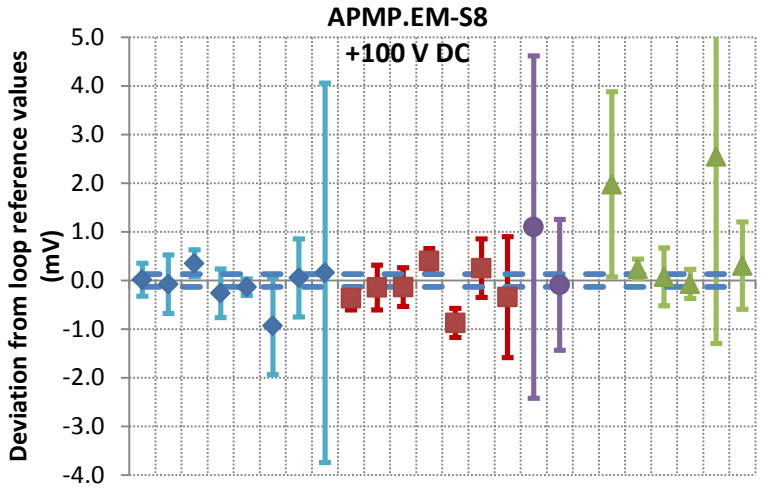
- A few CCEM key comparisons are considered **not anymore necessary**
  - probably nobody will organize the corresponding EURAMET KC

The problem (continued)

In the absence of comparisons different decisions can be made by reviewers in similar circumstances.

Solutions:

- Strategic planning of comparisons – presentation from Euramet (Luca)
- Where comparisons are not possible:
  - State of the art service
  - Too hard to organise/ not in the RMO plan
- Top service for a developing NMI
- Hybrid comparisons



Bureau International des Poids et Mesures

Actions to address the issue:

Action 3 - The existing working group (Ilya, Lucas, Marko, Nobu and Gert) to provide draft of *CCEM Supplementary Guidelines for the Acceptance of Calibration and Measurement Capabilities*, including case studies, by the 2020 meeting.

Action 4 - RMOs to continue developing strategic plans for EM comparisons.

Action 5 - JCRB Secretary to request information from other CCs on their guidance on what evidence is required to support CMCs.

Decisions from the 2019 Meeting of CCEM-WGRMO

Decision 1 - If a small number of CMC lines are delaying approval of a CMC batch, the reviewing RMO TC chair shall notify the submitting RMO TC chair. If they cannot quickly resolve the issue then they should notify the WGRMO Chair.

Decision 2 - RMOs to continue CMC review process as usual. However they should consult the KCDB coordinator before submitting CMCs for review to check for updated timing of KCDB2.0 introduction.

Decision 3 – WGRMO to hold a meeting in August 2020 at the time of CPEM2020.

Dr Lucas Di Lillo, presently SIM TCEM Chair, will be the Chair of CCEM-WGRMO until March 2021.

Actions from the 2019 Meeting of CCEM-WGRMO

Action 1 - Michael and new WGRMO chair to update *Electricity and Magnetism Supplementary Guide for the Submission of CMCs* to include examples of matrices.

Action 2 - Susanne to approach WGRMO Chair and RMO TC Chairs when CCEM "beta" review of KCEB2.0 is required.

Action 3 - The existing working group (Ilya, Lucas, Marko, Nobu and Gert) to provide draft of *CCEM Supplementary Guidelines for the Acceptance of Calibration and Measurement Capabilities,* including case studies, by the 2020 meeting.

Action 4 - RMOs to continue developing strategic plans for EM comparisons.

Action 5 - JCRB Secretary to request information from other CCs on their guidance on what evidence is required to support CMCs.

Action 6 - EURAMET to provide a proposal for a new service sub-category for digital meters and merging units.

Action 7 - New working group (Gert and Ilya) to propose a solution to including linearity in the CMC Categories List.

Action 8 - RMO TC chairs to report by the 2020 meeting how the requirement of a 5-year periodic review of CMCs is met.

Questions ?

Thank you

Bureau International des Poids et Mesures