GAS METROLOGY

PROPOSAL OF NEW PROVISIONS FOR REGULATORY CONTROLS ON ATMOSPHERIC EMISSIONS WITH A VIEW TO REDUCING ELVs

EURAMET Programme
EMPIR Project: IMPRESS 2

IN
MEASUREMENT
WE TRUST

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EURAMET’s Research Programme

The European Metrology Programme for Innovation and Research (**EMPIR**) was developed as an integrated part of the EU’s **Horizon 2020** framework programme.

From 2014 – 2020, several EMPIR calls led to the establishment of **Joint Research Projects** (JRPs) within specified fields like **Industry**, **Energy**, **Environment** and **Health** – all of which were carefully selected to address Europe’s greatest societal challenges.

The structured approach of the programme has enabled EURAMET to encourage **collaboration in measurement science** between metrology institutes, academia, industry & medical organisations across Europe. The programme has also supported the development of the fundamental **SI system** of measurement units.

EMPIR follows on from the **EMRP** programme, which was successfully completed in 2019.

EMPIR EURAMET

The EMPIR initiative is co-funded by the European Union's Horizon 2020 research and innovation programme and the EMPIR Participating States

Introduction : Somes figures, context and regulations

Somes figures:

- 2016, WHO, 7 millions premature death from air pollution, 3,7M from outdoor air pollution
- Between 2010 and 2018 : Stricter regulations, reduction of pollutants from 30% to 90% depending on the species
- 2018 : EEA report 417 000 premature deaths associated with air pollution in Europe

⇨ Impact of atmospheric pollution shall decrease and should continue to decrease thanks to ~~of~~ regulatory developments

Regulatory developments

BAT Associated Emission Level

BREF → BAT-AEL → New ELV

Identify the BAT for a defined type of industrial plant (Waste incineration, combustion plant, …)

Plants under IED regulation must comply with these new ELV

Example of ELV and BAT-AEL value for new WIP:

Compound	WIP	
	Daily ELV (mg/m³ NTP)	BAT-AEL (mg/m³ NTP)
NO_x	200 / 400	50-120
CO	50	10-50
SO_2	50	5-30
Dust	10	2-5
HCl	10	< 2-6

ELV: *Emission Limit Value*
BAT: *Best Available Techniques*
BREF: *Best Available Techniques Reference Document*
IED: *Industrial Emission Directive*
WIP: *waste incineration plant*

IED requirements

In terms of ELVs

- **Periodic controls by control laboratories: application of SRM**
  - "Automatic" methods (with P-AMS): O_2, CO, CO_2, NO_x, VOCT
  - "Manual" methods (sampling on site + analysis in laboratory): dust, SO_2, HCl, NH_3, HF, HAP, PCDD-PCDF…
- **Continuous monitoring: AMS**

In terms of quality assurance of continous monitoring of the emissions for WIP and LCP

- **Criteria of relative expanded uncertainty at ELV level: U_c(AMS)**
- **Calibration of AMS by means of parralel measurement with SRM from control laboratories**
  - ⇨ it is expected U_c(SRM) << U_c(AMS)

SRM: Standardised Reference Method
P-AMS: Portable Automated Measurement System
AMS: Automated Measurement System

AMS and SRM main characteristics

AMS and SRM main characteristics to ensure the reliability of the measurement:

- **Limit of Quantification (LoQ)**
  - To limit the risk of error on compliance/non-compliance to ELV → LoQ significantly lower than ELV
    In France SRM : LoQ] < 10% ELV
  - Good Practice for AMS: LoQ < 20% ELV
- **Relative expanded measurement uncertainty at ELV**

Determination of those characteristics:

	LoQ	Uncertainty
AMS	From certification data	Budget uncertainty approach from certification
SRM: automatic method P-AMS	From certification data	Budget uncertainty approach from certification ILC approach: INERIS results
SRM: manual methods	Calculated from analysis LoQ and gas volume sampled	Budget uncertainty approach from laboratories ILC approach: INERIS results

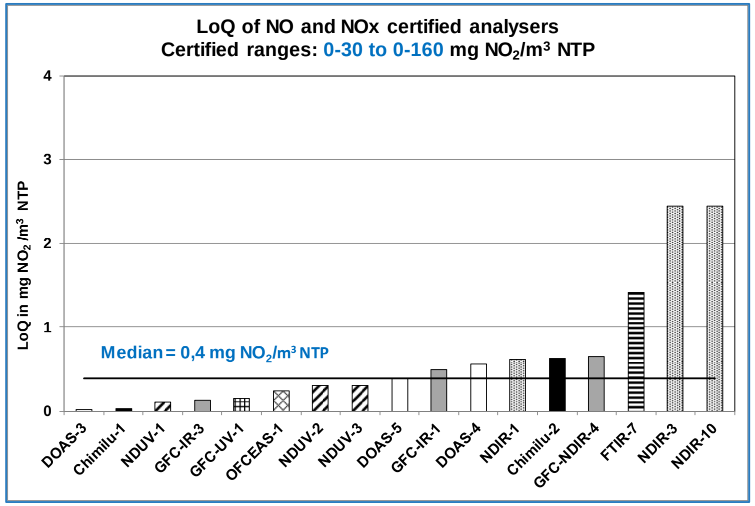
How will the decrease of ELV impact the measurements ?

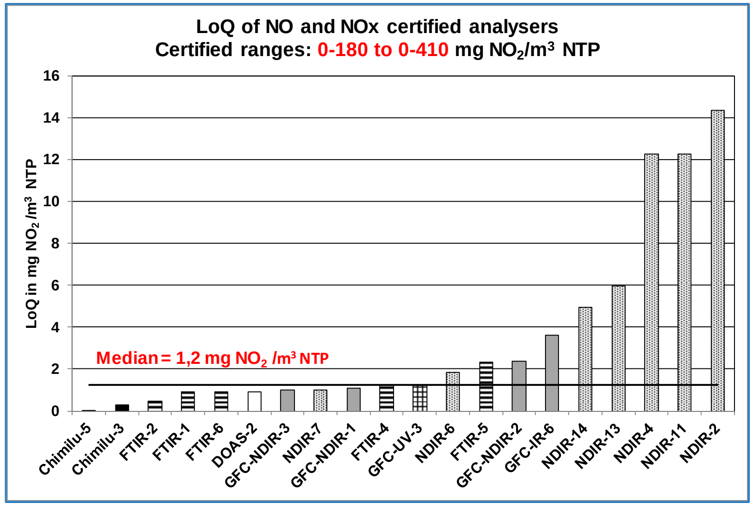
Are the actual SRM and AMS able to characterize the emissions with compliant LoQ and U_c at stringent ELV ?

Review of measurement LoQ

Automatic methods used for continuous and periodic monitoring: AMS / P-AMS

- In general low values adequate for future ELVs for several AMS/P-AMS
  - ⇨ but the choice becomes limited for the lowest values of BAT-AEL
- Importance of considering the certification range when considering performance: in general, for a model, the LoQ decreases with the range





Manual methods used for periodic monitoring

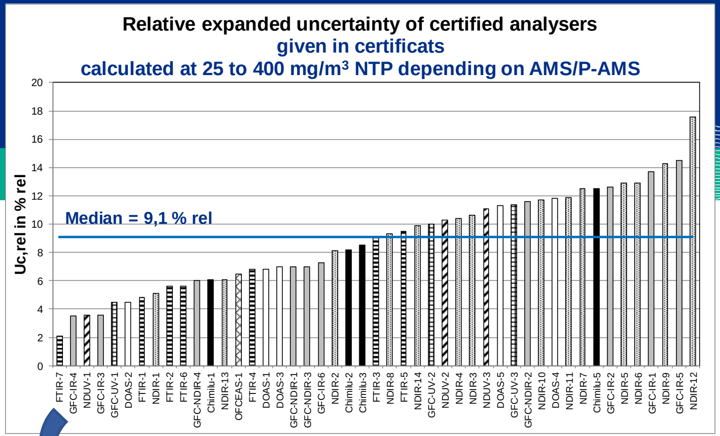
- Measurement LoQ ↘ with the analysis LoQ and when the volume of gas sampled ↗ i.e. when the sampling time ↗
- For the lowest BAT-AEL values: 30 minutes of sampling may not be sufficient; for some compounds such as dust, times longer than 60 min may be required

More data available in the report:
https://www.ineris.fr/fr/surveillance-rejets-atmosphere-proposition-nouvelles-dispositions-controles-reglementaires

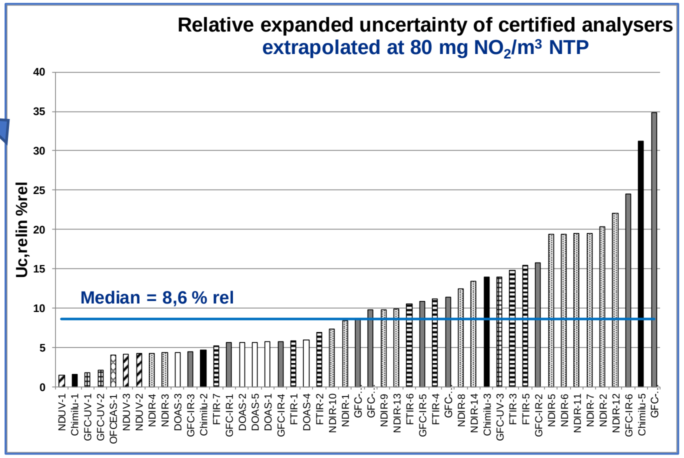
Review of relative expanded uncertainties Uc,rel

P-AMS / AMS

- Uc,rel must be evaluated at the same concentration level to compare instruments
  - But ⚠ extrapolation to be considered with caution

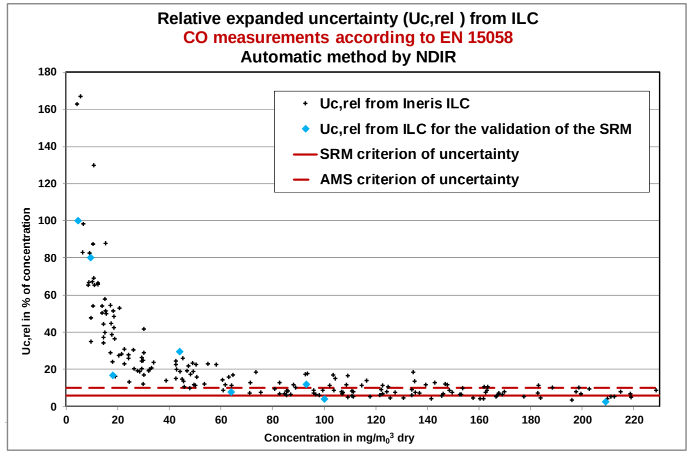


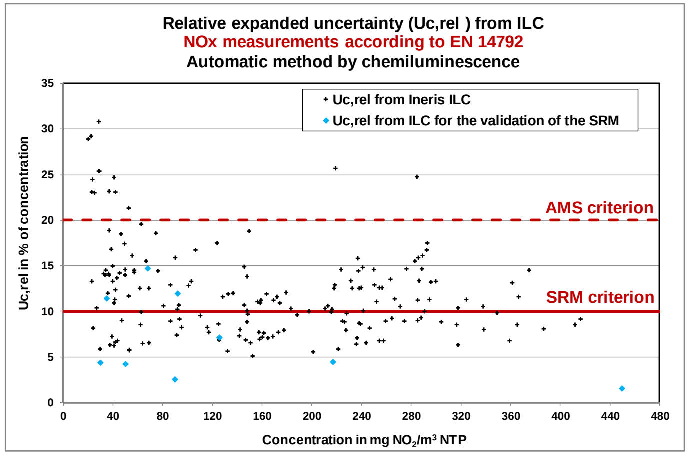
Extrapolation of Uc,rel given in certificates

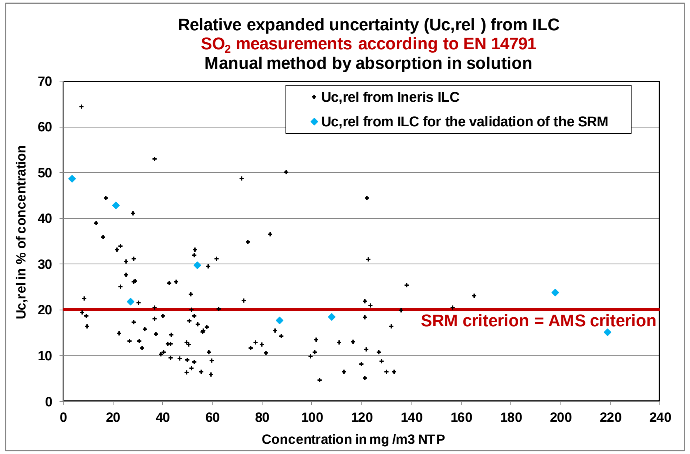


Comparison of Uc,rel to criteria

- Uc,rel ↗ as the concentration ↘
- The ILCs show:
  - One step for concentrations above a concentration level
  - Below this level a non-linear and more or less marked increase according to the methods
- In general: Uc,rel criteria respected for future ELVs for several AMS/P-AMS according to certification data; but the choice becomes limited for the lowest values of BAT-AEL
- In general: Uc,rel of manual methods > Uc,rel of automatic methods according to ILC







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Possible ways to improve performance of monitoring?

Automatic methods used for periodic and continuous monitoring (P-AMS / AMS)

- Certify AMS and P-AMS **over lower ranges** ⇨ to refine the determination of the LoQ and uncertainty
- Use of **more selective and sensitive techniques** ⇨ to improve performance of monitoring
  - e.g.: tunable laser diode absorption spectroscopy (TDLAS), optical cavity spectroscopy (CRDS), optical feedback cavity absorption spectroscopy (OFCEAS)…

Manual methods used for periodic monitoring

- To lower LoQ
  - **Increase sampling time ➔** but may be difficult to implement and costly
- To lower LoQ and uncertainty
  - Use **more sensitive analytical techniques and equipment ➔** but little prospect e.g. for dust
  - **Substitute manual methods with automatic methods**
    - » European standards already available for alternative methods ⇨ e.g.: CEN/TS 17021 for SO_2, TS 16249 for HCl..

Current limits of "new" automatic measurement methods

- **Not available or possible for all compounds** ⇨ e.g.: for compounds with particulate phase
- **Specificity of the emission matrices**: variable according to the installations and hot, humid, corrosive gases
- **Adaptation of laboratories practices** for some compounds ⇨ e.g. use of wet reference material on site for HCl, NH_3
- **No or few certified devices**

Proposal for new provisions in France

Described in standard NF X 43-551 (to be published by the end of 2021)

Pending the successful development of new measurement techniques: a reflection (2019-2021) on the adaptation of monitoring rules, conducted within the Stationary Source Emissions French Committee (X43B) of the Association Française de NORmalisation (AFNOR):

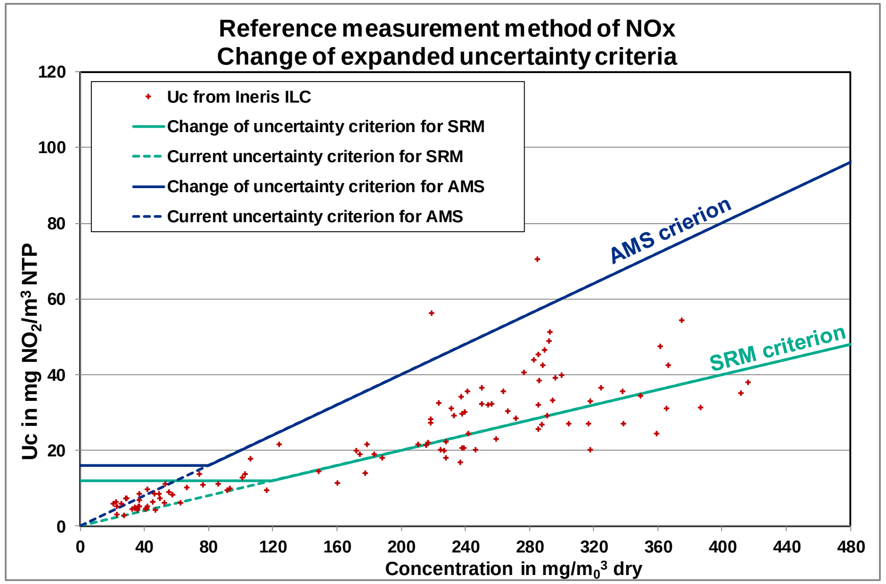
LoQ criterion:

- **Relaxation of the criterion**: LoQ < 20 % ELV, or even LoQ < 30 % ELV if the < 20 % criterion leads to sampling times > 2 h
  - maintains a level of requirement that limits the risk of erroneous declaration at an acceptable cost of monitoring

Uncertainty criteria

- Definition of **concentration thresholds for both SRM and AMS below which the uncertainty criterion is expressed in mg/m³** and is therefore fixed

	SRM		AMS	
Conc. & Uc in mg/m³ NTP	**Conc. threshold**	**Uc criteria**	**Conc. threshold**	**Uc criteria**
Dust	≤ 5	1,0	≤ 5	1,5
Chlorures (expressed in HCl)	≤ 5	1,5	≤ 5	2
HF	≤ 2	0,6	≤ 1	0,4
SO_2	≤ 10	2	≤ 10	2
NH_3	≤ 8	1,6	≤ 8	3,2
NOx	≤ 120	12	≤ 80	16
CO	≤ 100	6	≤ 50	5
COVT	≤ 25	3,75	≤ 10	3



Thank you for your attention

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