

# CADRE DE L'AGRÈMENT DES LABORATOIRES DU RNM ET BILAN DES COMPARAISONS INTERLABORATOIRES ORGANISÉES PAR L'IRSN

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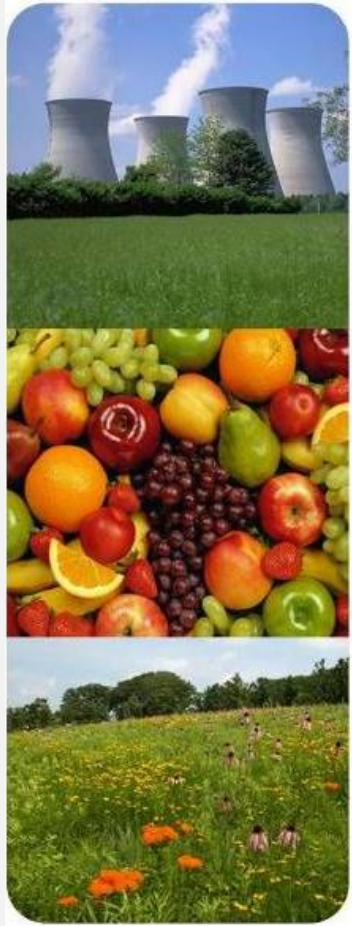
# THE NATIONAL NETWORK FOR ENVIRONMENTAL RADIOACTIVITY MEASUREMENTS (RNM)

## In French : « Réseau national de mesures de la radioactivité de l'environnement » (RNM)

- Created in 2003, under the responsibility of ASN, and managed by IRSN
- Gathers all the actors and stake holders involved in radioactivity monitoring of the environment :
  - ❖ Ministries, ASN, IRSN, nuclear operators, public or private laboratories, NGO, etc.
- Two main committees:
  - ❖ Steering committee: gives its opinion on the general objectives of the RNM decided by ASN
  - ❖ Approval Committee: gives an advice to ASN on the applications for approval submitted by the laboratories



# THE NATIONAL NETWORK FOR ENVIRONMENTAL RADIOACTIVITY MEASUREMENTS (RNM)



## Objectives of the RNM

- To contribute to the dose estimation of the population exposure to ionizing radiation  
➔ development of a database (today, more than 2.5 M data)
- To ensure the transparency of information on environmental radioactivity in France  
➔ development of a web site [www.mesure-radioactivite.fr](http://www.mesure-radioactivite.fr) opened in 2010, to publish the results of environmental radioactivity measurements by IRSN and by approved laboratories to the general public
- To pursue a quality policy for the measurements performed by laboratories  
➔ establishment of a system of *approval* delivered by ASN to the laboratories



# THE NATIONAL NETWORK FOR ENVIRONMENTAL RADIOACTIVITY MEASUREMENTS (RNM)



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## Regulatory framework

- The RNM complies with the European regulatory framework:
  - ❖ Directive 2003/4/CE: public information on the status of the environment and data quality
  - ❖ Directive 2013/59/Euratom: estimation of doses due to nuclear facilities
- In the French regulation, art. R. 1333-25 of the Public Health Code establishes the creation of the RNM
- ASN decision n° 2008-DC-0099 of April 29, 2008 (amended by resolutions n° 2015-DC-0500 and 2018-DC-0648) sets the organization of the RNM and the conditions for laboratory approval

# THE NATIONAL NETWORK FOR ENVIRONMENTAL RADIOACTIVITY MEASUREMENTS (RNM)

## Laboratory approval system

- Different environment compartments (*Water, Soils, Biological, Aerosols, Gases, Air kerma dose rates*)
- Different types of measurements ( *$\alpha$  and  $\beta$  global measurements, artificial radionuclides by  $\alpha$  and  $\gamma$  spectrometry, natural radionuclides by  $\alpha$  and  $\gamma$  spectrometry, pure  $\beta$  emitters by liquid scintillation, ...*)

## Requirements for getting approval

- The laboratory must comply to NF/EN/ISO/IEC 17025 standard
- The laboratory must demonstrate its ability to perform adequate measurements through **good results obtained at intercomparison campaigns (EIL) organized by IRSN**
- In the event of failure or poor result, ASN may require additional explanations, and possibly participation in a new intercomparison exercise (EC: contradictory exercise), or only issue approval for 1 year (instead of 5 years usually)

# IRSN : proficiency test provider

## IRSN COMMITMENTS

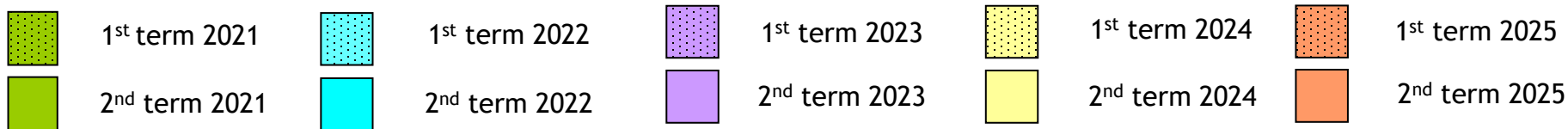
- **5 to 7 proficiency tests provided each year** and regularly every five years to evaluate a wide range of possible radionuclide/matrix combinations
- Mainly designed for French approval laboratories but **open to any laboratory** worldwide
- IRSN has been **accredited by COFRAC** since 2006 according to ISO/IEC 17043 standard for organizing proficiency tests
- IRSN is in charge of the design of PT samples, performs statistical analysis of all results and **sends a report** to each participating laboratory
- From its performance results the laboratory can set up an approval request to be submitted to ASN



The screenshot shows the IRSN website home page. At the top, there is a navigation bar with links for ACCUEIL, RECHERCHE, NOUVEAUTES, QUESTIONS/REponses, LIENS, and CONTEXTE RÉGLEMENTAIRE. The main content area features a large banner for the 'Programme des essais interlaboratoires 2016-2020' with a calendar view. To the right, there are statistics: 'ORGANISATION' with '6 à 6 EIL/An' and 'Rapports publiés sous 4 mois', 'PARTICIPATION' with '150 Laboratoires clients', and 'DIVERSITÉ DES ESSAIS' with '7 TYPES DE MATRICES DETERMINATIONS'. There is also a section for 'ACCREDITATION' mentioning 'COFRAC' and 'www.cofrac.fr'. At the bottom, there is a search bar for 'RECHERCHER UN ESSAI' with dropdown menus for 'Année', 'Prescripteur', 'Matrice', and 'Catégorie de mesure'.



The screenshot shows the 'Mon Espace Labo' user interface. It features a navigation bar with the same links as the home page. The main content area is divided into two columns. The left column, titled 'ESSAIS EN COURS', lists active tests such as '150 V 300', 'EIL Test 2.A.17', and '137 V 300 TEST', each with a 'Détail' link and a set of icons for actions like 'Description', 'Statut', 'Résultats', and 'Rapports'. The right column, titled 'DERNIERS MESSAGES', displays a list of recent messages with dates and brief descriptions, such as '150 V 300 - 08. avr. 2016 - Résultats sont en attente' and '150 V 300 - 08. avr. 2016 - Le formulaire de base des résultats est désormais disponible'.



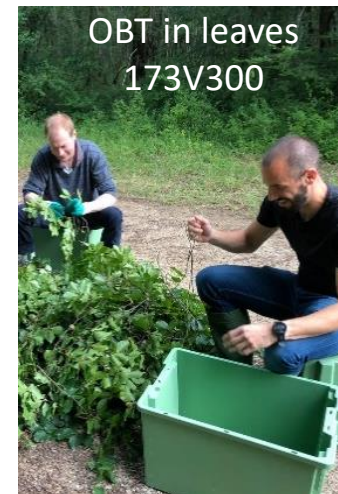
CODE	Class of radionuclides	Type 1		Type 2		Type 3		Type 4		Type 5		Type 6		Type 7	
		Sea Water	Water	Soil		Biological matrixes		Air filters		Gaz - air		Ambiant monitoring		Food monitoring	
01	Gamma emitters > 100 keV		1_01	2_01	3_01	4_01	5_01					-	7_01		
02	Gamma emitters < 100 keV		1_02	2_02	3_02	4_02	5_02					-	7_02		
03	Alpha gross activity		1_03	-	-	4_03									
04	Bêta gross activity		1_04	-	-	4_04									
05	H-3		1_05	2_05	3_05	-	5_05								
06	C-14		1_06	2_06	3_06	-	5_06								
07	Sr-90/Y-90		1_07	2_07	3_07	4_07									
08	Other pure beta emitters		1_08	2_08	3_08	-	-								
09	Uranium isotopes		1_09	2_09	3_09	4_09									
10	Thorium isotopes		1_10	2_10	3_10	4_10									
11	Ra-226 + desc.		1_11	2_11	3_11	-	Rn 222 : 5_11								
12	Ra-228 + desc.		1_12	2_12	3_12	-	Rn 220 : 5_12								
13	Pu, Am, (Cm, Np) isotopes		1_13	2_13	3_13	4_13									
14	Halogen radionuclides		-	-	-	-	5_14								
15	Rare gas radionuclides		<sup>222</sup> Rn 1_15	-	-	-	<sup>85</sup> Kr 5_15								
16	Gamma dose rate		-	-	-	-						6_16			
17	Uranium concentration		1_17	2_17	3_17	4_17									



# Proficiency test samples

## USE OF NATURAL MATRIX SAMPLES

- Sample taken from environment
- Matrix is divided into several sub-samples and each participating laboratory test one
- Small difference between PT samples and routine samples
- The PT samples do not have a known composition (need to do perform analysis)



## USE OF SPIKED SAMPLES

- Spiked matrix (drinking water, milk, tea) divided into several sub-samples
- Addition of carriers and acid for stability
- Addition of interfering radionuclides
- Activity consistent with environmental levels
- The PT samples have a known composition



Impregnation of a radioactive solution on commercial tea

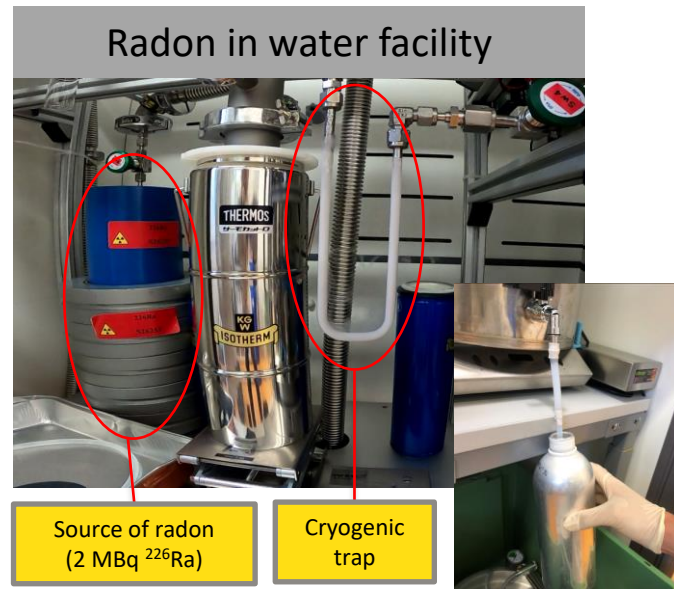
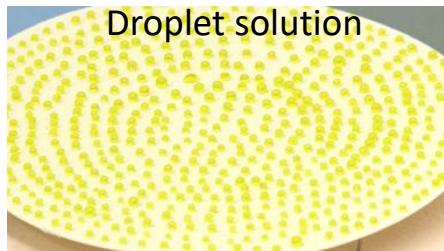


Mixture of water and radioactive solution in an 80L tank

# Proficiency test samples



## SPECIFIC PT SAMPLES



How to provide PT samples strictly equivalent to the one routinely tested ?

## Reference value determination

### ➔ REFERENCE VALUE MEASUREMENT

- A random selection of the prepared PT samples is measured by IRSN using a standard method. The assigned value and traceability is derived directly from the results of the used standard method.
- Uncertainty is derived from the test results and the uncertainty of the standard

### ➔ FORMULATION

- By addition of a known amount of concentration of radionuclide to a base material containing none
- Formulation is used in the case of destructive measurements when each item has its own reference value (air filters for exemple)
- Uncertainty is derived from the combination of uncertainties



**Advantage of an independant external measurement  
➔ no bias due to the general use of wrong methodology**

## Performance evaluation for PT



### STANDARD DEVIATION FOR PROFICIENCY ASSESSMENT

- | Derived from the results reported by the participants in the same round
- | The standard deviation of the results reported by all the participants (outlier excluded)
  - » **This value may vary substantially from round to round**
  - » **Not suitable for small numbers of participants**

# Performance evaluation for PT

## PROFICIENCY TEST CRITERIA

RELATIVE DEVIATION

$E_N$  SCORE

Z-SCORE

$$E_i = \frac{x_i - x_{réf}}{x_{réf}}$$



15%



20%



$$E_n = \frac{x_i - x_{réf}}{\sqrt{(U_{réf})^2 + (U_i)^2}}$$



1



1,3



$$z = \frac{x_i - x_{réf}}{s}$$



2



3

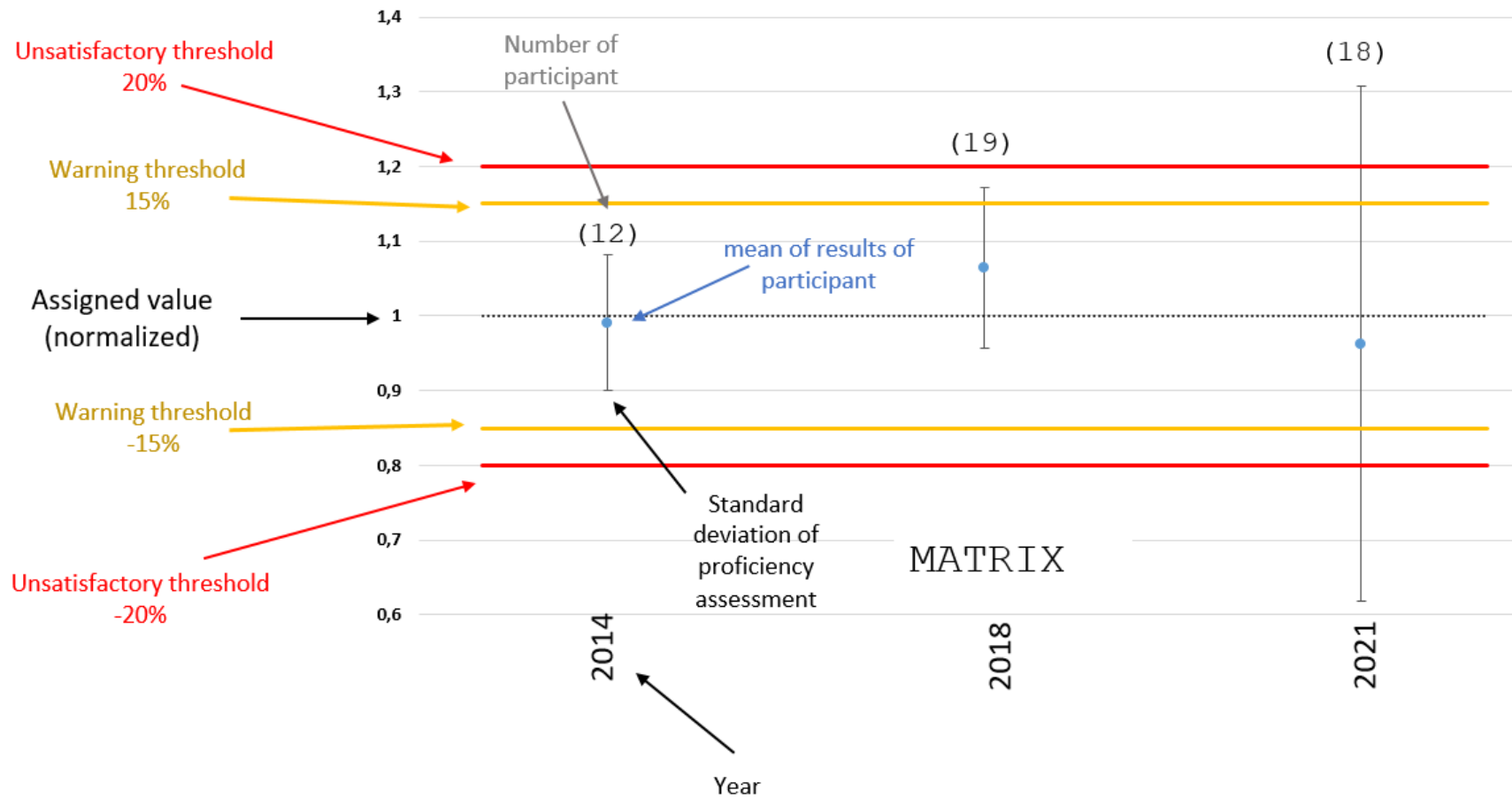




# Monitoring PT performance over time

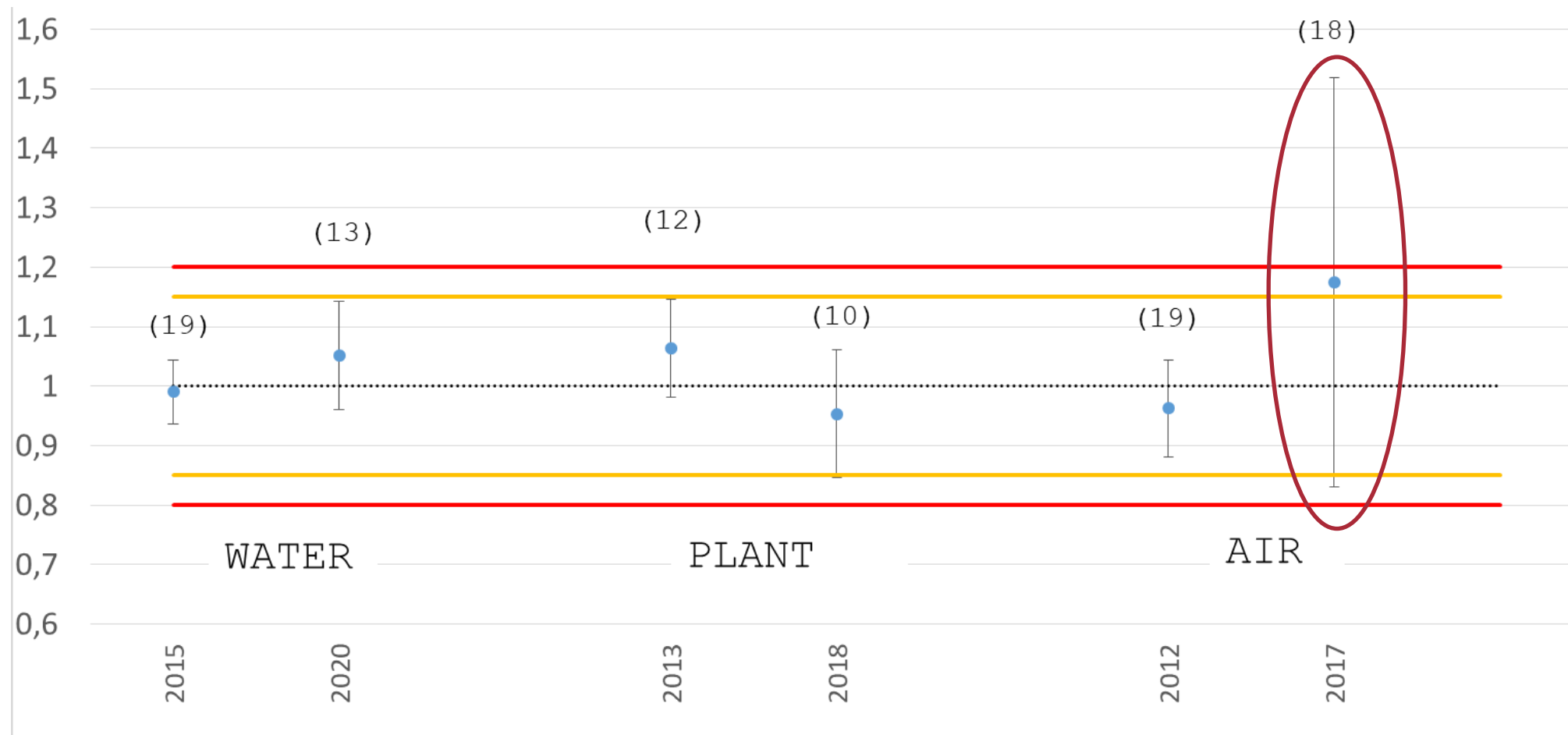


## GRAPHICAL REPRESENTATION OF LABORATORY PERFORMANCE



## Exemple of the C-14 measurement

Results are in good compliance with the reference value for the water and plant sample. Measurement in the air sample is more problematic

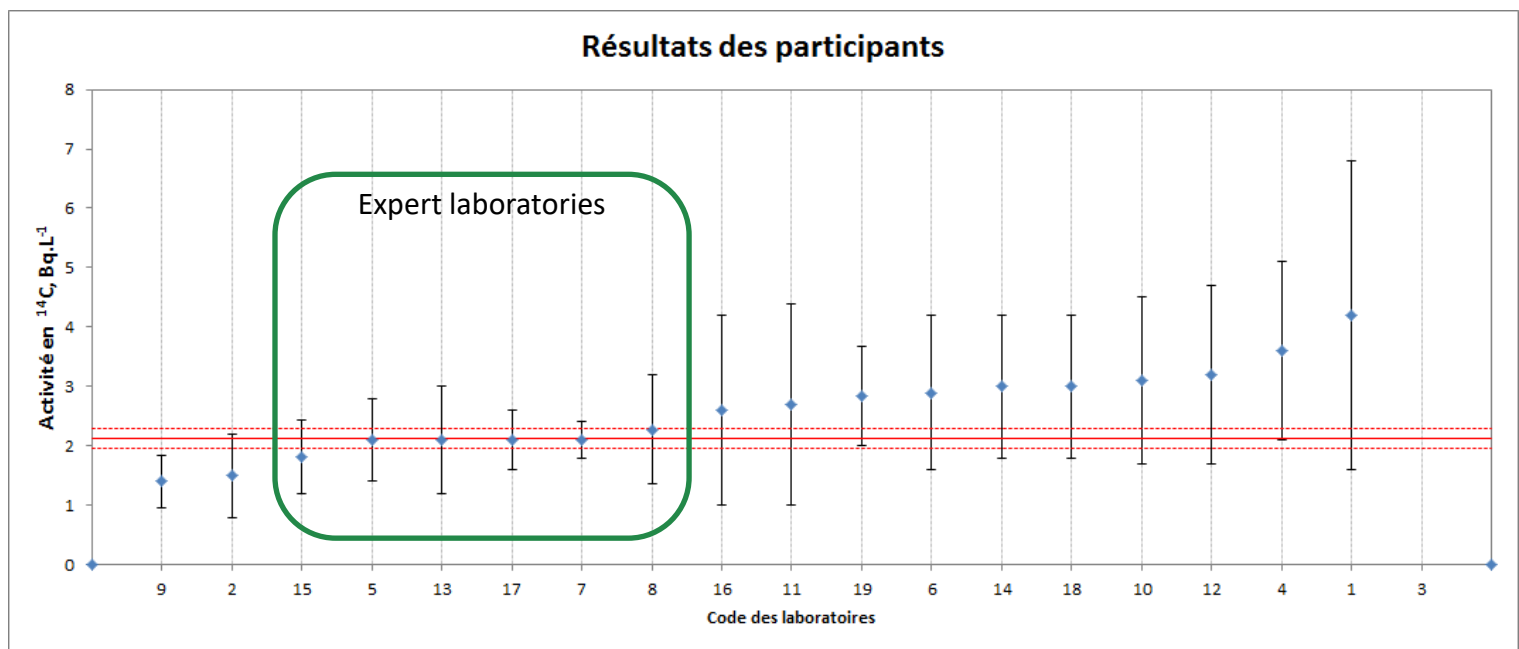


18,7 Bq/L => 2,1 Bq/L

## C-14 in air : exemple of the C-14 measurement in a sodium sample (149 DI 300)

### ➔ BIAS DU TO A WRONG METHODOLOGY

**Objective of the PT:** check the compliance of measurement with the regulation threshold of  $0,1 \text{ Bq/m}^3 \text{ }^{14}\text{C}$  in air



Blank management

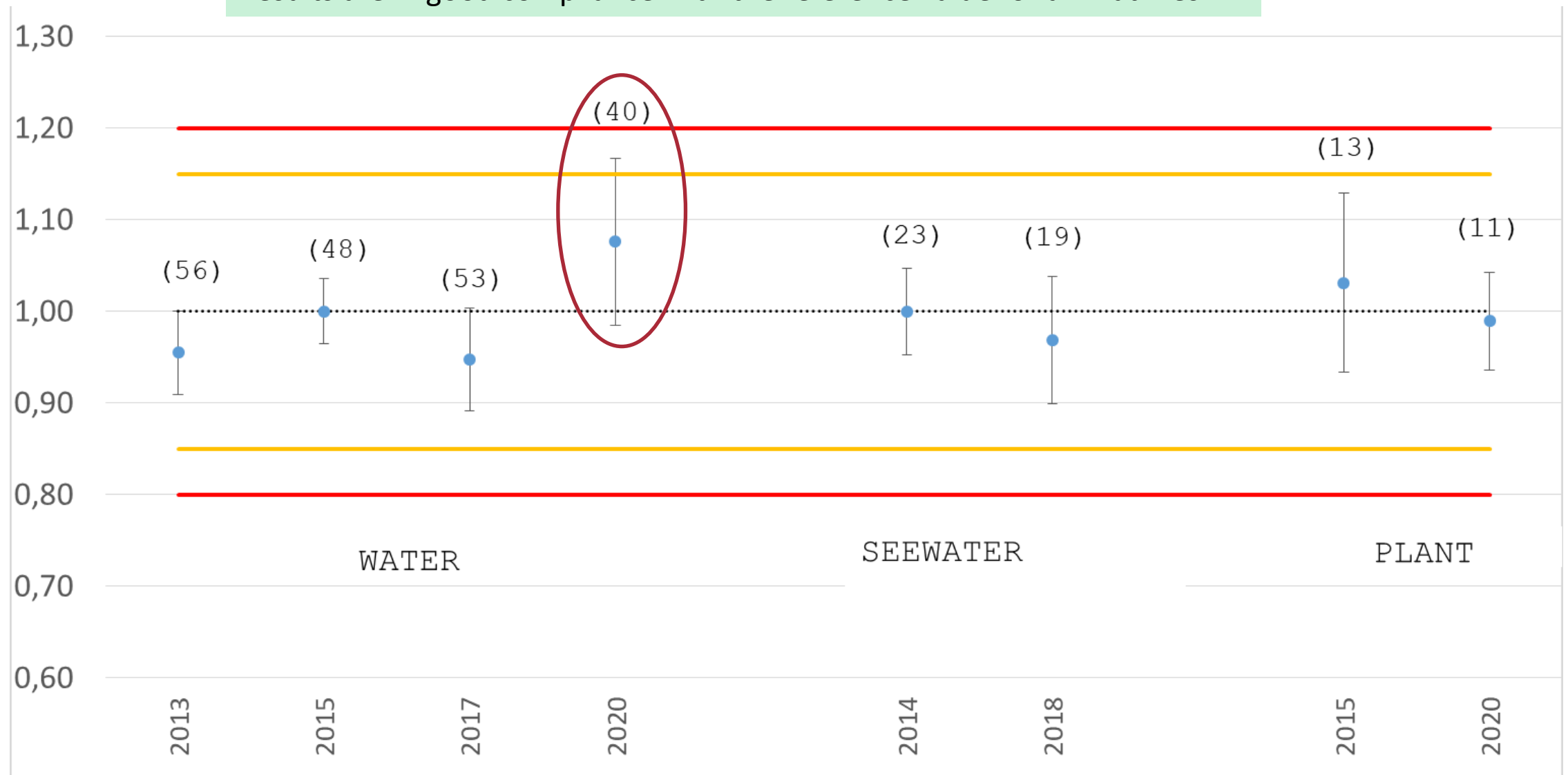
Counting time not suitable to the decision threshold

Quality of the  $^{14}\text{C}$  standard used

No update of the standard operation procedure (SOP) to take into account the evolution of the regulatory threshold

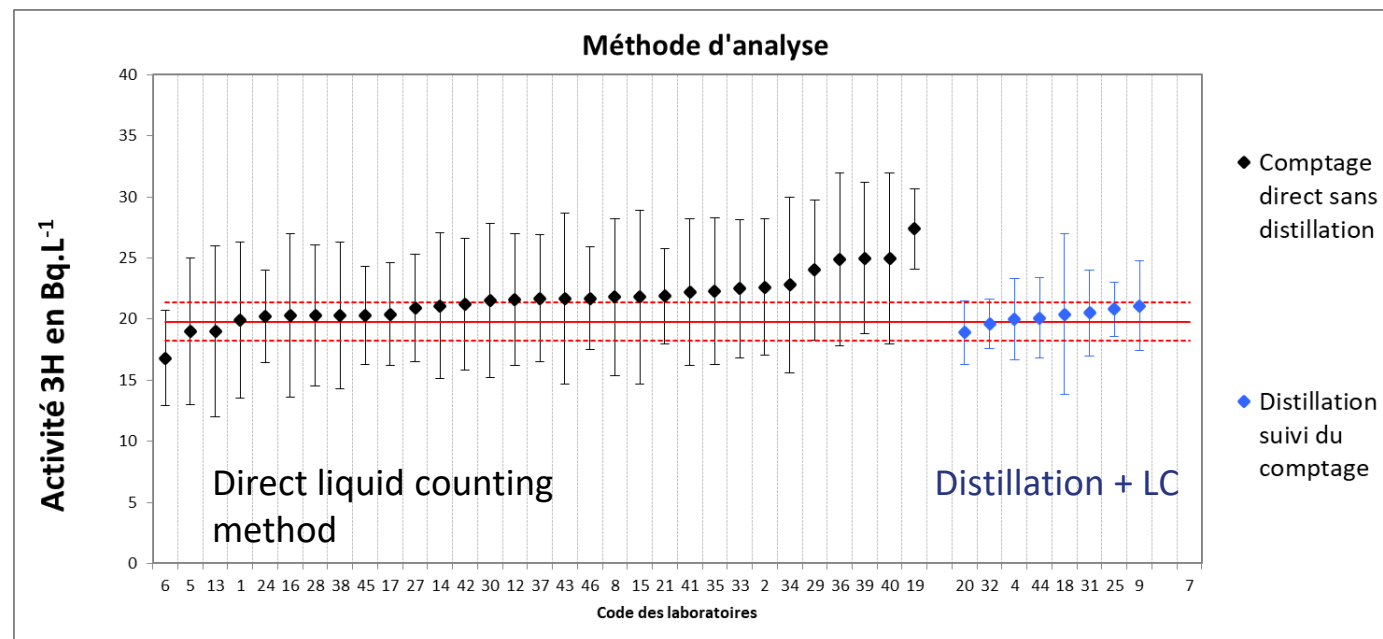
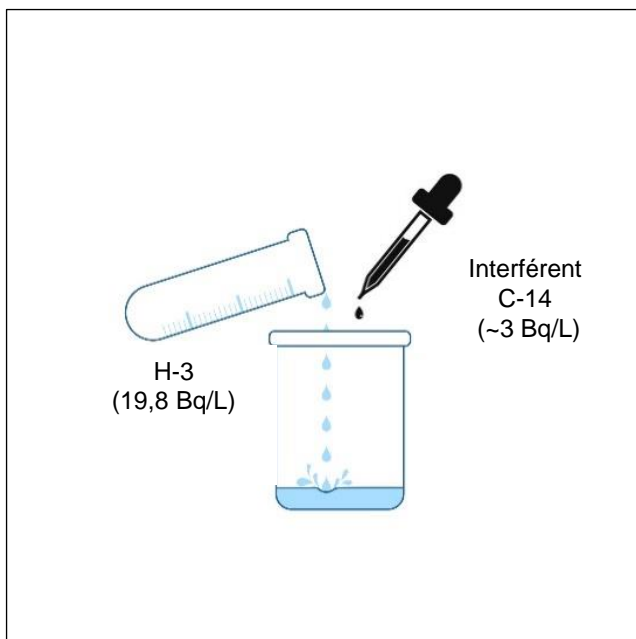
## Exemple of the H-3 measurement

Results are in good compliance with the reference value for all matrixes



# Exemple of the H-3 measurement in water (169 SH 300)

## ➔ BIAS DU TO A WRONG METHODOLOGY

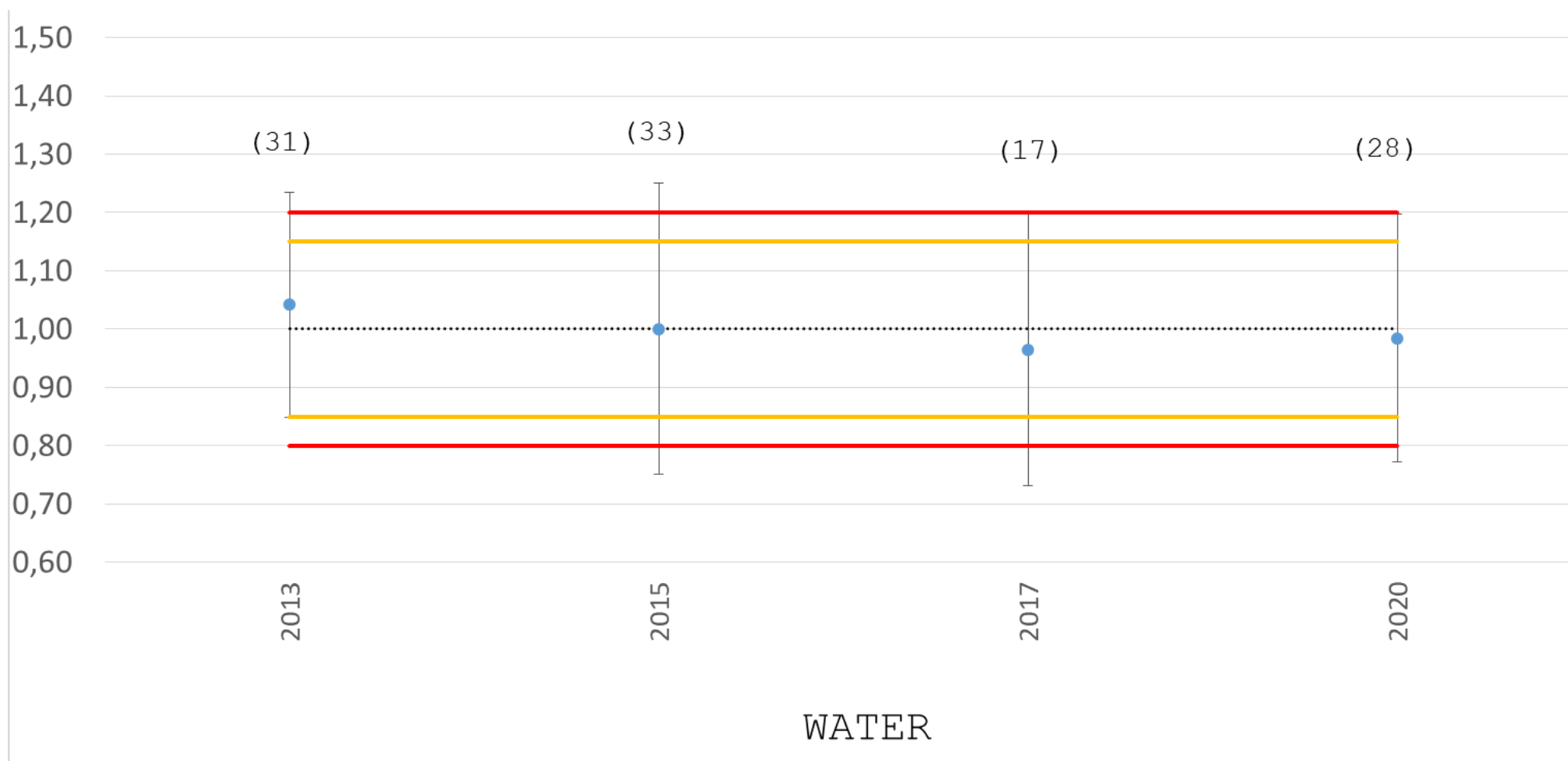


When distillation is not performed, direct liquid scintillator counting method can show a bias with the reference value



## Exemple of gross alpha activity in water

Results are in good agreement with the reference value but the standard deviation of proficiency assessment is roughly 20%



# Exemple of gross alpha measurement in water (169 SH 300)

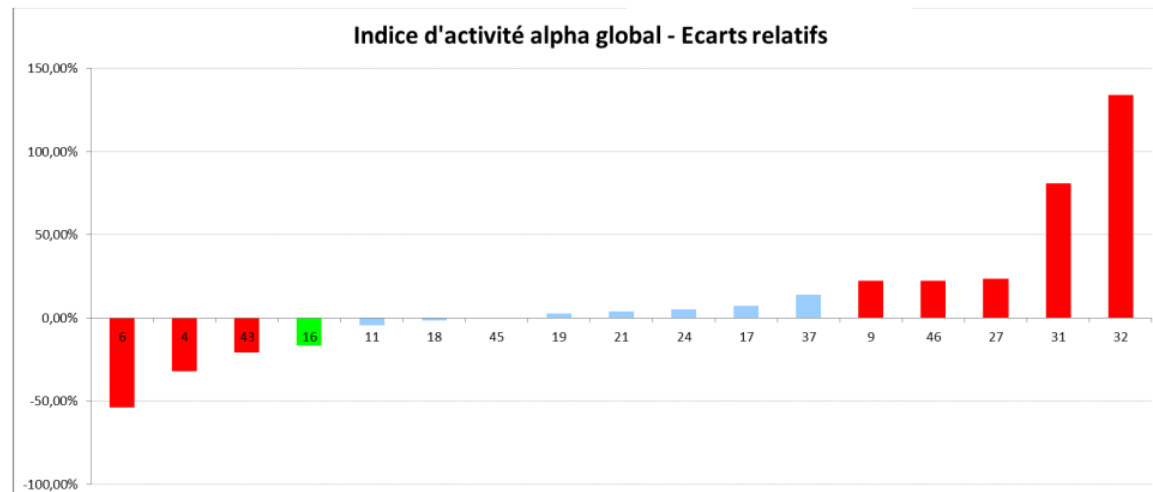
## LARGE STANDARD DEVIATION OF PROFICIENCY TEST

### Objective of proficiency test

- check the compliance of measurements with the french regulation threshold for gross alpha activity ( $^{239}\text{Pu}$  équivalent) in drinking water : 0,1 Bq/L

### Standard méthode of measurement used for reference value

- Test items : spiked water with a reference solution of natural uranium
- Acidification  $\text{HNO}_3$  0,1 M
- Evaporation on inox cups (51mm)
- CP counting with a calibration source of  $^{239}\text{Pu}$

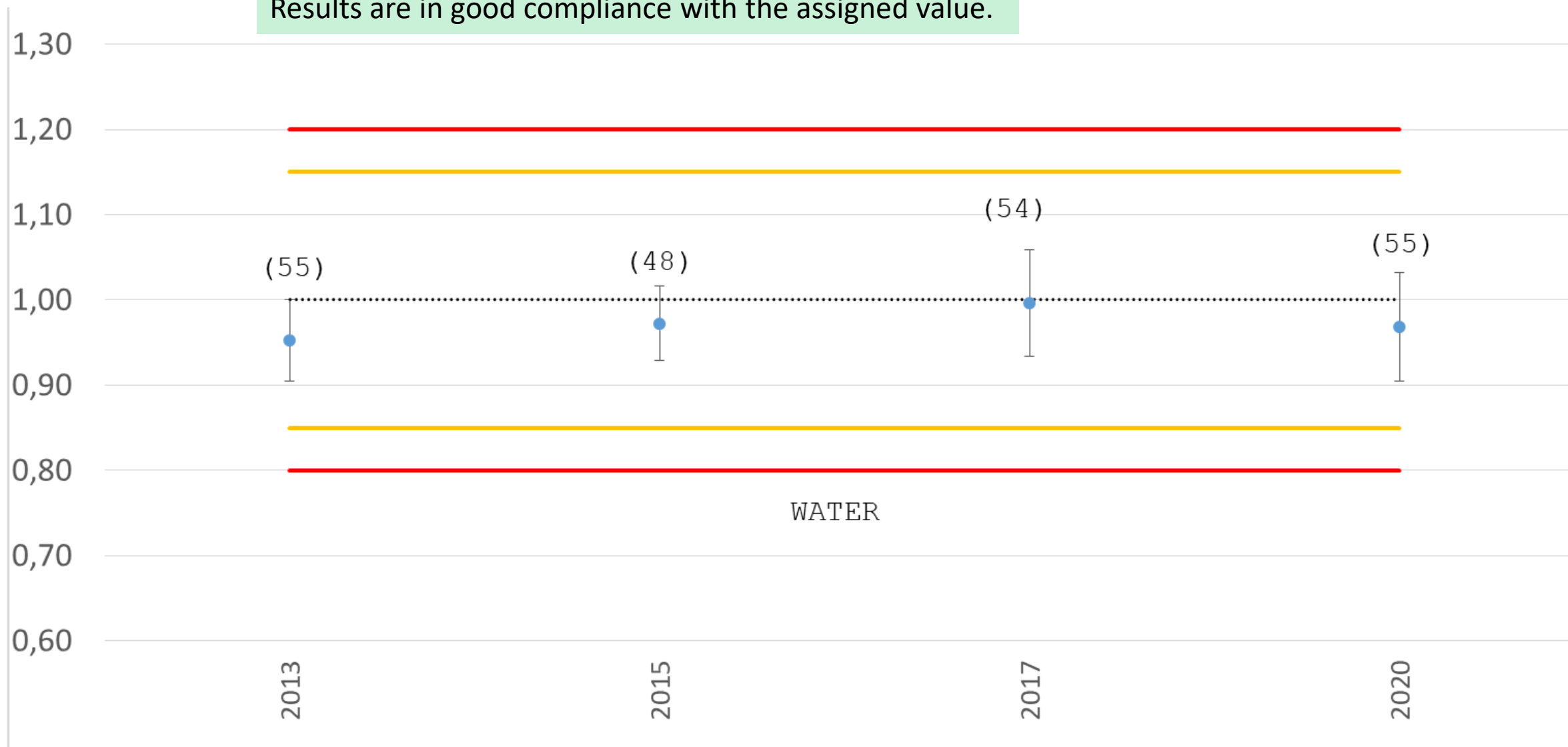


### Participant method : many parameters

- +— Counting method (SL or evaporation + CP)
- +— Calibration source :  $^{239}\text{Pu}$ ,  $^{241}\text{Am}$ ,  $\text{U}_{\text{nat}}$
- +— Source inox diameter : 51 mm, 130 mm
- +— Volume of the test sample
- +— Autoabsorption correction

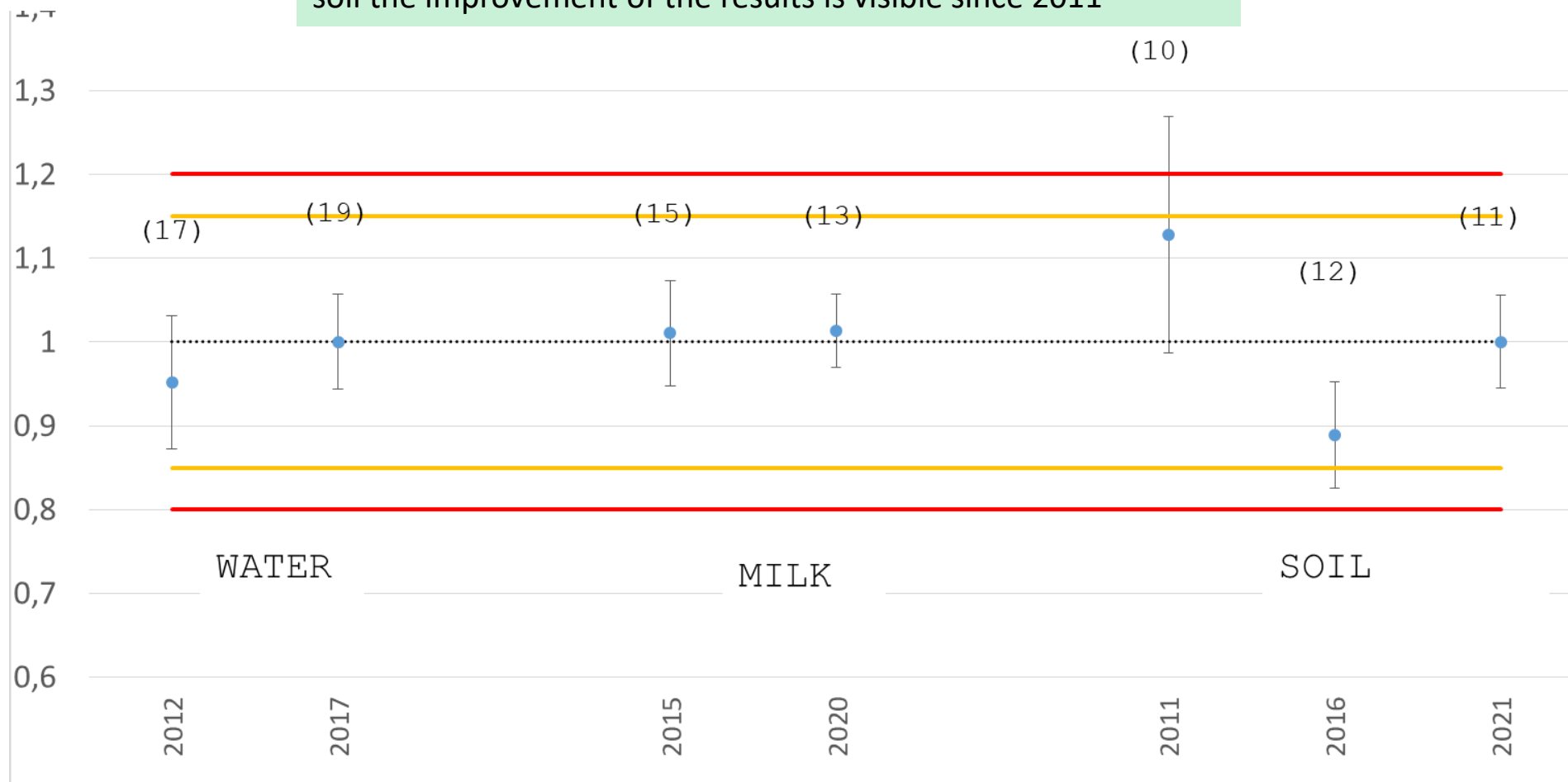
## Exemple of the gross beta measurement in water

Results are in good compliance with the assigned value.



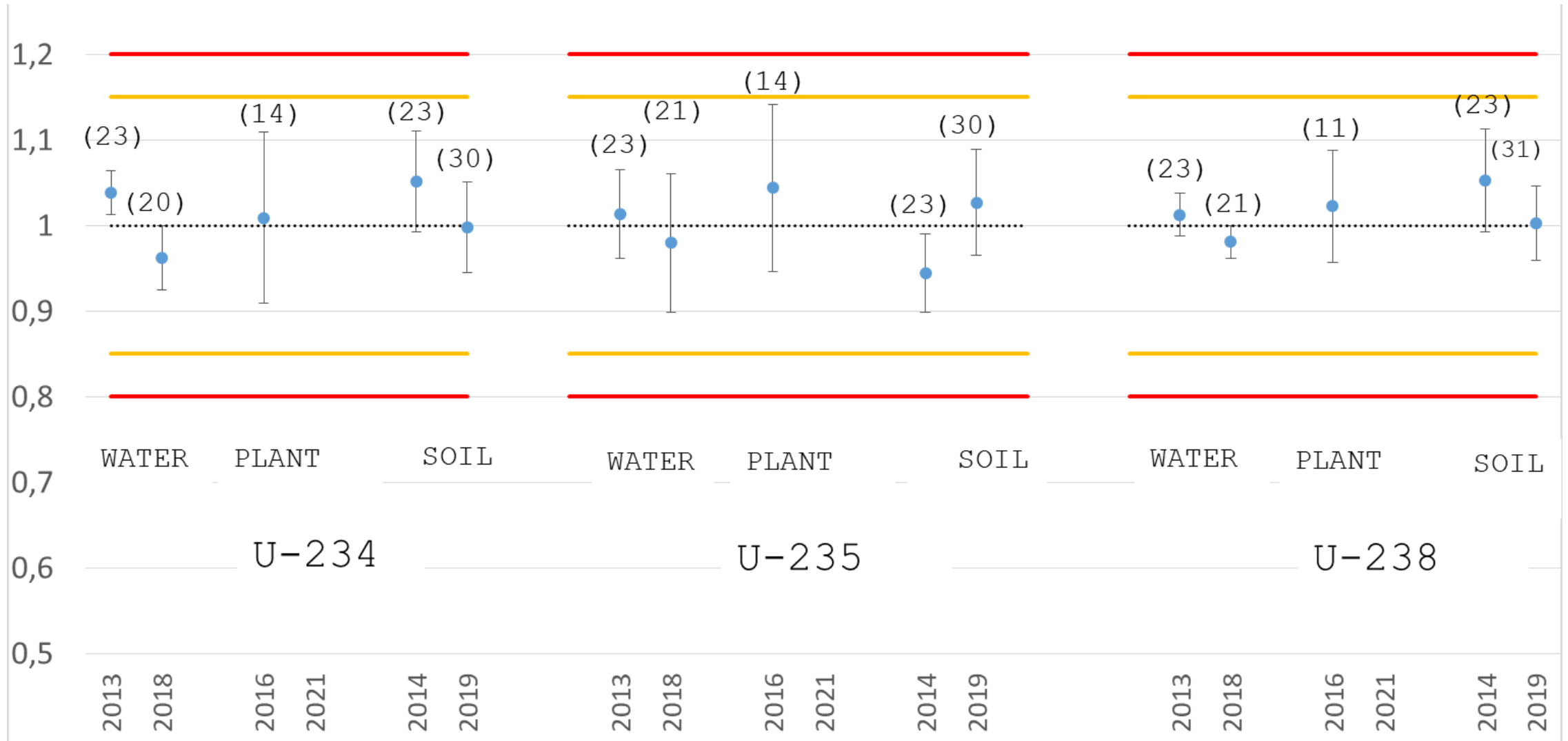
## Exemple of the Sr-90 measurement

Results are in good compliance with the assigned value. In the soil the improvement of the results is visible since 2011



## Exemple of the isotopes of uranium

Results are in good agreement with the reference value





# FEEDBACK FROM ASN CONCERNING EIL

## Since 2003

- Almost 130 organized EILs, covering all types of environmental compartments and all types of measures
- At present, tendency to have levels of radioactivity as similar as possible to those observed in natural environments, and possibly with interfering species
- In general, an overall increase has been observed among the population of approved laboratories: over time, the laboratories have obtained more satisfactory results in the EILs, and fewer contradictory exercises have been requested by ASN

# FEEDBACK FROM ASN CONCERNING EIL

## General conclusion

- ASN considers that IRSN's organization of the EIL is an **efficient, robust** and **proven system** which fully meets its objective of evaluating the **quality** and **reliability** of the measurements carried out by the laboratories
- It helps to promote a **continuous improvement** in the skills of laboratories and ensures that their **performance** is maintained over time, in order to guarantee the quality of the results of environmental radioactivity measurements made available to the public on the **RNM website** [www.mesure-radioactivite.fr](http://www.mesure-radioactivite.fr).