IRSN
INSTITUT
DE RADIOPROTECTION
ET DE SÛRETÉ NUCLÉAIRE

Enhancing nuclear safety

Routine operation of an RPL dosimetry laboratory for individual monitoring of RPL dosimeters

IAEA, Webinar 24.6.2020

MEMBER OF
ETSON
EUROPEAN TECHNICAL SAFETY ORGANISATIONS NETWORK

IRSN/FRM-414 ind 3

Contents

- IRSN Dosimetry Lab
- RPL process
- Metrology and QC
- Intercomparison results

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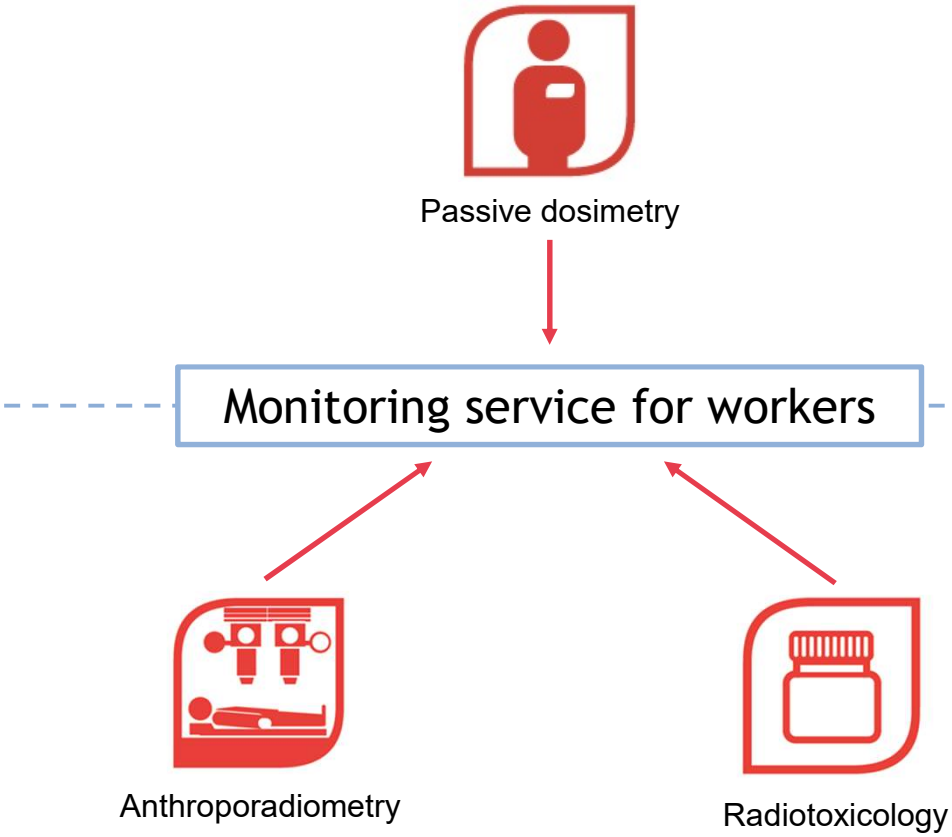
IRSN Dosimetry Lab



External exposures

- 4 types of passive dosimetry (RPL, TLD, SSNTD and ESR)
- 1 250 000 dosimeters analyzed per year
- 168 000 workers monitored

Internal exposures

- 14 500 radiotoxicological exams per year
- 740 anthroporadiometric exams per year (500 on site with mobile means)

External dosimetry products

Whole body

Criticality

Extremity and eye lens

High doses (irradiator)

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Use of RPL at IRSN

- Since 2009 (it replaced film dosimeters)
- Different use of RPL

Use	Quantity
Individual	$H_p(10)$ et $H_p(0,07)$
Workplace study	$H_p(10)$ et $H_p(0,07)$
Area / environment	$H^*(10)$ et $H'(0,07)$
Background	-

Individual : 60 %
Area / environment : 25 %
Background : 15 %

- Field
  - Medical : 75 %
  - Industry and research : 15 %
  - Nuclear : 10 %
- Periodicity of use
  - Quarterly : 75 %
  - Monthly : 25 %

1 Reception

2 Remove the plastic film

3 Disassembly/Assembly

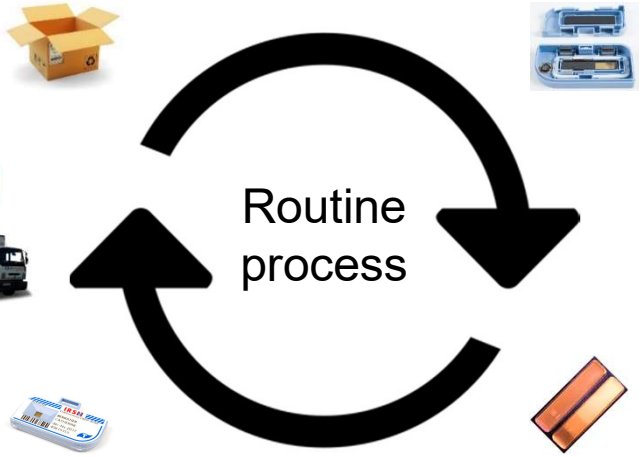
8 Packaging and shipping

4 Preheating

7 + 3 Labeling

6 Annealing

5 Reading and dose calculation



Specific process (expertise)

- For « high » dose or abnormal signal (≈ 400/year)
- RPL standard analysis is completed by a reading with the imager

Wearing conditions

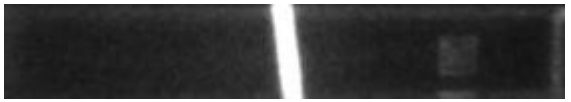
X-rays – dynamic exposure

X-rays – static exposure

Abnormal exposure

Contamination of the dosemeter

Shield in front of the dosemeter



Collimated exposure

Confirmation of the radiation type

β radiation

γ radiation

Maintenance

- 11 readers
- 4 ovens for preheating
- 3 ovens for annealing
- 2 machines for remove the plastic film
- 4 machines for RPL assembly or desassembly
- 2 machines for labeling
- A lot of computers

Internal maintenance

- Simple breakdown
- Regular cleaning
- Setting

350 interventions / year

External maintenance

- Preventive maintenance
- Complex breakdown

1 intervention / month

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Metrology and QC

- Annual calibration
- Quarterly verification with reference glasses exposed to ^{137}Cs source
- Regular linearity checks
- Daily check with reference glasses
- In each analysed batch, « control dosimeters » are added to check the preheating cycle and the reading step

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EURADOS IC 2018ph

(Data from IC2018ph Participants Meeting 12 Feb 2019 Łódź Poland)

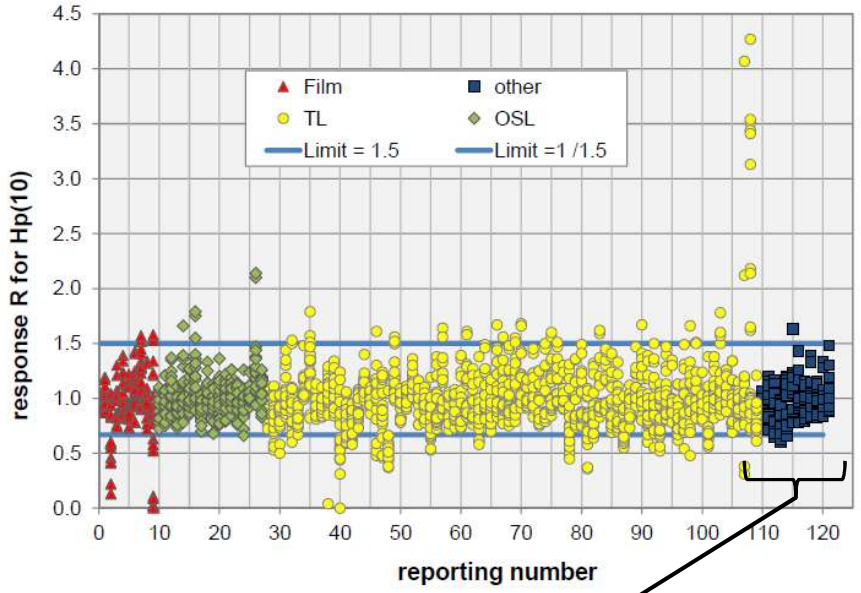
- 40 countries
- 101 IMS
- 121 systems

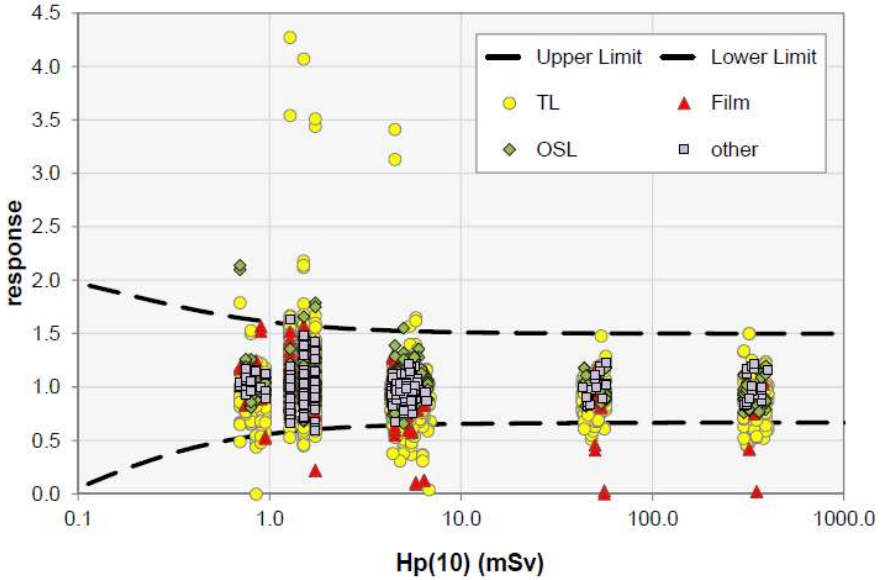
- Irradiation plan
  - Energy response
  - Angle
  - Linearity with Co-60
  - Mixed X-γ

	systems	% of all	% of type
TL	**82**	**68%**	**68%**
LiF:Mg, Ti	47	39%	57%
Li2B4O7/CaSO4	15	12%	18%
LiF:Mg, Cu, P	13	11%	16%
TL - Other	7	6%	9%
other	**12**	**10%**	**10%**
DIS	7	6%	58%
RPL	4	3%	33%
APD	1	1%	8%
Film	**9**	**7%**	**7%**
agfa	7	6%	78%
FOMA	2	2%	22%
OSL	**18**	**15%**	**15%**
Al2O3:C	13	11%	72%
BeO	5	4%	28%
All	**121**	**100%**	**100%**

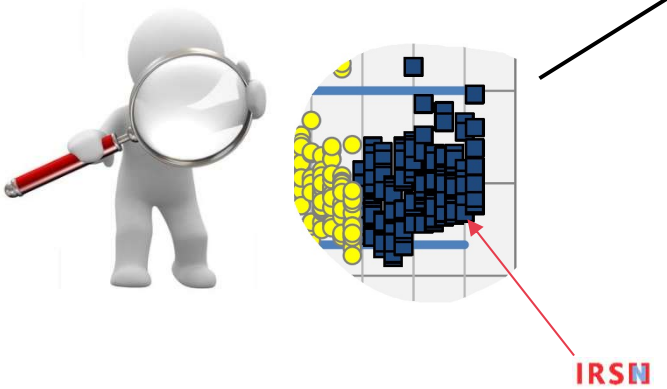
Hp(10)		Dose (mSv)			dose-meter
Radiation	Quality	Mean	Min	Max	
X-Ray	N-60	1.5	1.3	1.7	242
	N-60/60°	1.5	1.3	1.7	242
	W-110	5.0	4.5	5.5	242
	N-150/60°	1.5	1.3	1.7	242
Gamma	S-Cs-S	0.8	0.7	1.0	242
	S-Cs-L	4.9	4.3	5.8	484
	S-Co-L	5.0	4.3	5.8	242
	S-Co-M	50	43	57	242
	S-Co-H	346	300	400	242
mixed	N-150/Cs-137	6.0	5.2	6.9	242
All		38.8	0.7	400.0	2662

All participants





ISO 14146:2010



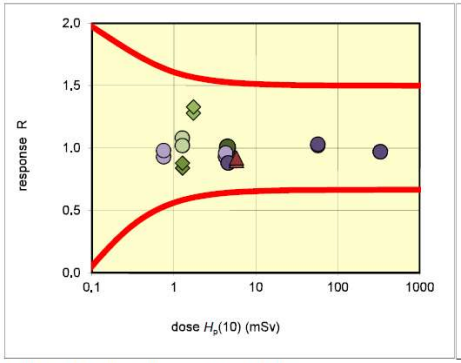
Outliers / Trumpet						
Quantity	Quality	TL	Film	OSL	other	All
Hp(10)	N-60	5%	0%	0%	4%	4%
	N-60/60°	12%	6%	8%	4%	10%
	W-110	5%	17%	3%	0%	5%
	S-Cs	5%	13%	2%	0%	4%
	S-Co	8%	19%	0%	0%	7%
	N-150/60°	4%	11%	0%	0%	3%
	N-150/Cs-137	7%	22%	0%	0%	7%
	All	6%	14%	2%	1%	6%

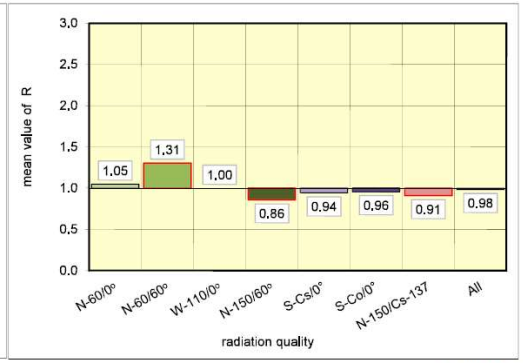
IRSN results

Reporting number 120: (other) for dose quantity Hp(10)

true values reported by the irradiating laboratory				values reported by participant	results	
radiation quality		dosemeter number	dose $H_p(10)$ mSv	dose $H_p(10)$ mSv	response R (reported/true)	
x-ray	N-60/0°	5	1.27	1.37	1.08	OK
		16	1.27	1.30	1.02	OK
	N-60/60°	34	1.73	2.21	1.28	OK
		29	1.73	2.31	1.33	OK
	W-110/0°	26	4.50	4.44	0.99	OK
		27	4.50	4.54	1.01	OK
	N-150/60°	12	1.28	1.07	0.84	OK
		22	1.28	1.12	0.88	OK
gamma	S-Cs-S/0°	15	0.75	0.70	0.93	OK
		13	0.75	0.74	0.98	OK
	S-Cs-L/0°	4	4.30	4.01	0.93	OK
		19	4.30	4.01	0.93	OK
		21	4.30	3.99	0.93	OK
		9	4.30	4.12	0.96	OK
	S-Co-L/0°	2	4.60	4.06	0.88	OK
		24	4.60	4.06	0.88	OK
	S-Co-M/0°	33	57.00	57.92	1.02	OK
		31	57.00	58.74	1.03	OK
	S-Co-H/0°	7	330.00	319.58	0.97	OK
		8	330.00	320.17	0.97	OK
mixed	N-150/Cs-137	32	5.80	5.21	0.90	OK
		18	5.80	5.32	0.92	OK

outliers: 0 of 22 **Fraction of outliers: 0%**





ISO14146:2000 trumpet curve parameter: 1.5 / 0.085 mSv

Results: IC2018

Note : dosemeters were exposed during transport

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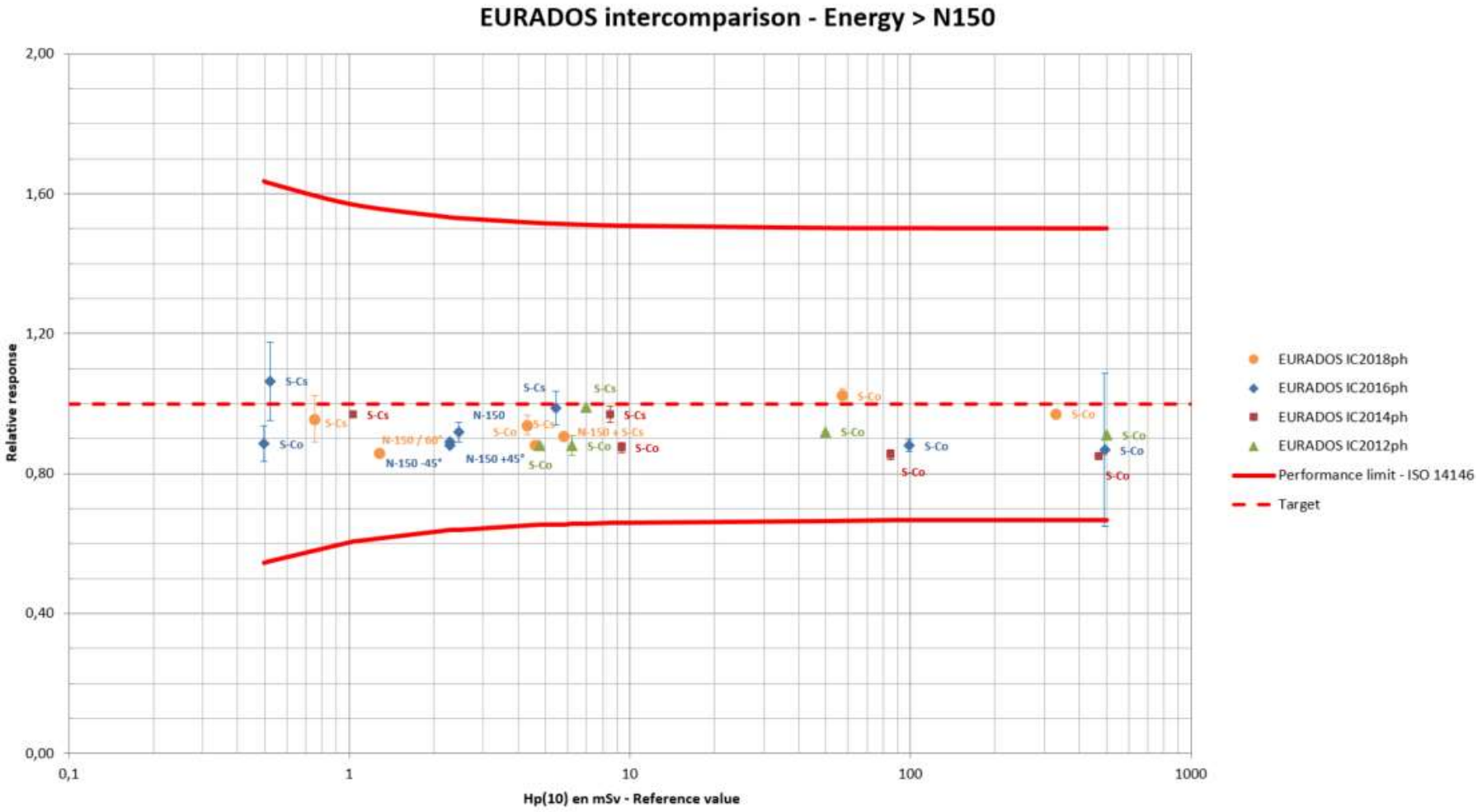
IRSN results for differents IC



Stable results

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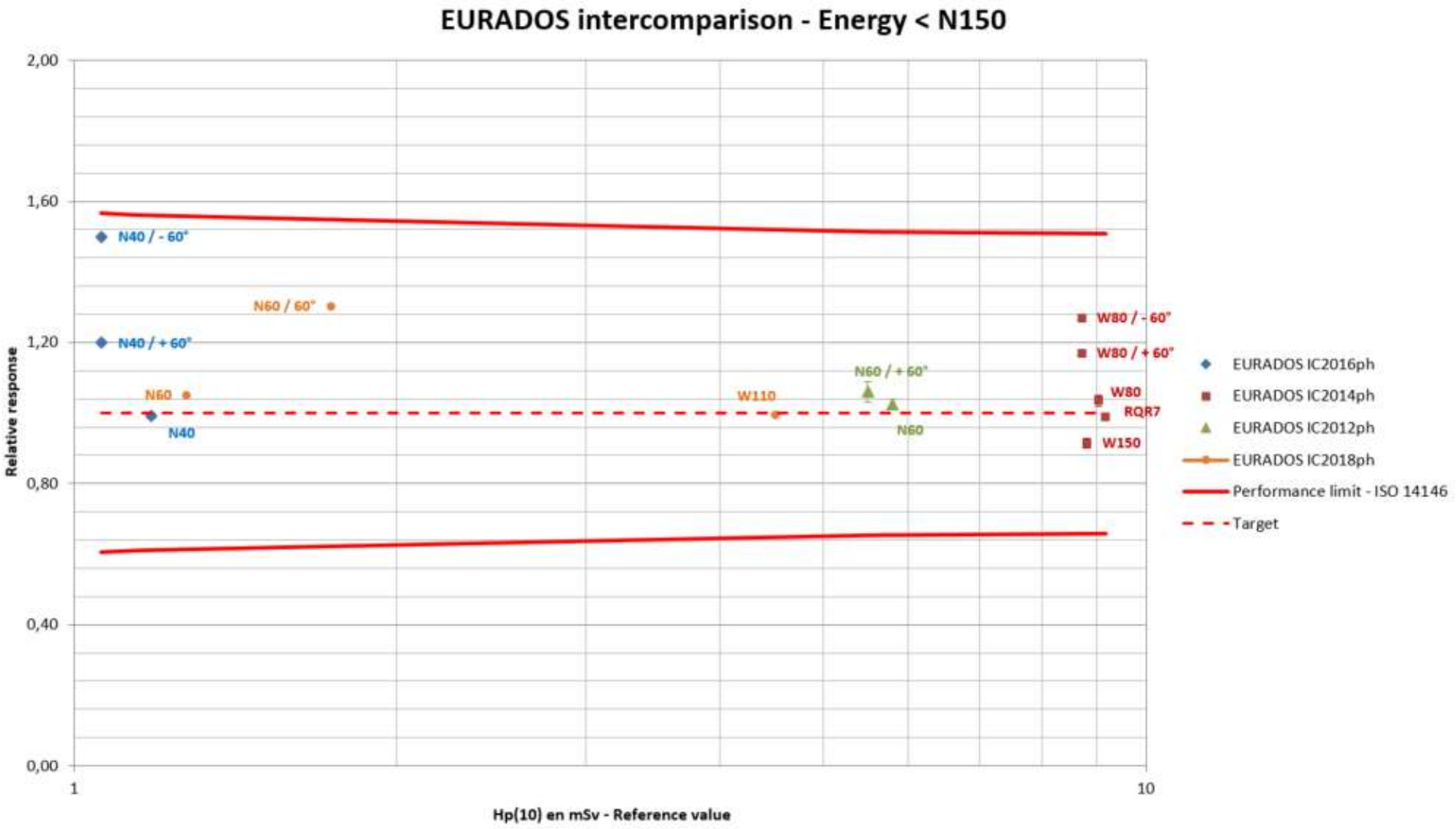
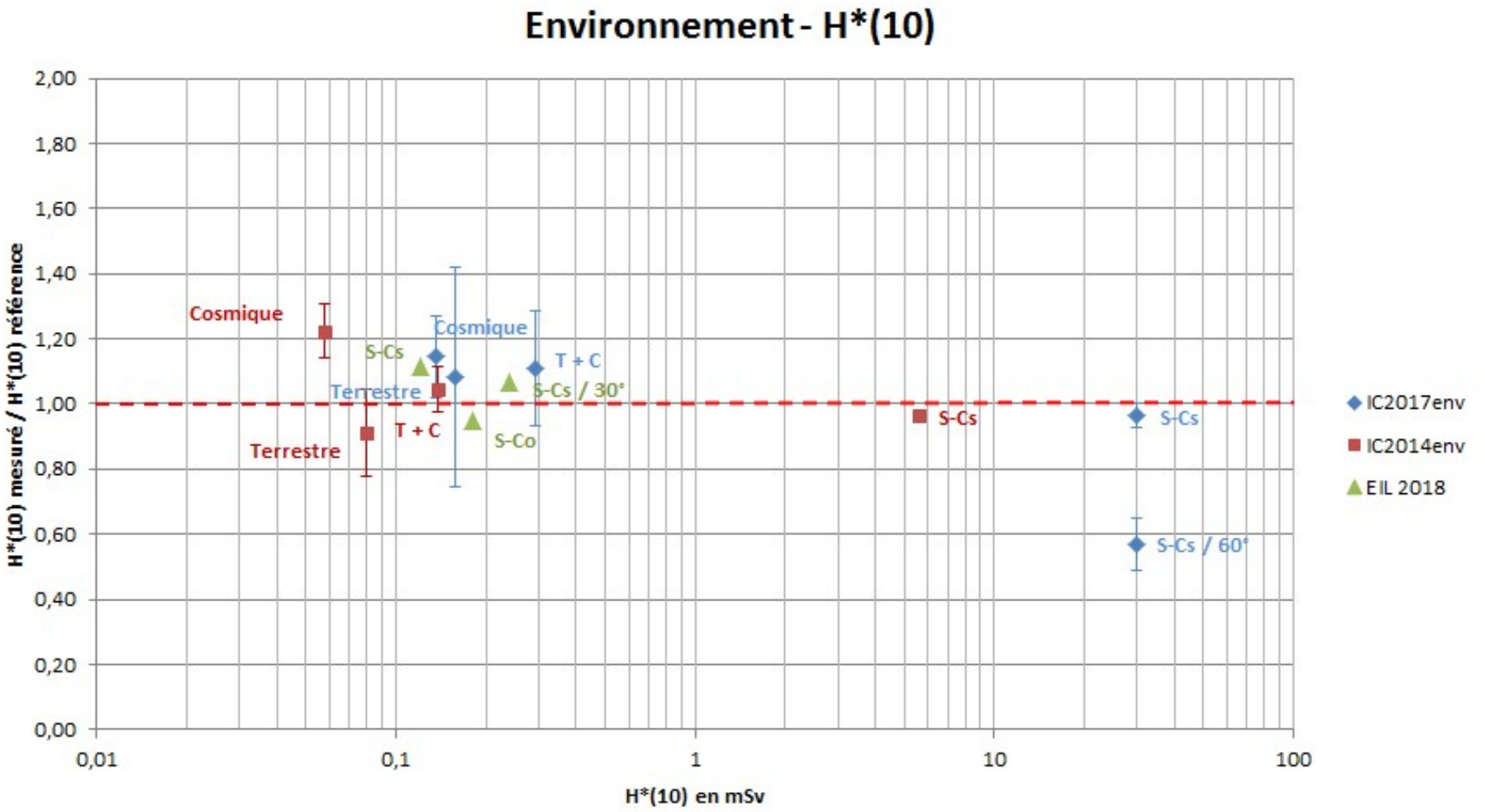

EURADOS intercomparison - Energy < N150
2,00
1,60
1,20
0,80
0,40
0,00
Relative response
1
10
Hp(10) en mSv - Reference value
N40 / - 60°
N40 / + 60°
N60
N40
N60 / 60°
W110
N60 / + 60°
N60
W80 / - 60°
W80 / + 60°
W80
RQR7
W150
EURADOS IC2016ph
EURADOS IC2014ph
EURADOS IC2012ph
EURADOS IC2018ph
Performance limit - ISO 14146
Target


Environnement - H*(10)
H*(10) mesuré / H*(10) référence
2,00
1,80
1,60
1,40
1,20
1,00
0,80
0,60
0,40
0,20
0,00
0,01
0,1
1
10
100
H*(10) en mSv
Cosmique
Terrestre
S-Cs
Cosmique
T + C
Terrestre
T + C
S-Cs / 30°
S-Co
S-Cs
S-Cs
S-Cs / 60°
IC2017env
IC2014env
EIL 2018

Summary

- RPL technology is reliable and robust
- The possibility of re-reading as many times as necessary is a real comfort
- The metrological performances are excellent
- Expertise capacity is an asset, particularly for accidental or abnormal exposures

Example of instructions for COVID

- Package received from our customers
  - Handling with gloves
  - 4 days waiting before opening
- At the opening workstation
  - Wear gloves and mask
  - Wash hands regularly
  - Clean workstation regularly
- In the building
  - Keep the doors open
  - Respect the floor markings and distancing

Thank you for your attention

http://dosimetrie.irsn.fr

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