



First National Intercomparison of Individual Dosimetry of Photon Radiation in Ukraine

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The 1st National Intercomparison

Initiated in 2014 under auspices of the “All-state Social Program of Enhancement of the Safety State, Occupational Hygiene and Work Environments for 2014-2018”

The aim: to cover all certified IDM laboratories in Ukraine

Design: in line with the designs of EURADOS intercomparisons (with some deviations)

Participation is free for all IDM labs

Intercomparison design: starting points

- Announced test with blind design (irradiation conditions are unknown to participants and coordinator of the intercomparison)
- Maximum engagement of IDM laboratories of Ukraine
- Participation is free for IDM laboratories
- Unbiased and objective judgment
- Test irradiations in domestic and foreign calibration labs
- Open discussion of the results
- Maximum dissemination of the results

Intercomparison design allows to:

- Evaluate ability of laboratories to adequately measure individual doses
- Evaluate effect of the conditions of irradiation on the results of dosimetry
- Estimate Type A and Type B uncertainties
- Estimate linearity of the response
- Evaluate impact of instrumentation and methodologies

Intercomparison design: control over transport/background doses

- In order to reduce natural background dose: short time for implementation - interval between annealing and readout of dosimeters – 37 days (mean), 49 days (max)
- In order to reduce transport dose: personal delivery of dosimeters by ground transportation



Intercomparison design: control over transport/background doses

Result: mean transport + natural background dose was about 60 μSv for both Mol and Byela Tserkva and is comparable to the natural background

Intercomparison design: securing the glasnost

- Circular notification and broadcast of information
- Open feedback from participants
- Solving open questions by general discussion
- No anonymity of the participants at the stage of discussion of the results

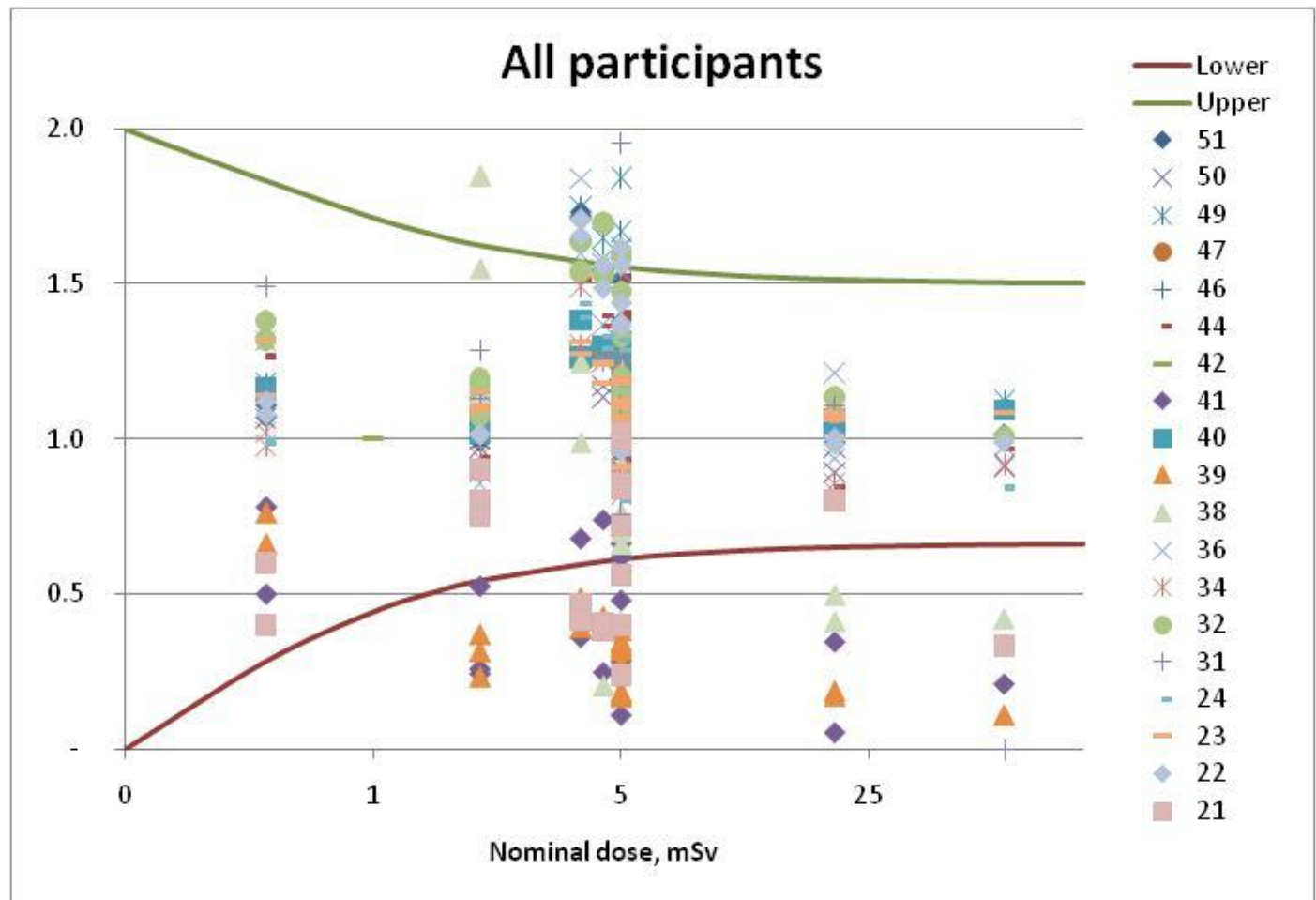
Dosimetric systems

- Film dosimetry – 1
- Manual TLD – 2 types (three dosemeter types)
- Semi-automatic TLD – 1
- Automatic TLD – 3 types (five dosemeter types)



Evaluation criteria

ISO 14146, $H_0=0.2$ mSv



Summary table for a participant

Results for all radiation qualities

Total number of irradiated dosimeters:	24
Total number of reported values:	24
Meets ISO 14146 criteria:	24
Percentage of the results, which meet the criterion (should be not less that 90%):	100%

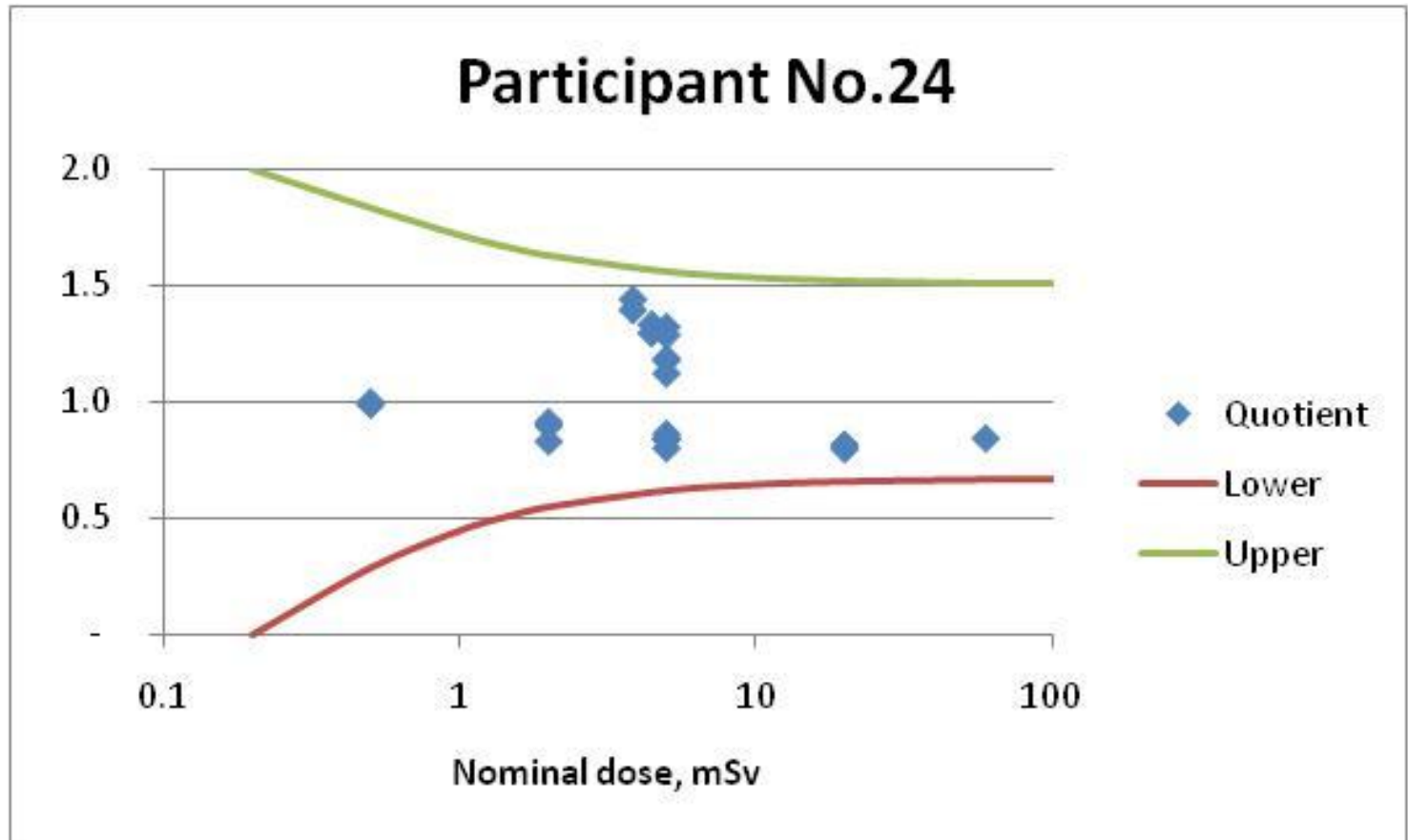
Does the lab meet ISO 14146 performance criteria: YES

Results separately for S-Cs series

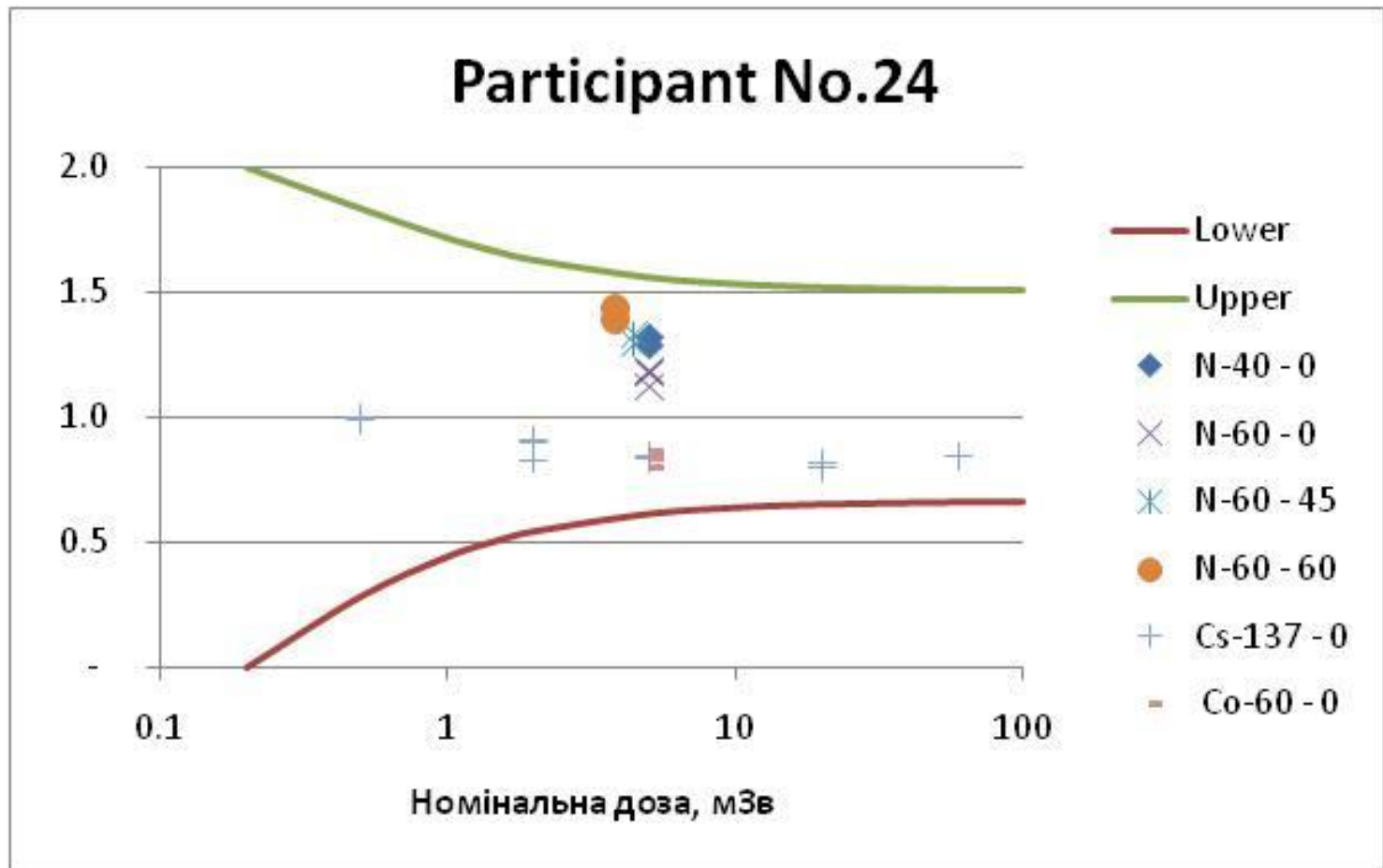
Total number of irradiated dosimeters:	12
Total number of reported values:	12
Meets ISO 14146 criteria:	12
Percentage of the results, which meet the criterion:	100%

Relative random error (Type A) at S-Cs source (5 mSv):	0.2%
Relative systematic error (Type B) at S-Cs source (dose range 0.5-60 mSv):	13%
Mean calibration coefficient at S-Cs source (dose range 0.5-60 mSv):	0.87

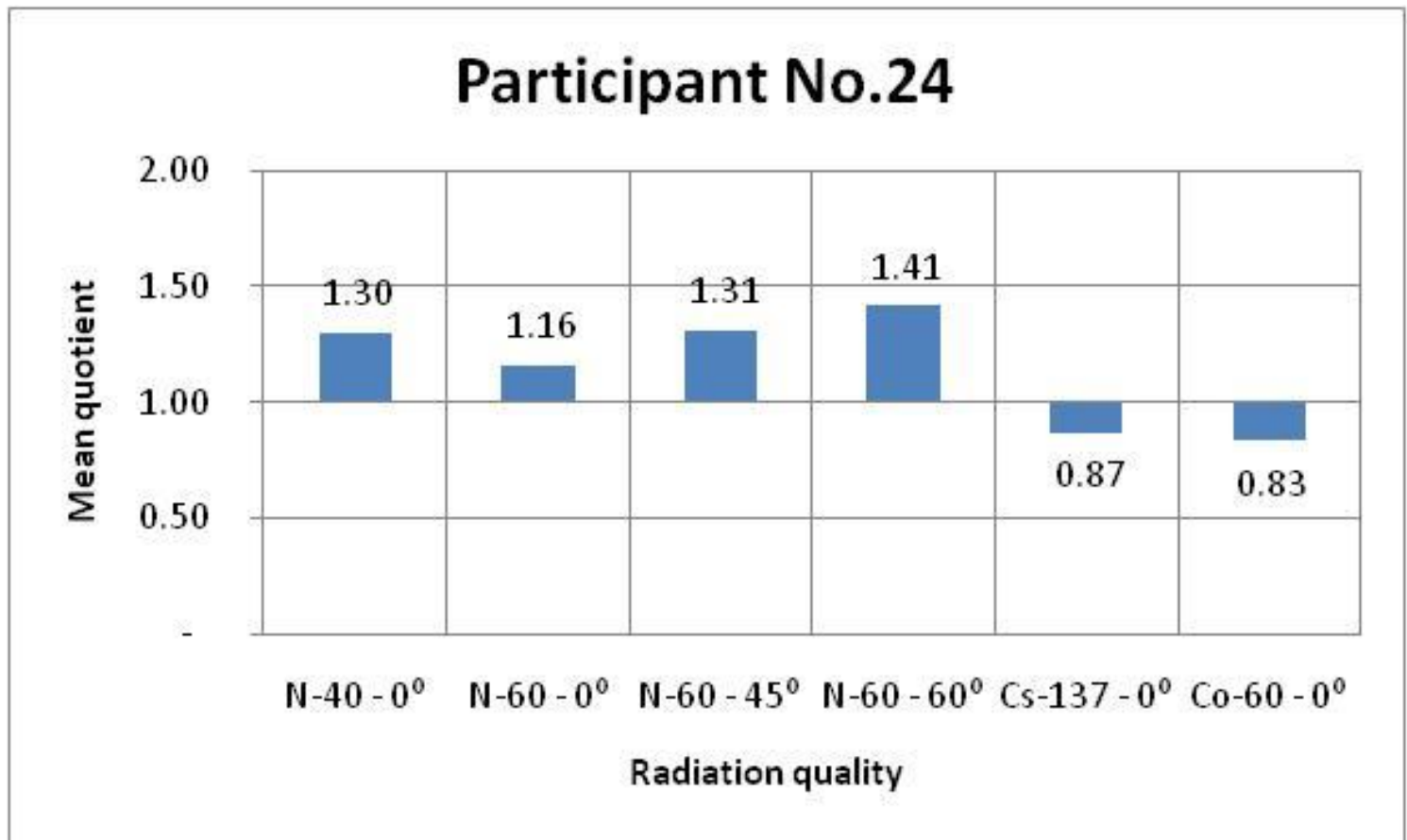
Trumpet curve for a participant (general)



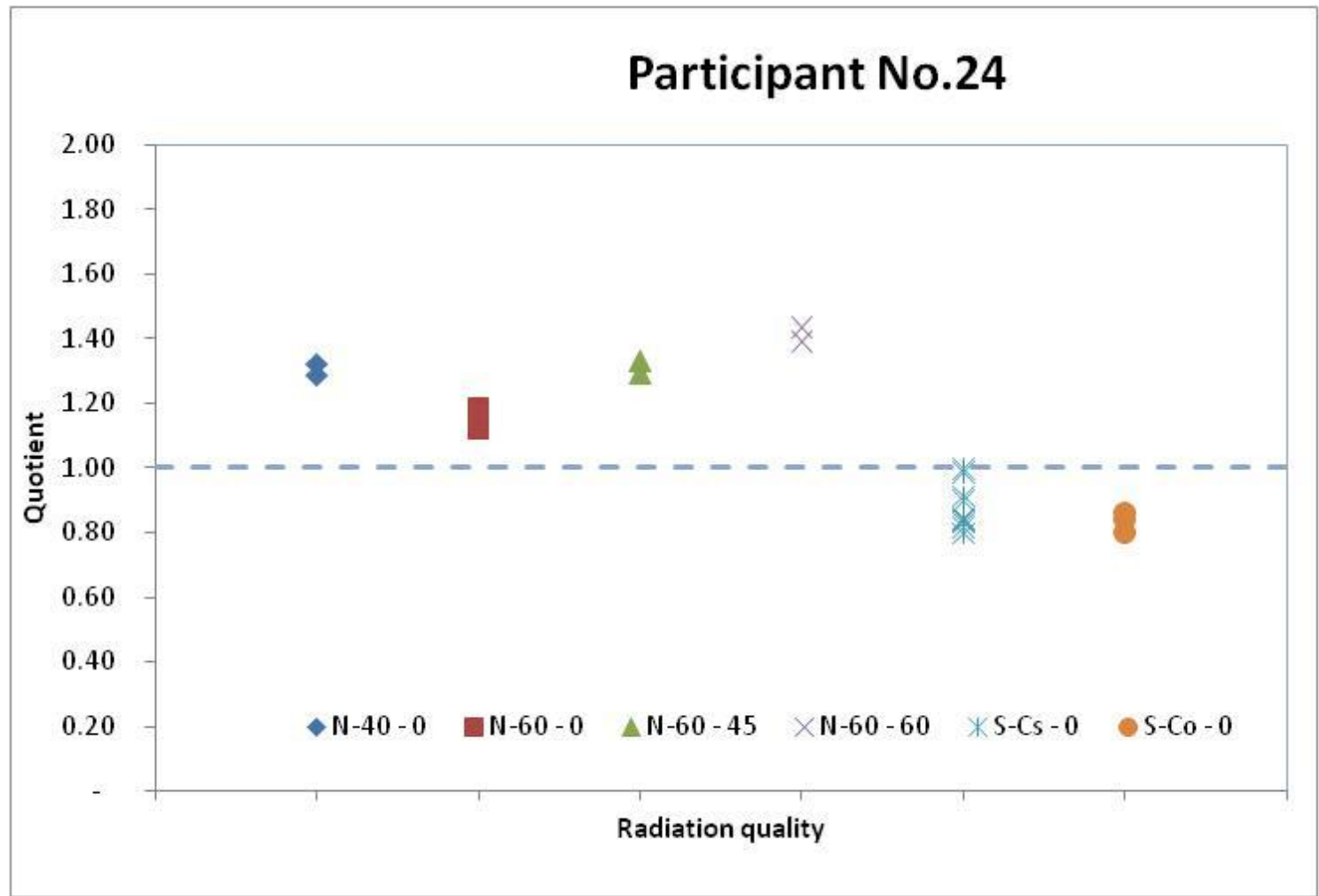
Trumpet curve for a participant (by quality)



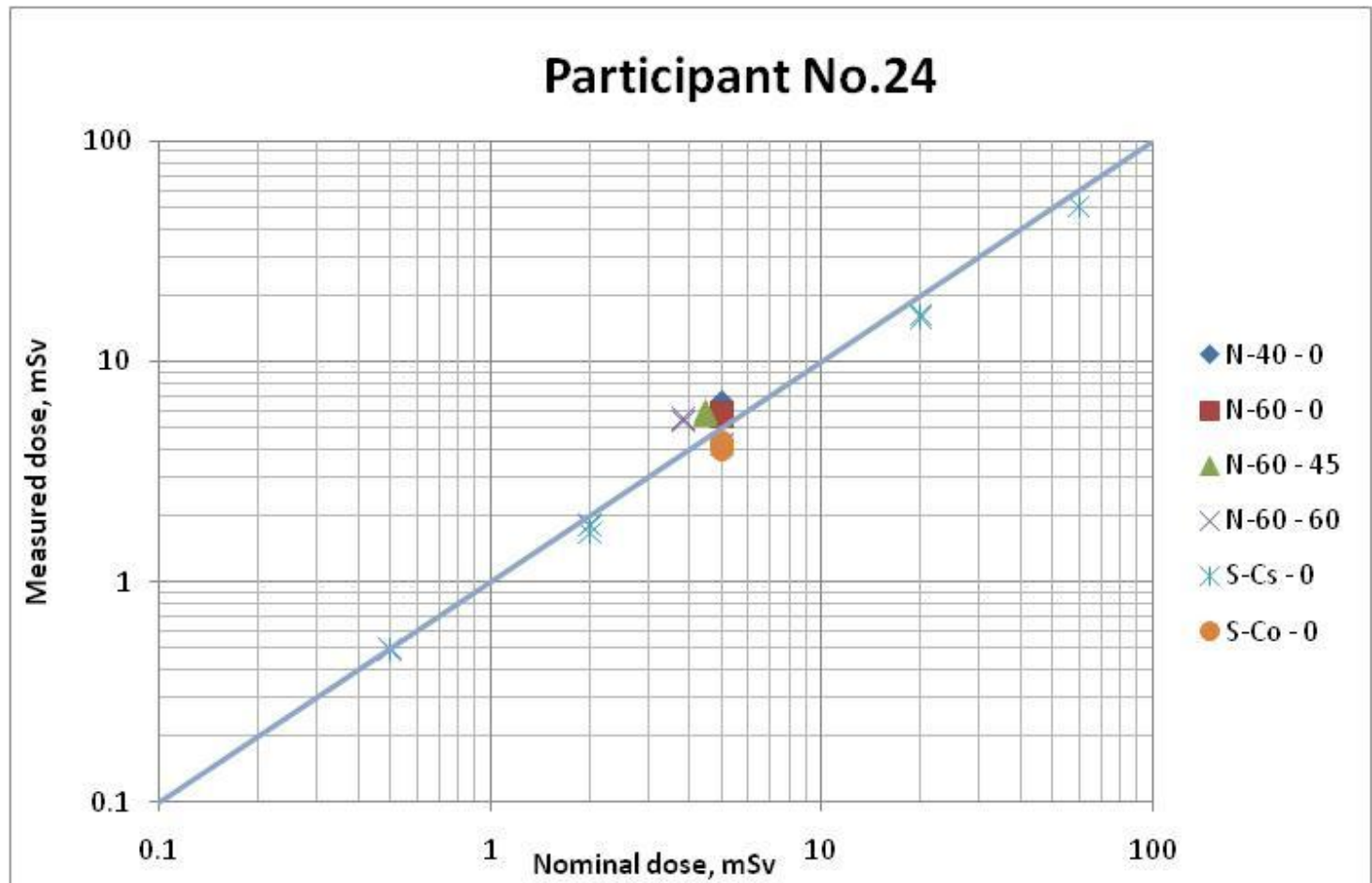
Mean quotient for a participant by quality



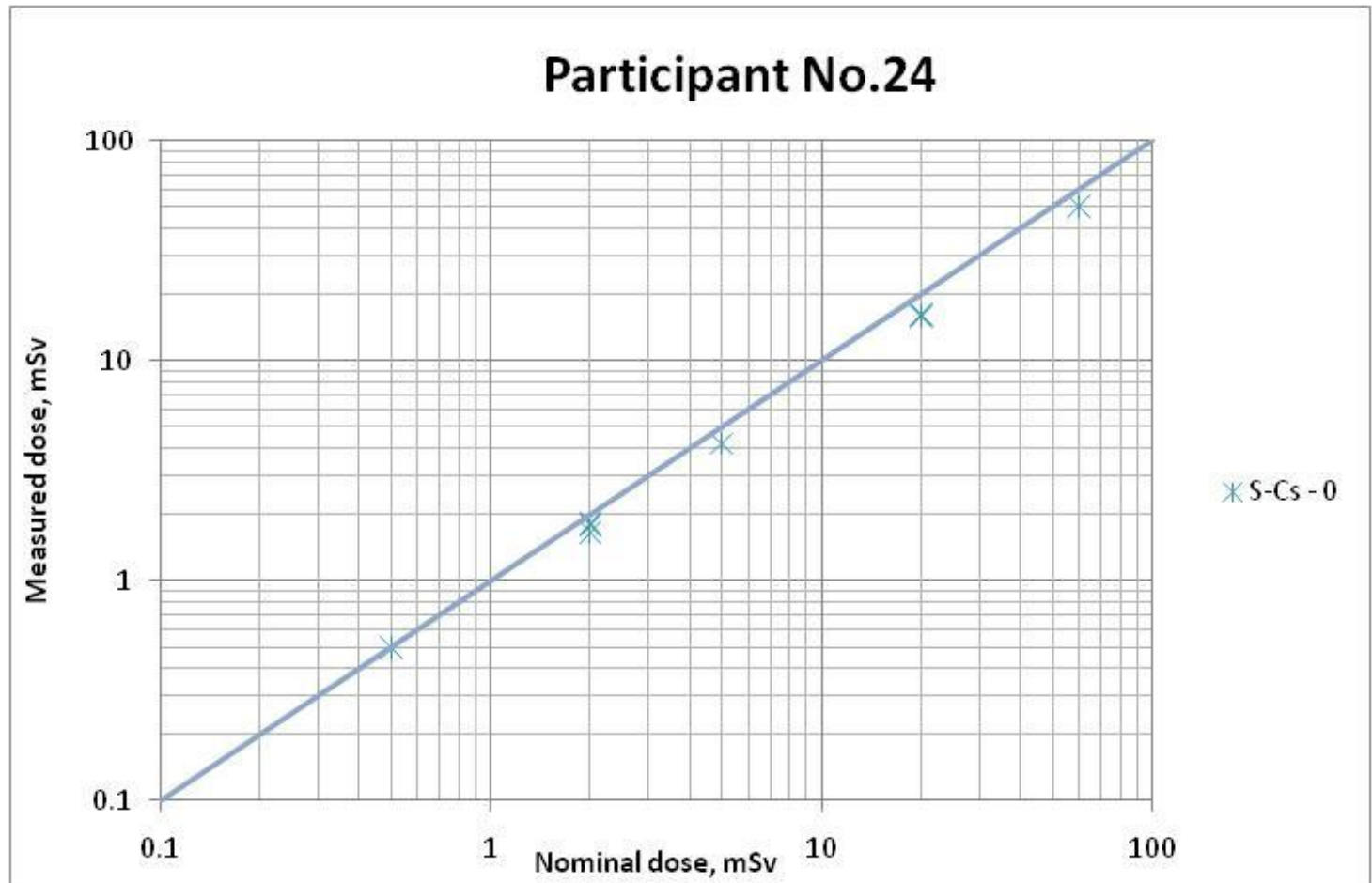
Individual quotients for a participant by quality



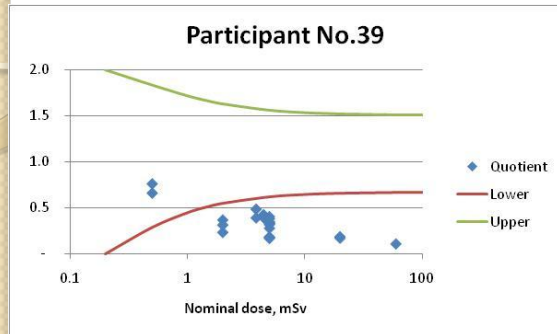
Scatter plot for a participant (all qualities)



Scatter plot for a participant (S-Cs)



Example of bad results



Results for all radiation qualities

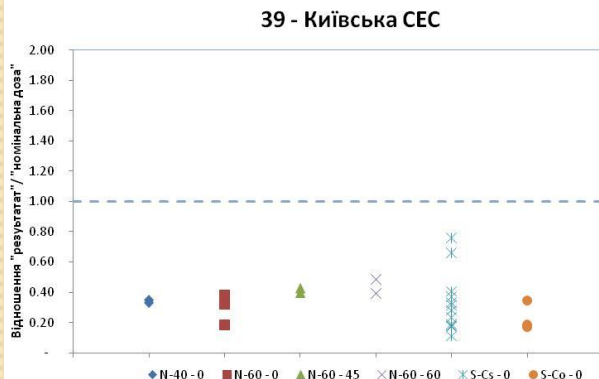
Total number of irradiated dosimeters: 24
 Total number of reported values: 24
 Meets ISO 14146 criteria: 2
 Percentage of the results, which meet the criterion (should be not less that 90%): 8%

Does the lab meet ISO 14146 performance criteria: NO



Results separately for S-Cs series

Total number of irradiated dosimeters: 12
 Total number of reported values: 12
 Meets ISO 14146 criteria: 2
 Percentage of the results, which meet the criterion: 17%



Relative random error (Type A) at S-Cs source (5 mSv): 31.7%

Relative systematic error (Type B) at S-Cs source (dose range 0.5-60 mSv): 66.6%

Mean calibration coefficient at S-Cs source (dose range 0.5-60 mSv): 0.33

Illustration of some results: performance of film dosimetry

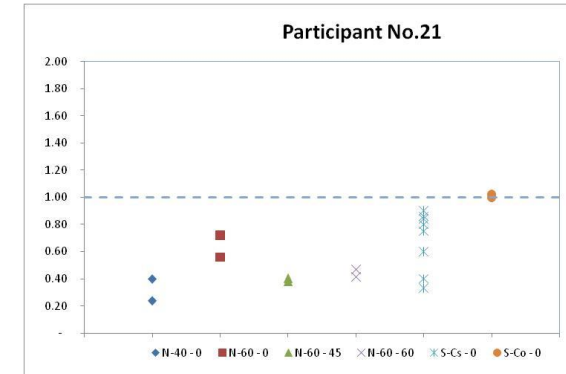
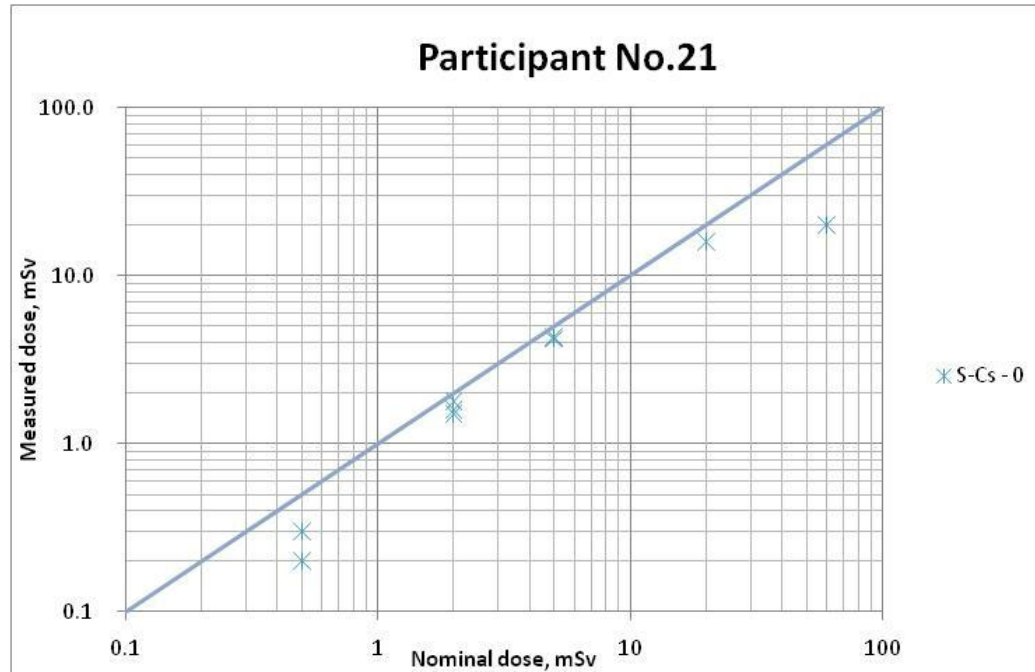
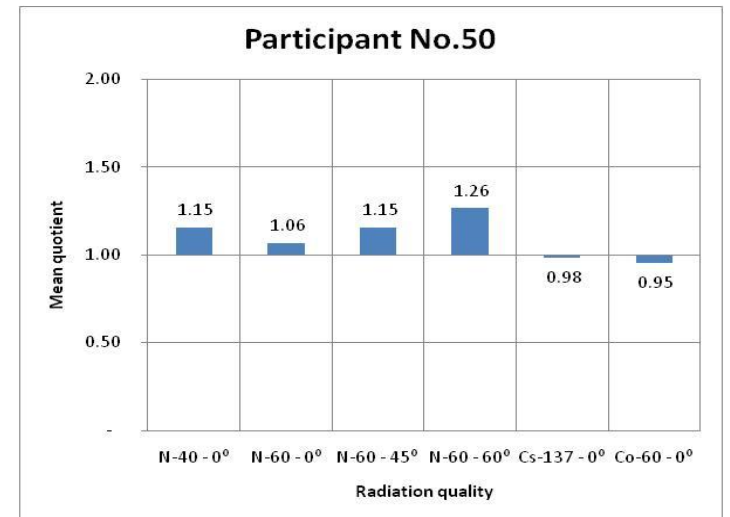
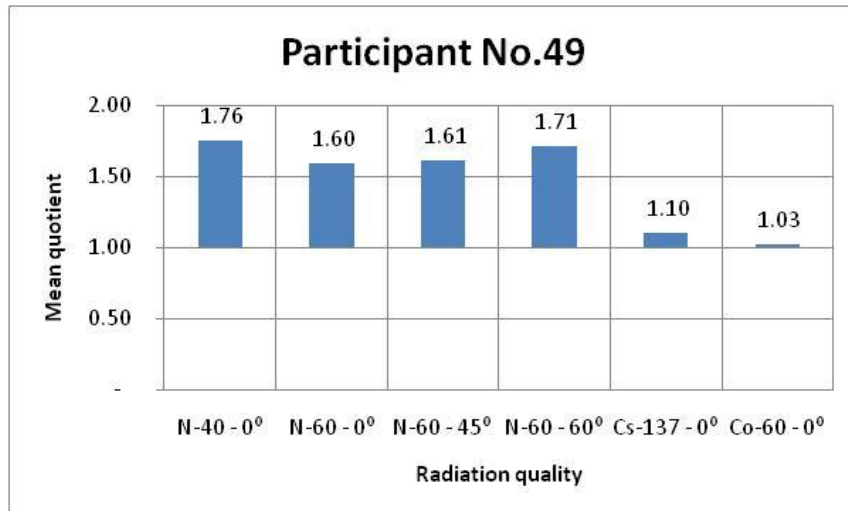
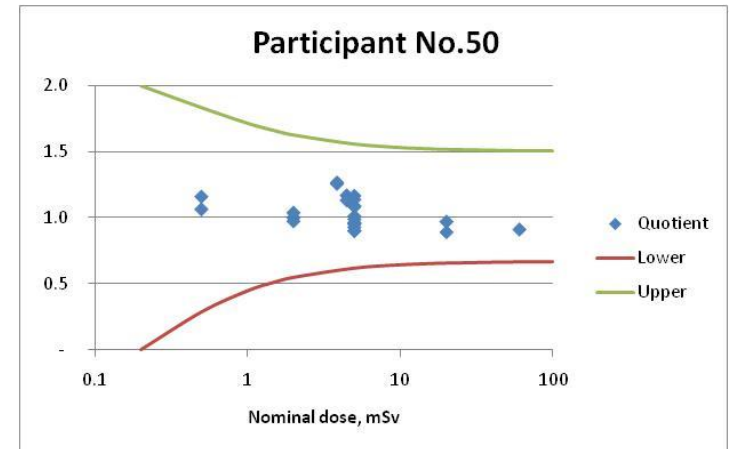
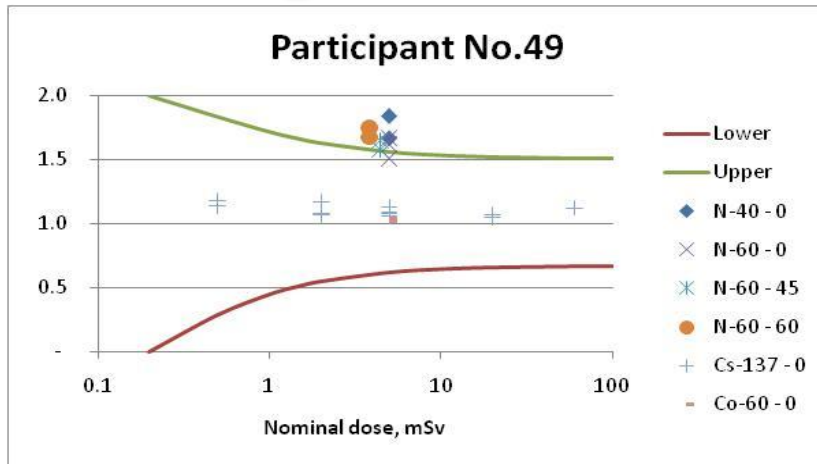
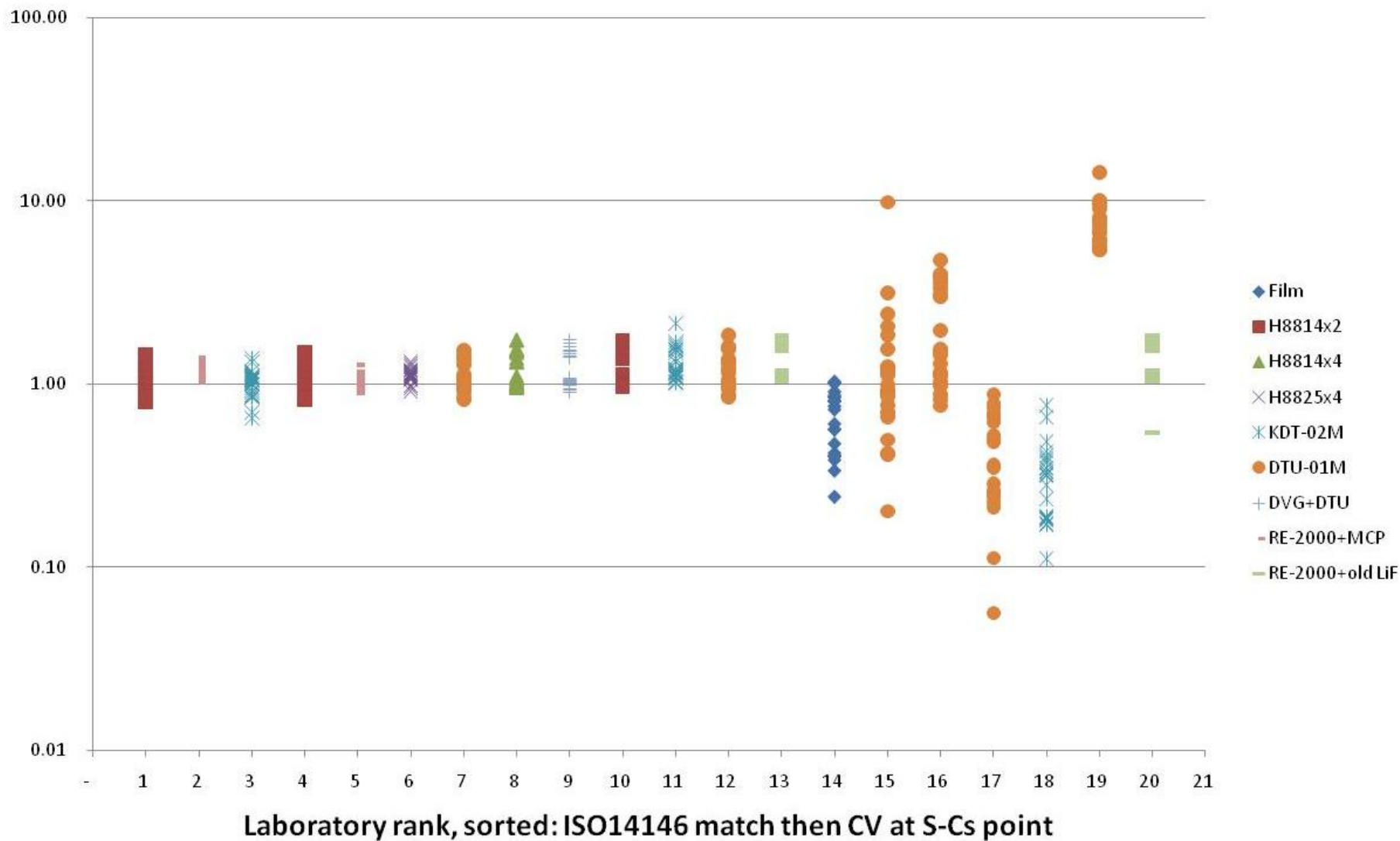


Illustration of some results: LiF:Mg, Ti vs. LiF:Mg,Cu,P



All results: effect of dosimetry system



Summary results (general)

Part.code	Meets ISO 14146	Total results	Within trumpet curve	% within trumpet curve	Min R	Max R	Min/Max R	Calibration coefficient S-Cs	R at 60 mSv
21	no	24	15	63%	0.24	1.02	4.25	0.73	0.33
22	no	24	19	79%	0.96	1.71	1.78	1.02	0.99
23	Yes	24	24	100%	0.91	1.32	1.45	1.10	1.08
24	Yes	24	24	100%	0.80	1.44	1.80	0.87	0.84
31	no	23	13	57%	-	4.73	-	1.01	-
32	no	24	19	79%	1.01	2.13	2.11	1.16	1.01
34	Yes	24	24	100%	0.82	1.49	1.81	0.90	0.92
36	no	24	19	79%	0.85	1.84	2.16	1.06	0.98
38	no	24	15	63%	0.20	9.80	48.51	1.80	0.42
39	no	24	2	8%	0.11	0.76	6.84	0.33	0.11
40	Yes	24	24	100%	0.65	1.38	2.12	1.09	0.95
41	no	23	9	39%	0.06	0.88	15.68	0.36	0.21
42	no	24	21	88%	0.90	1.73	1.91	1.00	1.05
44	Yes	23	23	100%	0.82	1.52	-	0.99	-
441	Yes	24	24	100%	0.82	1.52	1.85	0.99	0.97
46	no	24	0	0%	5.35	14.31	2.67	6.35	5.66
47	Yes	24	24	100%	1.02	1.38	1.36	1.07	1.09
49	no	24	13	54%	0.54	1.84	3.43	0.97	1.12
491	no	24	16	67%	1.02	1.84	1.81	1.10	1.12
50	Yes	24	24	100%	0.89	1.27	1.42	0.98	0.91
51	Yes	24	22	92%	0.95	1.73	1.82	1.02	1.01

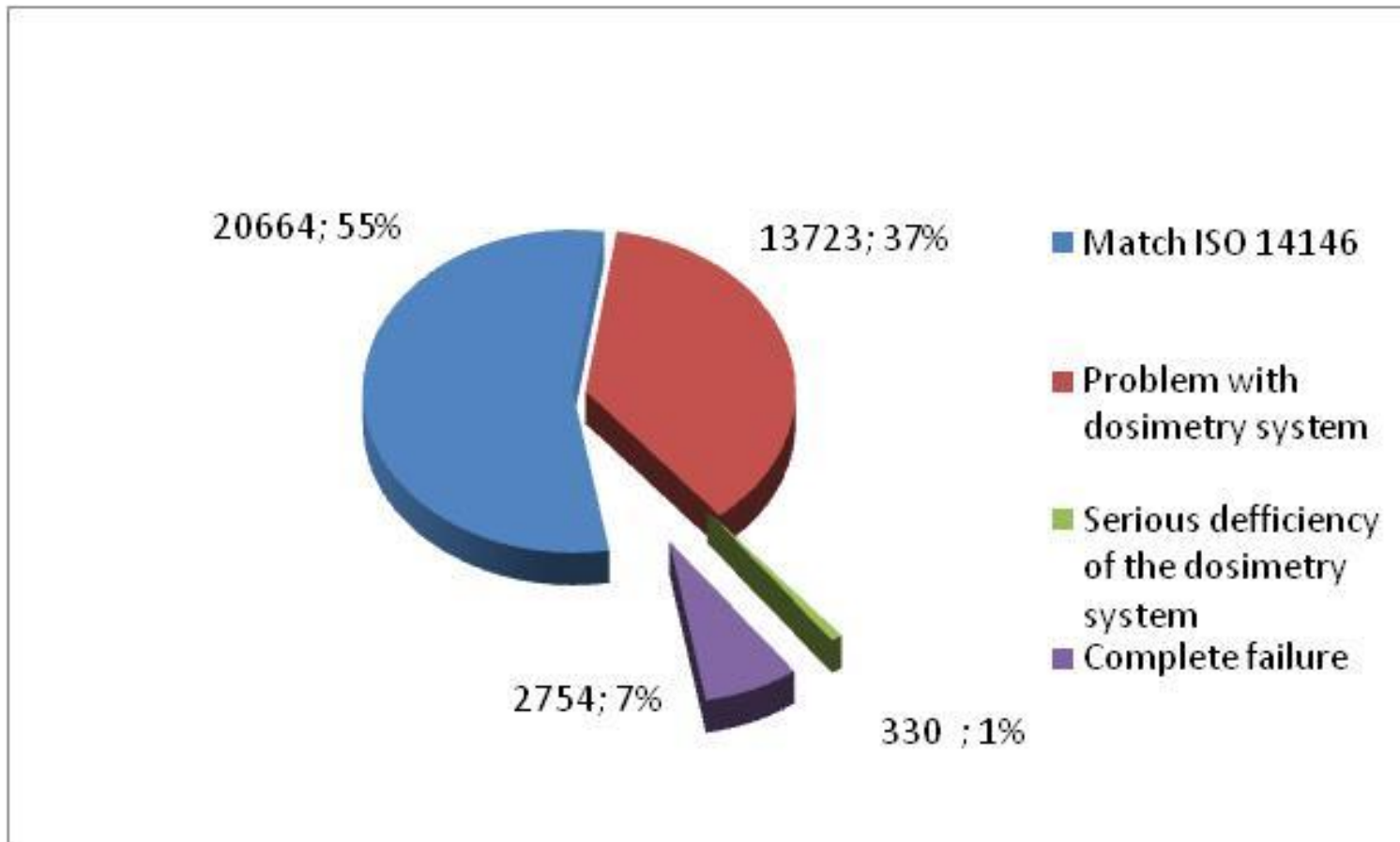
Summary results (S-Cs)

Participant code	Meets ISO 14146 (general)	Meets ISO 14146 (S-Cs)	Calibration S-Cs	% meets ISO 14146 (S-Cs)	Relative random error at 5 mSv
21	no	Yes	0.73	92%	1.2%
22	no	Yes	1.02	100%	1.9%
23	Yes	Yes	1.10	100%	8.7%
24	Yes	Yes	0.87	100%	0.2%
31	no	Yes	1.01	92%	36.9%
32	no	Yes	1.16	100%	4.1%
34	Yes	Yes	0.90	100%	3.2%
36	no	Yes	1.06	100%	7.7%
38	no	no	1.80	50%	19.5%
39	no	no	0.33	17%	31.7%
40	Yes	Yes	1.09	100%	2.6%
41	no	no	0.36	25%	57.8%
42	no	Yes	1.00	100%	1.7%
44	Yes	Yes	0.99	100%	5.5%
441	Yes	Yes	0.99	100%	5.5%
46	no	no	6.35	0%	14.9%
47	Yes	Yes	1.07	100%	0.4%
49	no	no	0.97	75%	38.9%
491	no	Yes	1.10	100%	2.8%
50	Yes	Yes	0.98	100%	4.6%
51	Yes	Yes	1.02	100%	0.8%

Effect of dosimetry system

Participant code	Meets ISO 14146	Instrument	Dosemeter type	Year of manufacturing	Metrology lab code
21	no	ИФКУ-1	Film		(3)
22	no	Harshaw 8800	TLD-100, 2-element/8814	1992	(1)
23	Yes	Harshaw 6600	TLD-100/8825		(1)
24	Yes	Harshaw 6600 Plus	TLD-100/8814	2004	(1)
31	no	ДТУ-01	LiF:Mg,Ti (Russia)	1987	(3)
32	no	КДТ-02М	Al ₂ O ₃	1989, 1990	(4)
34	Yes	Harshaw 8800	TLD-100/8814	1998	(1)
36	no	ДТУ-01М	LiF:Mg,Ti (Russia)	1996	(1)
38	no	ДТУ-01	LiF:Mg,Ti (Russia)	1995	(3)
39	no	КДТ-02М	Al ₂ O ₃	1998	(3)
40	Yes	КДТ-02М	Al ₂ O ₃	1990	(1)
41	no	ДТУ 01			(3)
42	no	ДВГ-02ТМ	LiF:Mg,Ti (Russia)	2009	(2)
44	Yes	ДТУ-01	LiF:Mg,Ti (Russia)	1990	(1)
441	Yes	ДТУ-01	LiF:Mg,Ti (Russia)	1990	(1)
46	no	ДТУ-01М	LiF:Mg,Ti (Russia)	2007	(1)
47	Yes	RE-2000	LiF:Mg,Cu,P	2008	(2)
49	no	RE-2000	LiF:Mg,Ti (Russia)	2006	(2)
491	no	RE-2000	LiF:Mg,Ti (Russia)	2006	(2)
50	Yes	RE-2000	LiF:Mg,Cu,P	2006	(1)
51	Yes	Harshaw 8800	TLD-100, 4-element/ 8814	1992	(1)

Distribution of results by the number of monitored persons



Conclusions

- The results of the 1st National Intercomparison proved to be very educative:
 - ISO 14146 criteria are met by 8 of 18 laboratories (9 of 19 dosimetry systems)
 - 55% of occupationally exposed personnel receives high quality IDM
 - About 3,000 individuals get IDM of catastrophic quality
- There is a strong demand for continuation of the intercomparison exercises at national and international levels



Thank you!