GAMMA SPECTROMETRIC MEASUREMENTS QUALITY ASSURANCE

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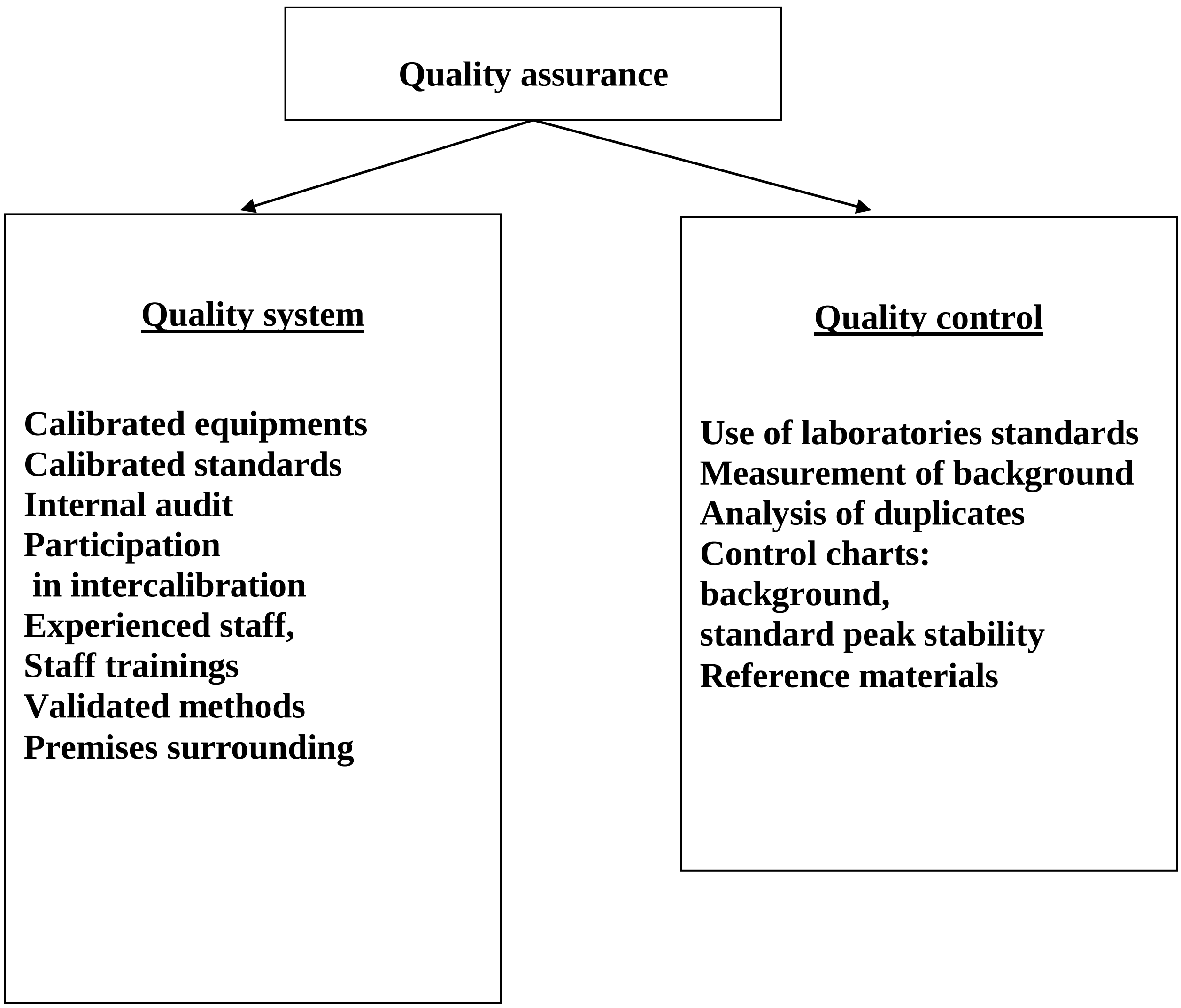
Introduction

The role of quality assurance in gamma spectrometric measurements of radioactivity is discussed. It is based on the real examples of laboratory practice. In our Laboratory of Radiation Physics are carried out the measurements of the gamma spectra of natural as well as artifical radionuclides in different environmental samples (soil, precipitation, different types of water, needles, etc.), various types of samples irradiated in the nuclear reactor and in the radioactive polluted objects. Since year 2000 our laboratory is accredited in the Latvian National Accreditation Service (LATAK) where the quality assurance system was implemented.
The credibility of obtained results is ensured by the quality assurance and control. The main requisitions involved in the quality assurance of the laboratory according to the requirements of ISO/IEC 17025:2005 /1/ are: 1) the use of calibrated equipment only; 2) the regular and long-time use of reference materials for the control of equipments; 3) the estimation of uncertainty sources and determination of uncertainties within the given interval of credibility; 4) the validation and verification. The very important requirement is a regular participation in the interlaboratory comparison exercises, which enables one to estimate and disclose possible sources of non-conformities as well as to carry out the corrective actions.

Results and discussion

The paper presents the laboratory's system of quality assurance and the process of its implementation. Further there is given the quality assurance scheme used in the laboratory.


Quality assurance
Quality system
Calibrated equipments
Calibrated standards
Internal audit
Participation
in intercalibration
Experienced staff,
Staff trainings
Validated methods
Premises surrounding
Quality control
Use of laboratories standards
Measurement of background
Analysis of duplicates
Control charts:
background,
standard peak stability
Reference materials

Our internal quality audit program covers all requirements of ISO/IEC 17025:2005 standard, but the main attention is paid to the analysis of results of laboratory's participation in intercomparison measurements, their evaluation, interpretation and determination of uncertainty sources.
Since 1999 laboratory is a regular participant in the interlaboratory comparison exercises organized by the RISO National Laboratory (Denmark) and IAEA (Vienna). Such nuclides as K-40, Mn-54, Co-57, Co-60, Zn-65, Cs-134, Cs-137, Eu-152, Ra-226, U-238 and Th-232 were analyzed in following intercomparison samples: soils, sediment, seaweed, aerosol, grass, hay, meat, dray milk, waters.

Table 1.

Participation of laboratory in the intercomparison exercises /2-5/

Year	Organizer	Object	Radionuclides
1999	**Risoe National laboratory, Denmark**	**Sediment, milk, meat, seaweed, hay**	**K-40, Mn-54, Co-60, Cs-137, Ra-226, Th-232**
2000	**Risoe National laboratory, Denmark**	**Milk, aerosols, soil, seaweed**	**K-40, Cs-137, Co-60, Mn-54, Ra-226, Th-232**
2002	**IAEA, Vienna**	**Mineral matrix**	**Mn-54, Co-57, Co-60, Cs-134, Cs-137, Eu-152**
2003	**Risoe National laboratory, Denmark**	**milk, mineral matrix, seaweed**	**Cs-137, K-40**
2004-2005	**Risoe National laboratory, Denmark**	**Sediment, soil, seaweed**	**K-40, , Cs-137, U-238, Th-232**
2006	**IAEA, Vienna**	**Soil, grass, water**	**K-40, Mn-54, Co-60, Zn-65, Cs-134, Cs-137**

Further on there are some examples of the intercalibration results. Fig. 1 compares our results with the weighted mean in seaweed. There is a good agreement between them.

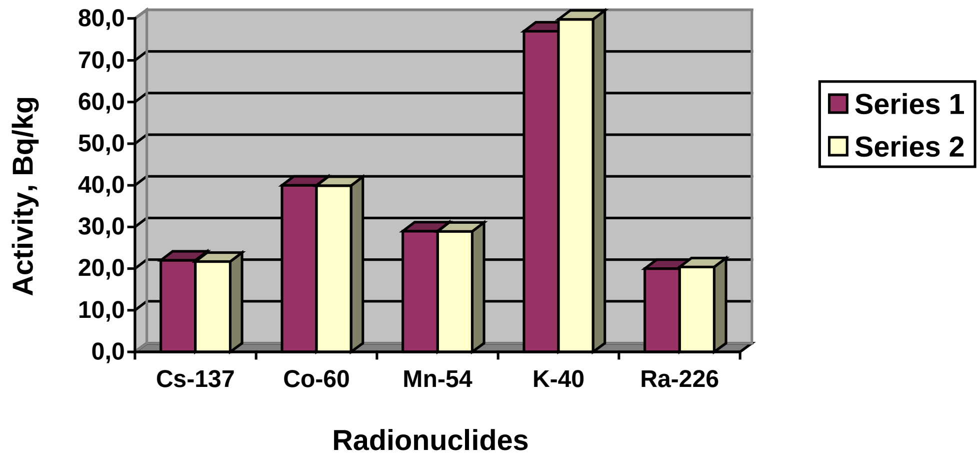


Fig.1. Comparision of reported value with the weighted mean in seaweed, Risoe

Series 1-reported value; series 2-weighted mean

Next two tables and figures demonstrate z-scores Cs-137 of separate laboratories and composed z-scores of all nuclides analyzed.

Table 2.

Statistical evaluation of results for Cs-137

Lab. No.	n	RSZ	Sign	SSZ	Sign
1	2	-1.1	ns	1.2	ns
2	3	0.4	ns	0.3	*
3	5	0.1	ns	0.7	*
4	5	-1.6	ns	16.9	**
5	5	-2.2	*	57.8	***
6	4	4.4	***	25.2	***
7	5	-2.7	**	19.1	**
9	2	0.5	ns	0.4	ns
10	2	-2.7	**	7.3	ns
11	1	-0.3	ns	0.1	ns
12	4	-0.2	ns	2.2	ns
13	5	2.7	**	48.1	***
14	3	0.0	ns	0.0	***
15	3	-0.2	ns	0.4	ns
16	4	1.4	ns	5.6	ns
17	5	0.2	ns	3.8	ns

ns - denotes not significant; * - sign. at the 95% level; ** - at 99%; *** - at 99.9%

RSZ - the resealed sum of z-scores

SSZ - the sum of squares of z-scores

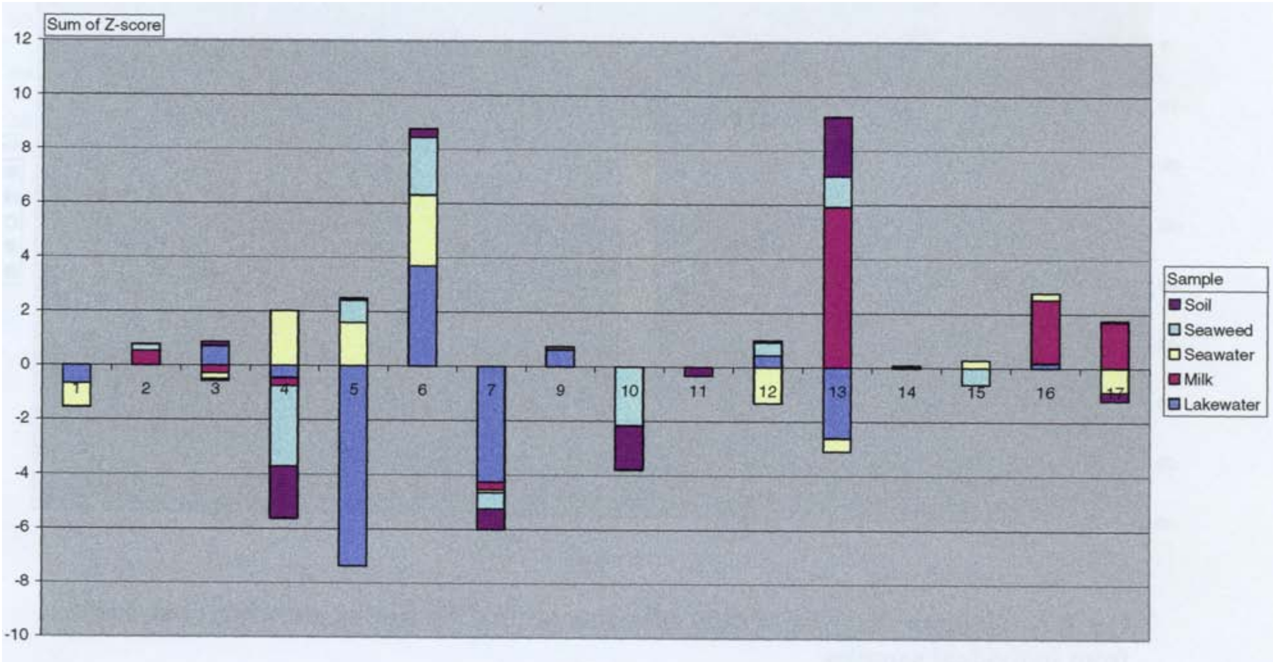


Fig. 2. Column diagram of sum of z-scores for Cs-137 results showing contributions from individual samples (No. 17-Laboratory of Radiation Physics Inst. Of Solid State Physics).

Table 3.

Statistical evaluation of results for all radionuclides combined

Lab. No.	n	RSZ	Sign	SSZ	Sign
1	7	2.6	*	24.0	**
2	9	0.0	ns	1.9	*
3	19	-0.5	ns	10.4	ns
4	13	-0.7	ns	48.6	***
5	14	-5.4	***	117.9	***
6	10	5.2	***	37.2.	***
7	14	-31.5	***	2743.2	***
9	4	5.0	***	41.4	***
10	7	-7.6	***	22.8	**
11	4	0.0	ns	6.1	ns
12	6	3.0	**	22.8	***
13	9	2.5	*	93.3	***
14	10	-1.5	ns	3.0	*
15	7	-0.7	ns	1.2	*
16	9	-1.3	ns	32.2	***
17	8	0.6	ns	6.4	ns

ns - denotes not significant; * - sign. at the 95% level; ** - at 99%; *** - at 99.9%
RSZ - the resealed sum of z-scores
SSZ - the sum of squares of z-scores

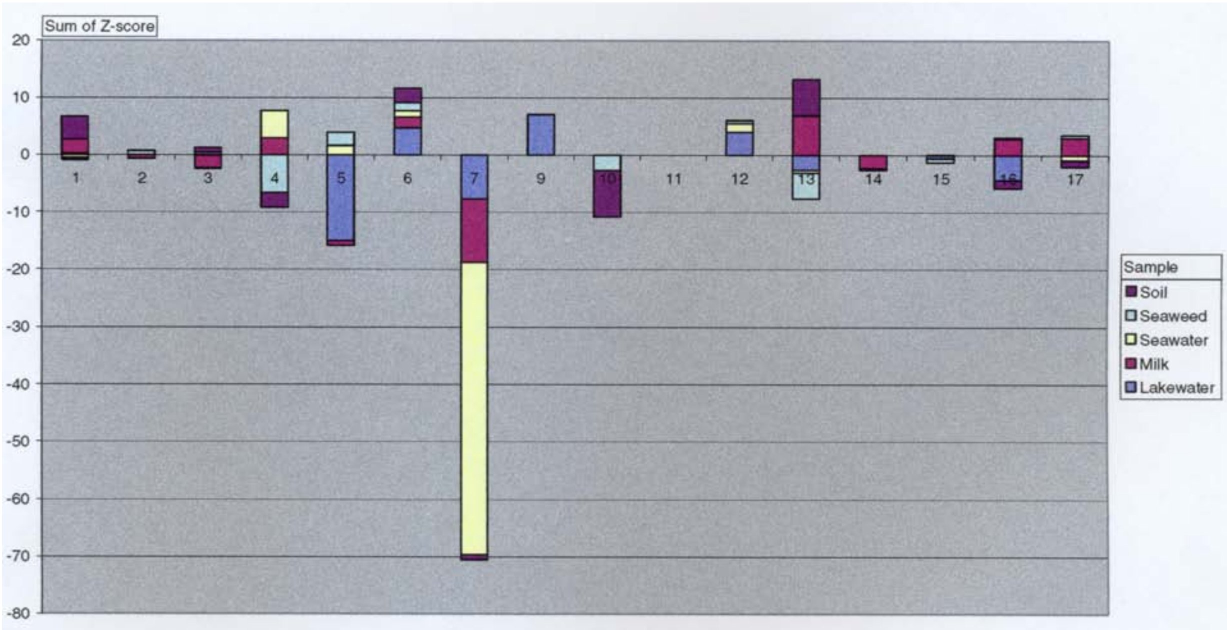


Fig. 3. Column diagram of sum of z-scores for results from all radionuclides combined showing contributions from individual samples (No. 17-Laboratory of Radiation Physics Inst. of Solid State Physics).

Conclusions

The 9 years work at the quality control and quality assurance of the laboratory and participation in the intercalibration exercises allowed:

- to get the laboratory accreditation according to ISO/IEC 17025 standard,
- to enlarge the sphere of application the gamma spectrometric methods.

Only credible and justified results can be the basis for further use in any field, thus making it possible to make legitimate decisions.

References

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