



NKS-295  
ISBN 978-87-7893-371-3

---

# GammaTest 2013 Proceedings

Henrik Ramebäck (ed)<sup>1</sup>

Elisabeth Strålberg<sup>2</sup>

Óskar Halldórsson Holm<sup>3</sup>, Sigurður Emil Pálsson<sup>3</sup>

Seppo Klemola<sup>4</sup>

Sven P. Nielsen<sup>5</sup>

<sup>1</sup> FOI – Swedish Defence Research Agency

<sup>2</sup> IFE – Institute for Energy Technology, Norway

<sup>3</sup> IRSA – Icelandic Radiation Safety Authority

<sup>4</sup> STUK – Radiation and Nuclear Safety Authority, Finland

<sup>5</sup> DTU-Technical University of Denmark, NUTECH

January 2014

## Abstract

Due to a sparse interaction during the last years between practitioners in gamma ray spectrometry in the Nordic countries, a NKS activity was started in 2009. This activity, GammaSem, was focused on seminars relevant to gamma spectrometry. A follow up seminar was held in 2010. As an outcome of these activities it was suggested that the 2011 meeting should include a series of workshops focused on practical issues, e.g. different corrections for systematic effects needed in gamma spectrometric measurements. GammaWorkshops 2011, was held in September at DTU Risø Campus and was a huge success. Based on feedback from the participants a new series of workshops were held in September 2012 in Hveragerði, Iceland, which included practical exercises on real-world spectra. In discussions with the participants at the 2012 meeting it was decided that the 2013 meeting should include intercomparisons. Three intercomparisons were carried out: one on peak identification (two spectra); one on a real spectrum (a calibration spectrum and detector details were given); and one on a real-world sample.

Two experts in gamma spectrometry were invited to the 2013 meeting. The lectures covered Monte Carlo simulations for efficiency calculations, calculation of correction factors for e.g. true coincidence summing, as well as some special applications such as the use of the sum-peak method for measurement of the half life of  $^{176}\text{Lu}$ . The results from the three intercomparisons were also presented. Presentations by participants were also included. Finally, four different tools for e.g. calculation of different correction factors were presented and demonstrated.

## Key words

Gamma spectrometry, systematic effects, corrections

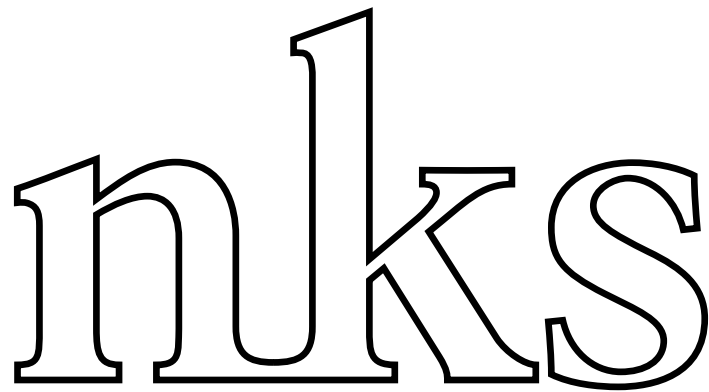
NKS-295  
ISBN 978-87-7893-371-3

Electronic report, January 2014  
NKS Secretariat  
P.O. Box 49  
DK - 4000 Roskilde, Denmark  
Phone +45 4677 4041  
[www.nks.org](http://www.nks.org)  
e-mail [nks@nks.org](mailto:nks@nks.org)

# GammaTest 2013 Proceedings

Nordic workshops for users of gamma ray  
spectrometry

Umeå, Sweden,  
17-19 September 2013

The logo consists of the lowercase letters 'n', 'k', and 's' followed by an uppercase 'S'. The letters are rendered in a bold, outlined, serif font. The 'n' and 'k' are lowercase, while the final 'S' is uppercase. The letters are closely spaced and share a common baseline.

Henrik Ramebäck (ed), Elisabeth Stråberg, Óskar Halldórsson Holm, Sigurður Emil  
Pálsson, Seppo Klemola, Sven P. Nielsen



## Table of contents

Introduction.....	3
GammaTest 2013.....	3
GammaSem 2009 and 2010.....	5
GammaWorkshops 2011.....	6
GammaWorkshops 2012.....	7
Concluding remarks.....	8
Short resumes of the lectures.....	9
Appendix 1 – Agenda of the NKS-B GammaTest 2013.....	12
Appendix 2 – List of participants.....	14

## Introduction

Due to a sparse interaction during the last years between practitioners in gamma ray spectrometry in the Nordic countries, a NKS activity was started in 2009. This activity, GammaSem, was focused on seminars relevant to gamma spectrometry. A follow up seminar was held in 2010. As an outcome of these activities it was suggested that the 2011 meeting should include a series of workshops focused on practical issues, *e.g.* different corrections for systematic effects needed in gamma spectrometric measurements. GammaWorkshops 2011, was held in September at DTU Risø Campus and was a huge success. Based on feedback from the participants a new series of workshops were held in September 2012 in Hveragerði, Iceland, which included practical exercises on real-world spectra. In discussions with the participants at the 2012 meeting it was decided that the 2013 meeting should include intercomparisons. Three intercomparisons were carried out: one on peak identification (two spectra); one on a real spectrum (a calibration spectrum and detector details were given); and one on a real-world sample.

Two experts in gamma spectrometry were invited to the 2013 meeting. The lectures covered Monte Carlo simulations for efficiency calculations, calculation of correction factors for *e.g.* true coincidence summing, as well as some special applications such as the use of the sum-peak method for measurement of the half life of  $^{176}\text{Lu}$ . The results from the three intercomparisons were also presented. Presentations by participants were also included. Finally, four different tools for *e.g.* calculation of different correction factors were presented and demonstrated.

## GammaTest 2013

37 persons from 25 different organisations in the Nordic countries attended the workshop. Most participants were young scientists who work with gamma spectrometry. Invited lecturers were:

- Professor Octavian Sima from the University of Bucharest, Romania. Professor Sima is one of the developers of the software GESPECOR, which can be applied for different issues in gamma ray spectrometry including efficiency calculations, efficiency transfer and for the calculation of correction factors like self attenuation and true coincidence summing. The topic of Professor Sima's lecture were 'Monte Carlo Simulations Applied to Gamma Ray Spectrometry'.
- Dr. Tim Vidmar from SCK-CEN, Belgium. Dr. Vidmar has developed the software EFFTRAN, which can be used for efficiency transfer and calculation of correction factors in gamma spectrometry. Dr. Vidmar gave three lectures: a) 'Angular correlation and their influence on coincidence summing corrections'; b) 'The sum-peak method as a tool for radionuclide standardization'; and c) 'An example of the application of the sum-peak method- determination of  $^{176}\text{Lu}$  half life'.

There were also presentations given by persons from the GammaTest project board, as well as by participants:

- Dr. Sven P. Nielsen from DTU Nutech, Denmark, presented the results of the intercomparison of the real-world samples.
- Dr. Seppo Klemola from STUK, Finland, presented the results from the peak identification intercomparison
- Trygve Bjerk and Elisabeth Strålberg from IFE, Norway, presented the results of the intercomparison comprising a sample spectrum and spectrum from a calibration of the detector as well as detector details.
- Dr. Sofia Jonsson from FOI, Sweden, gave a presentation on the implementation of computer codes for the calculation of efficiency transfer and correction factors in gamma spectrometry.
- Annika Tovedal from FOI, Sweden, gave a presentation of a gamma spectrometric method for the screening of natural radionuclides.

The agenda for the workshop is attached in Appendix 1.

### **Response by participants**

At the end of the meeting a survey amongst the participants was conducted. Written comments included evaluation of this meeting as well as suggestions for future events. The overall opinion was very positive. Suggestions for possible future topics include library tuning, continuation with intercomparisons, other detector types (LaBr<sub>3</sub>, NaI etc.). Again, this NKS meeting was highly appreciated by the participants. Some examples of feedback from the participants:

- *'Comparison measurements were good and challenging'*
- *'Software presentations were great'*
- *'Highly valuable networking platform'*
- *'Great!'*
- *'Practical exercises are always useful'*
- *'Very nice workshop with a lot of insight into practical matters'*

All the participants would like to see a continuation in 2014 of this series of seminars/workshops. These series of NKS events have over the years been highly appreciated by Nordic and Baltic practitioners in gamma spectrometry.

A more detailed summary of the GammaTest meeting will be published as an NKS report as has been done with the previous related activities. These reports are all available at the NKS web-site:

1. Elisabeth Strålberg (ed.) *et al.*: GammaWorkshops 2012 proceedings – Nordic workshops for users of gamma ray spectrometry – Hveragerði, Iceland, 11-12 September 2012 – Report NKS-274
2. Henrik Ramebäck (ed.) *et al.*: GammaWorkshops Proceedings - Nordic workshops for users of gamma ray spectrometry – Risø-DTU 26-28 September 2011 – Report NKS-259

3. Elisabeth Strålberg (ed.) *et al*: GammaSem Proceedings - A Nordic seminar for users of gamma spectrometry - Kjeller 28-29 September 2010 – Report NKS-224
4. Paula Nunez (ed.) *et al*: GammaSem Proceedings - A Nordic seminar for users of gamma spectrometry - Oslo 15-16 September 2009 – Report NKS-212

A summary of these activities follows.

### **GammaSem 2009 and 2010**

At the first GammaSem seminar the well-known expert in gamma spectrometry, Dr. Gordon Gilmore, gave an overview of some of the most common difficulties and mistakes when using gamma spectrometry. Also, several key issues for follow-up were identified and working groups for addressing the identified problems were established. It was decided that the topics for the working groups should form the basis for the seminar in 2010, where the groups should be invited to present the results of their work and ideas/solutions to the problems. This was thought to ensure that the identified key issues were not forgotten but followed up, and hopefully lead to solutions that will increase the performance of the individual laboratories.

Working groups established at GammaSem 2009 included:

- Uncertainties and detections limits
- True coincidence summing corrections
- Monte Carlo simulations and efficiency transfer
- Absorption (density corrections and geometries)
- Mobile gamma spectrometry systems
- Nuclear forensics (on special samples and special parts of the spectra)

At the seminar in 2009 it was also decided that the participants of the GammaSem activity should organise web sites for posting relevant information and discussion forums. This would make it easier to contact Nordic colleagues on issues related to gamma spectrometry.

At GammaSem 2010, all six working groups from GammaSem 2009 were invited to give presentations of their work accomplished during the last year. However, only two out of six working groups gave such presentations:

- Working group on uncertainties and detections limits
- Working group on true coincidence summing corrections

The working group concept did not work out as intended. The reason for this was probably because most of the laboratories that signed up to join the working groups, signed up because they wanted to learn more about the different subjects. In combination with the fact that no funding was made available for the working groups, it was difficult to establish goals on what to achieve. Based on this, it was suggested to arrange a series of workshops covering relevant issues suggested by the participants, rather than continuing with a third seminar.

The web sites, GammaForum and GammaWiki, were also presented for the participants as possible solutions for Nordic colleagues to posting relevant information and discussion forum. During the general discussion at the end of GammaSem 2010, it was agreed to close down the GammaForum, but to keep GammaWiki. In the period after GammaSem 2010, GammaWiki has been regularly used by the GammaSem/Workshops organisers for posting relevant information for the participants.

At GammaSem 2010 also Dr. Lars-Erik De Geer from the Swedish Defence Research Agency gave a lecture that covered aspects of true coincidence summation corrections and developments in this field accomplished at the Provisional Technical Secretariat (PTS) for the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO) in Vienna.

## **GammaWorkshops 2011**

GammaWorkshops 2011 was arranged based on feedback from participants at GammaSem 2010. Lecturers were invited to give presentations about subjects suggested by the participants at GammaSem 2010. Practical demonstrations were included in the presentations, and participants were encouraged to try to solve problems on their own (on their own computers).

Dr. Tim Vidmar from SCK CEN in Belgium talked about efficiency transfer and self-absorption corrections in gamma ray spectrometry, and true coincidence corrections in the software Genie-2000,. He also provided a version of the program EFFTRAN in which efficiency transfer, self-absorption correction as well as true coincidence corrections can be done.

Dr. Menno Blaauw from Delft University of Technology in the Netherlands gave a lecture regarding true coincidence summing and also had a practical session on TCC for GammaVision users.

Dr. Tuukka Turtiainen gave a lecture on the gamma spectrometric measurements of natural radionuclides and Dr. Kaj Heydorn gave a lecture on detection limits and the ISO-standard ISO-11929:2010

There were also lectures, and practical sessions, given by several of the GammaWorkshops organisers, including presentations of

- SMath, a freeware form solving e.g. the Bateman equations
- an empirical correction method for self-absorption
- combined uncertainty calculation according to GUM (Guide to the expression of Uncertainty in Measurements) and its application to gamma ray spectrometry.

The overall opinion about both the lectures and practical sessions was very positive. It was appreciated that the focus was on practical issues and teaching. The selection of speakers was also appreciated. All participants were looking forward to a second GammaWorkshops in which issues not covered in the 2011 workshop could be included.



## GammaWorkshops 2012

As earlier, this meeting was to a large extent based on the suggestions from the participants of the previous meeting in 2011. The meeting included lectures from experts within the field of gamma ray spectrometry, as well as a practical session in analysing complex gamma ray spectra.

Dr. Sandor Tarjan presented a comparison of different software (GammaVision, Genie2k and Winner) for the evaluation of gamma ray spectra. The software packages were compared with regard to peak identification, libraries, true coincidence summing correction, self-attenuation correction and decay correction. Spectra from fallout from the Fukushima nuclear power plant accident were used in the comparison. These, and other, spectra were also used in practical exercises amongst the participants. Dr. Tarjan also discussed the possibility for validating *in situ* gamma ray spectrometric measurements. 450 'point sources' printed with ink spiked with a  $^{131}\text{I}$  reference solution were used to get a 20 m x 20 m surface for calibration of a detector. This calibration was compared to a mathematical calibration using the ISOCS software from Canberra, and the two methods showed good agreement on two different surfaces.

Dr. Andrew Tyler gave a lecture on *in situ* gamma ray spectrometry. This method is less time consuming compared to soil sampling and subsequent laboratory measurements. However, care has to be taken both in calibration and in taking into account the variation in *e.g.* vertical radionuclide distribution.

Dr. Gerhard Fritz presented the implementation of cascade summing corrections in Genie 2000. The lecture included the requirements for performing TCS corrections in Genie 2000 as well as Canberra's method for detector characterisation. The method for TCS correction applied in Genie 2000 was given. Finally, a comparison of correction factors for different radionuclides and detector geometries was shown.

There were also presentations by the organisers of the GammaWorkshops:

- QA, what is needed in an accredited laboratory?
- Validation of detection limits
- Background components in gamma spectrometry
- New developments
- Other types of detectors (LaBr<sub>3</sub>, NaI): comparisons with respect to identification
- User experience with new techniques: electric cooling, integrated electronics, safe working environments

## **Concluding remarks**

There is still a need for cooperation and interaction as well as for training in within the field of gamma spectrometry. This fact has been proven through the two seminars GammaSem 2009 and 2010, through the GammaWorkshops in 2011 and 2012, and now through the latest meeting GammaTest.

The participants at all these events agreed that the seminars and workshops have been extremely successful in providing a forum not otherwise present to practitioners in gamma ray spectrometry in the Nordic as well as in neighbouring countries. Moreover, all participants found teaching, practical sessions, and now at the latest meeting the intercomparisons, very useful in learning how to deal with difficult issues relevant to gamma spectrometry. This fact is very important since a very limited number of students choose to study *e.g.* nuclear sciences at a university level. Instead many young people have to learn their professional skills within their employment. Events like the GammaSem, GammaWorkshops and GammaTest have therefore helped to boost up the general knowledge regarding important issues in measurements of gamma emitting radionuclides.

The different workshops and seminars organised within the framework of NKS have gained a high reputation amongst both international experts as well as amongst the participants. At the 2013 meeting in Umeå the participants expressed a strong wish for a continuation of this work.

## Short resumes of the lectures

The following section gives short resumes of the lectures given at the workshop. The available presentations can be downloaded from the GammaWiki web site (<https://www.gr.is/wiki/GammaWiki/>).

### **Octavian Sima:**

#### **Monte Carlo simulations applied to gamma-ray spectrometry**

Octavian Sima gave a comprehensive presentation on Monte Carlo simulations in gamma spectrometry. First he gave an introduction of the basic principles of Monte Carlo simulations. Thereafter he discussed the calculation of the full energy peak efficiency. Although the full energy peak efficiency can be calculated, the detector model has to be validated with experimental data. He then discussed the calculation of correction factors for self-attenuation, which can be done if the sample composition is known, otherwise it has to be done experimentally. Calibration via efficiency transfer can be used when the sample dimensions differ from the calibration source. Best results are obtained for small differences between calibration source and sample, *e.g.* different filling height in sample container compared to the calibration. The calculation of correction factors for true coincidence summing was then discussed. This is becoming more important today since larger detectors are used, and more efficient measurement configurations are applied. Finally he presented some special applications of Monte Carlo calculations including *e.g.* non-uniform sources, Compton-suppressed spectrometers, and *in situ* measurements.

### **Tim Vidmar:**

#### **Angular correlations**

#### **Sum-peak method**

#### **Half-life of Lu-176**

Tim Vidmar gave three presentations, which were interconnected. The first one considered angular correlations between gamma photons emitted in a cascade. The first gamma ray is emitted in any direction (isotropically) but the second in the cascade is not. This might enhance the summing-in and summing-out. For large sample-detector distances the correlation factor can be large, but on the other hand then the coincidence effect is small. However, in close geometries the effect from angular correlation is low.

His second presentation was on the sum-peak method, which is a primary method used in radionuclide standardization. It requires no efficiency calibration but is limited to a few radionuclides and to point sources. The sum-peak method is affected by angular correlations, but since close geometries is preferred the effect is small. However, corrections are still needed when applied in metrological applications like radionuclide standardization.

Tim's third presentation was on the measurement of the half-life of  $^{176}\text{Lu}$ . Precise knowledge of the half-life of  $^{176}\text{Lu}$  is important in geological science. If the number of  $^{176}\text{Lu}$  atoms are known, a precise measurement of the activity will give the half-life (from:  $A=N\lambda$ ). Since the sum-peak method has the potential of resulting in low measurement uncertainties of activity determinations, it will, in combination with measurements in an underground laboratory, give a low uncertainty of the half-life. Moreover, angular correlations had to be accounted for.

### **Trygve Bjerck and Elisabeth Strålborg:**

#### **GammaTest 2013: Results from exercise spectra**

This exercise was on the analysis of a spectrum of water from the primary circuit of a research reactor. One aim of this intercomparison was to offer the possibility to evaluate detector modeling capabilities. Nine laboratories submitted results in this exercise. Measurement conditions given included geometry and detector characteristics. A background and a calibration spectrum were also given. Results were reported by nine participants. The exercise showed some discrepancies in the reported activities. The worst case was for  $^{58}\text{Co}$ , where the results ranged almost a factor of three (ratio highest/lowest result = 2.3). The reason for this discrepancy is not known, but could be a relevant subject for follow-up at future meetings.

### **Sven P. Nielsen:**

#### **Gamma analysis of soil sample**

This exercise was on the measurement of a real-world sample: a soil from the Gävle area in Sweden collected on 1 July 2000. This sample was previously used in the NKS intercomparison exercise LABINCO in 2004. 16 laboratories submitted results. Regarding  $^{137}\text{Cs}$  and  $^{40}\text{K}$  measurement results are generally in good agreement. However, some laboratories report too low uncertainties. Moreover, several laboratories seem to not be familiar with measurement of radionuclides in the natural decay chains, and some results indicate missing decay corrections, as well as not taking detector background into consideration.

### **Seppo Klemola:**

#### **Results of the peak identification exercise**

This exercise was only on the identification of peaks in gamma spectra. Two spectra were given: one from the measurement of dried sewage sludge, and one from the measurement of a contaminated film dosimeter. Twelve participants submitted reports on the spectra. For a full score, not only radionuclides present in the sample should have been reported, but an explanation of all peaks should have been given. The results were good, except that  $^{238}\text{U}$  and perhaps  $^{228}\text{Th}$ ,  $^{231}\text{Th}$  and  $^{232}\text{Th}$  is only possibly present (detection is questionable) in the sewage sludge sample. Moreover, radionuclides present but not reported include  $^{211}\text{Pb}$ ,  $^{223}\text{Ra}$  and  $^{227}\text{Th}$ . All the peaks in

the dosimeter spectrum originated only from  $^{111}\text{I}$ , but summing of gamma and X-ray peaks and additionally Ge escape peaks made spectrum especially complex. About half of the participants correctly identified most of the peaks.

**Sofia Jonsson:**

**Implementation of efficiency transfer, and methods for corrections of systematic effects in gamma spectrometry**

In this presentation the implementation of different corrections needed in gamma spectrometry was presented. Four calculation codes were explored: EFFTRAN, VGSL, Angle and GESPECOR. Of these, Angle cannot calculate correction factors for true coincidence summing. Corrections explored included self-attenuation, true coincidence summing and variations in filling height between sample and standard. Efficiency transfer was also evaluated. The results were validated using a reference solution as well as reference materials. It could be concluded that for a well characterized detector model, all different codes equally well could be used for calculation of different correction factors.

**Trygve Bjerck and Elisabeth Strålberg:**

**Experiences with TCS calibration and corrections with GammaVision at IFE**

This presentation was an overview of IFE's experiences in using GammaVision (and earlier version of Ortec software for the evaluation of gamma spectrometric measurements). As a consequence of the different meetings (GammaSem 2009 and 2010 and GammaWorkshops in 2011) IFE started to implement true coincidence summing corrections. They have explored the possibility to make use of the inherent TCS calibration possibility in GammaVision. The pre-requisite for this is to use a special calibration solution containing both TCS and non-TCS radionuclides. One practical problem is that US date format has to be used, otherwise the program will crash. More important, users have no control of the quality of the TCS calibration. Moreover, on measurement reports there is no information about the correction factors, only that correction has been done.

**Annika Tovedal:**

**NORM and TENORM - a quick screening using gamma spectrometry**

Annika Tovedal gave a presentation of a screening method for NORM and TENORM using gamma spectrometry. Based on an internal calibration using peaks from  $^{228}\text{Ac}$ , other radionuclides could be evaluated with respect to relative activities. This would also guide in the further measurement process of *e.g.* samples of unknown origin. Relevant radionuclides, *i.e.* that have to be measured and that can be measured using gamma spectrometry, in the natural decay chains were also discussed.

## Appendix 1 – Agenda of the NKS-B GammaTest 2013

### Tuesday 17 September

- 12.00 Lunch
- 13.00 Introduction to the workshop including some logistics
- 13.30 Invited lecture: Professor Octavian Sima, University of Bucharest -  
*Monte Carlo simulation applied to gamma-ray spectrometry*
- 15.00 Coffee break
- 15.15-16.45 cont. *Monte Carlo simulation applied to gamma-ray spectrometry*
- 18.30 Workshop dinner at Mässen

### Wednesday 18 September

- 08.30 Invited lecture: Dr. Tim Vidmar, SCK-CEN:  
*-Angular correlation and their influence on coincidence summing corrections;*  
*-The sum-peak method as a tool for radionuclide standardization;*  
*-An example of the application of the sum-peak method- determination of <sup>176</sup>Lu half life*
- 09.00 Dr. Trygve Bjerk, IFE:  
*Presentation of the results from the calibration and evaluation exercise*
- 10.15 Coffee break
- 10.30 Dr. Sven P. Nielsen, DTU Nutech:  
*Results of soil sample analyses*
- 11.15 Dr. Seppo Klemola, STUK:  
*Presentation of results from the exercise on ‘complicated’ spectra*
- 12.00 Lunch
- 13.00 Dr. Sofia Jonsson, FOI:  
*Implementation of efficiency transfer, and methods for corrections of systematic effects in gamma spectrometry*
- 14.00 Coffee break
- 14.30 Dr. Elisabeth Strålberg, IFE:  
*Experiences with TCS calibration and corrections with GammaVision at IFE*
- 15.30 Annika Tovedal, FOI:  
*NORM and TENORM - a quick screening using gamma spectrometry*

## **Thursday 19 September**

- 08.30        Demonstrations of GESPECOR, EFFTRAN, ANGLE and VGSL  
              Discussion and summary of the workshop and a possible way ahead
- 09.30        Laboratory tour (in four groups)
- 11.00        Lunch

## Appendix 2 – List of participants

Name	Affiliation
Kasper Andersson	DTU-NUTECH, Denmark
Karin Andgren	Vattenfall, Sweden
Trygve Bjerk	Institute for Energy Technology, Norway
Hanne Breivik	Norwegian Defence Research Establishment (FFI)
Michel Ceuppens	CANBERRA, Sweden
Lilian del Risco Norrlid	Swedish Radiation Safety Authority (SSM)
Sara Ehrns	Swedish Radiation Safety Authority (SSM)
Olle Eriksson	National CBRN Defence Centre, Sweden
Marian Fajak	Central Laboratory for Radiological Protection, Poland
Óskar Halldórsson	Icelandic Radiation Safety Authority
Antti Hatakka	Teollisuuden Voima Oyj. (TVO), Finland
Stefan Isaksson	Gammadata Instrument AB, Sweden
Sofia Jonsson	Swedish Defence Research Agency (FOI)
Seppo Klemola	STUK - Radiation and Nuclear Safety Authority, Finland
Patrik Konnéus	Studsvik Nuclear AB, Sweden
Miia Lampén	Fortum, Loviisa Nuclear Power Plant, Finland
Yurii Mandro	Zhytomyr State Technological University, Ukraine
Alexander Mauring	Norwegian Radiation Protection Agency (NRPA)
David Mendes	CANBERRA, Sweden
Stefan Mårtensson	Gammadata Instrument AB, Sweden
Bredo Møller	Norwegian Radiation Protection Agency (NRPA)
Dmytro Nalyvaiko	Dept. of Physics, Uni Helsinki/Sensor Center Ltd., Finland
Sven Nielsen	DTU Nutech, Denmark
Jonas Nilsson	Medical Radiation Physics, IKVM, Lund university, Sweden
Asser Nyander Poulsen	National Institute of Radiation Protection (SIS), Denmark
Mattias Olsson	Forsmarks Kraftgrupp, Sweden
Gustav Pettersson	Studsvik Nuclear AB, Sweden





Jixin Qiao

Henrik Ramebäck

Henrik Roed

Octavian Sima

Elisabeth Strålberg

Ingrid Sværen

Annika Tovedal

Tim Vidmar

Robert Weimer

Alex Winkler

Technical University of Denmark

Swedish Defence Research Agency (FOI)

National Institute of Radiation Protection (SIS),  
Denmark

University of Bucharest, Romania

Institute for Energy Technology, Norway

Institute of Marine Research, Norway

Swedish Defence Research Agency (FOI)

SCK.CEN, Belgian Nuclear Research Centre

Swedish University of Agricultural Sciences (SLU)

Dept. of Physics, Uni Helsinki/Sensor Center Ltd.,  
Finland

Title	GammaTest 2013 Proceedings
Author(s)	Henrik Ramebäck (ed) <sup>1</sup> , Elisabeth Strålberg <sup>2</sup> , Óskar Halldórsson Holm <sup>3</sup> Sigurður Emil Pálsson <sup>3</sup> , Seppo Klemola <sup>4</sup> , Sven P. Nielsen <sup>5</sup>
Affiliation(s)	<sup>1</sup> FOI – Swedish Defence Research Agency <sup>2</sup> IFE – Institute for Energy Technology, Norway <sup>3</sup> IRSA – Icelandic Radiation Safety Authority <sup>4</sup> STUK – Radiation and Nuclear Safety Authority <sup>5</sup> DTU – Technical University of Denmark, NUTECH
ISBN	978-87-7893-371-3
Date	January 2014
Project	NKS-B / Gammatest
No. of pages	15
No. of tables	2
No. of illustrations	0
No. of references	0
Abstract	<p>Due to a sparse interaction during the last years between practioners in gamma ray spectrometry in the Nordic countries, a NKS activity was started in 2009. This activity, GammaSem, was focused on seminars relevant to gamma spectrometry. A follow up seminar was held in 2010. As an outcome of these activities it was suggested that the 2011 meeting should include a series of workshops focused on practical issues, <i>e.g.</i> different corrections for systematic effects needed in gamma spectrometric measurements. GammaWorkshops 2011, was held in September at DTU Risø Campus and was a huge success. Based on feedback from the participants a new series of workshops were held in September 2012 in Hveragerði, Iceland, which included practical exercises on real-world spectra. In discussions with the participants at the 2012 meeting it was decided that the 2013 meeting should include intercomparisons. Three intercomparisons were carried out: one on peak identification (two spectra); one on a real spectrum (a calibration spectrum and detector details were given); and one on a real-world sample. Two experts in gamma spectrometry were invited to the 2013 meeting. The lectures covered Monte Carlo simulations for efficiency calculations, calculation of correction factors for <i>e.g.</i> true coincidence summing, as well as some special applications such as the use of the sum-peak method for measurement of the half life of <sup>176</sup>Lu. The results from the three intercomparisons were also presented. Presentations by participants were also included. Finally, four different tools for <i>e.g.</i> calculation of different correction factors were presented and demonstrated.</p>
Key words	Gamma spectrometry, systematic effects, corrections