



Nordisk kernesikkerhedsforskning
Norrænar kjarnöryggisrannsóknir
Pohjoismainen ydinturvallisuustutkimus
Nordisk kjernesikkerhedsforskning
Nordisk kärnsäkerhetsforskning
Nordic nuclear safety research

NKS-238
ISBN 978-87-7893-310-2

In-vivo whole body measurement of internal radioactivity in the Nordic countries

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February 2011

Abstract

The PIANOLIB activity aims to harmonize the calibrations of the measurement equipment in the region and to evaluate the quality status of this kind of measurement by means of a proficiency test exercise. In this report the first results of the PIANOLIB activity are presented, that is, a compilation of existent regional resources for in-vivo whole body measurement and the phantom library website. In 2010 the project PIANOLIB collected the relevant information about the regional facilities, distributed the exercise instructions and managed the circulation of the phantom IRINA among the participant laboratories. The inventory within the activity has showed that the regional whole body counting assets has relatively diminished compared to 2006, the last time an inventory of the kind was made. Both the field laboratories as the stationary ones are equipped with sophisticated whole-body counting systems with Ge-or NaI-detectors. The regional competence is good and still retains experienced staff, but it is clear that a new generation is coming that needs training and exchange of experiences. It is important to keep the practice of intercomparison and NKS continues to be the best framework for supporting this kind of activity.

Key words

Whole body counting, measurement quality

NKS-238
ISBN 978-87-7893-310-2

Electronic report, February 2011

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Report from the NKS-B PIANOLIB in 2010 (Contract: AFT/B (10) 6)

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1. Introduction

Whole body counting has been used since the early 1950s as a method for determination of internal radioactivity; the term has been quoted for the measurement of x-ray and γ radiations emitted from radionuclides inside of the human body. Radiation from external sources cannot be measured by whole body counting, with the exception of exposures to high energy neutrons or γ radiation (> 8 MeV) that can make some of the stable nuclides in the body to become radioactive and thus measurable within a matter of hours and for up to a few days.

“Whole” refers to the entire body without specifying the part of the body or the organ containing the radioactivity. Specific organ counts are referred as “lung counting”, “liver counting”, etc. Whole body counting determines the amount of radioactivity present in the body at the time of measurement but it cannot directly determine the radioactivity present at a previous time. To assess the latter, the measured body content and the bio-kinetic model (retention/biological decay) that describes the behaviour of the radionuclides in the body are needed.

The internal dose from radioactive substances in humans can be calculated from known intake, from whole body counting or from measurements of the activity in the blood or secretions like the urine or faeces. In practice however, it is rather unusual for the intake to be known. Therefore whole body counting is one of the most important tools for internal dosimetry, offering the possibilities to quantify the internally deposited radionuclides directly in a speedy way and to detect insoluble materials, with long retention time scales. However its limited detection sensitivity makes an accurate determination of the internal radioactivity quite challenging.

The main factors affecting the detection sensitivity and the accuracy of the in vivo measurement are the ambient background, the sensitivity range of the detection equipment and the calibration for these detectors. Quality assurance in whole body measurement is therefore of particular importance. The activity “Phantom-based intercomparison among Nordic whole body counting facilities and the development of a Nordic phantom library website (PIANOLIB)” provides insight into the situation regarding resources, capabilities and calibration at in vivo laboratories in the region.

In this report the first results of the PIANOLIB activity are presented, that is, a compilation of existent regional resources for in-vivo whole body measurement and the phantom library website.

2. The PIANOLIB activity

The PIANOLIB activity aims to harmonize the calibrations of the measurement equipment in the region and to evaluate the quality status of this kind of measurement by means of a proficiency test exercise. The exercise consists in determining the activity of a phantom filled with certified radioactive material, homogeneously distributed inside the phantom.

The NKS has previously sponsored other intercomparison exercises for whole body counting facilities in the Nordic countries in 1993 and in 2006, including an intercomparison dedicated

to thyroid systems (Rahola T., Falk R. and Tillander M., 1994), (Rahola T. et al, 2006). Some Nordic whole body counting laboratories have taken part in European intercomparison projects, during 1995 – 1996, (Thieme M. et al., 1998). The region's jointly owned phantom IRINA has, since its acquisition in 1996 been circulated with different sets of radioactive material in all the regional exercises of this kind.

The project PIANOLIB collected the relevant information about the regional facilities, distributed the exercise instructions and managed the circulation of the phantom IRINA among the participant laboratories. The intercomparison phantom has been at 10 laboratories of a total of 19 registered participants' laboratories in 2010.

3. The intercomparison phantom IRINA

A view of the possible sizes for IRINA is shown in Figure 1.

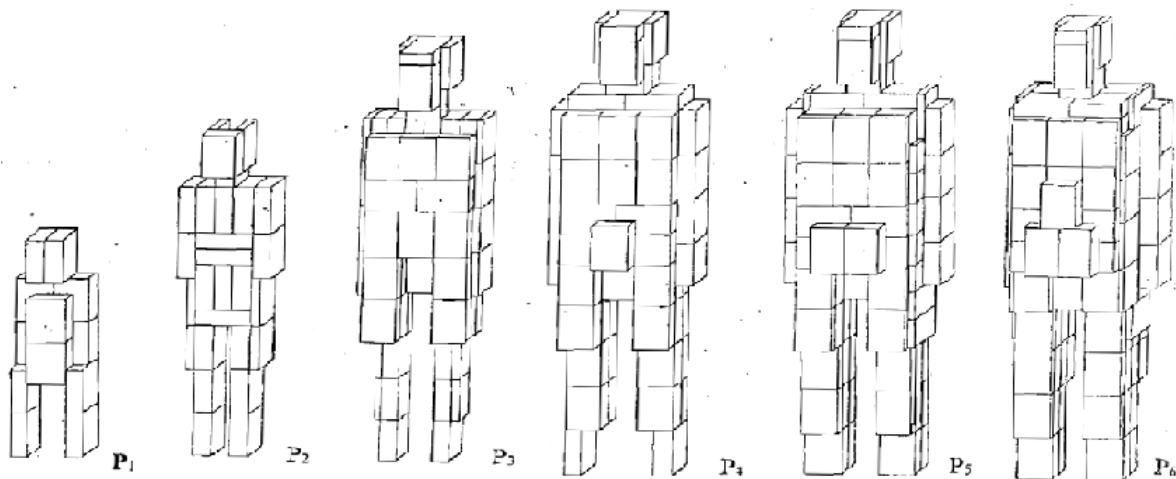


Figure 1. Available sizes for the phantom IRINA in the geometry standing / lying. From P1 to P6 the weights span 10 – 96 kg and the heights 82 – 170 cm.

The phantom IRINA (RIISH/STC, 1995) comprises tissue equivalent blocks of polyethylene and uses only solid source components, which significantly facilitates the transportation and reduces the risk of contamination during transport. This phantom was developed by the Research Institute for Industrial Sea Hygiene in St. Petersburg, Russia. Note that IRINA also is sometimes referred as the St. Petersburg's phantom (Thieme M. et al., 1998).

The radioactive material for all the sets of rods have been certified by Mendeleev Institute for Metrology (VNIIM, www.vniim.ru), which holds the primary standard for the unit of activity, flux and flux density of particles and photons of radionuclide sources for the Russian Federation. The phantom is comprised of two sizes of scattering blocks with holes for rods of radionuclide sources. The smaller blocks should be filled with half-unit radioactivity rods while the larger blocks with one-unit radioactivity rods Figures 2 a) and b). When the blocks are filled and the phantom is assembled into humanoid shape, the radioactivity sources are close to homogeneously distributed.

library; the users must first register in order to check out the library's resources. The phantoms on loan are listed with their contact person, permanent address and technical documentation. Online requests for a loan generate two automatic electronic letters: one to the owner of the phantom and the other to the requester as a confirmation. An email address, phantomlib@nks.org, has specifically been set up in order to serve as a node for the automatic messages generated by use of the library. A log of the traffic history of loans is saved in the inbox of this email address. The status of the library resources is updated after the completion of every loan request. In this way any user can check upon availability/waiting time for the phantoms online.




The coordinators of PIANOLIB will rotate the responsibility for updates in the library and for verifying that the physical status of the library items corresponds with the online information at the website, by means of the information collected at phantomlib@nks.org. Each coordinator is responsible for this task for one year at a time starting in 2011 with the coordinator from Iceland, and thereafter in alphabetical order. That is, Norway in 2012, Sweden in 2013, Denmark in 2015 and Finland in 2016, returning this responsibility to Iceland in 2017.

5. Compilation of present resources and capabilities for in-vivo whole body measurements of internal radioactivity in the Nordic countries

A listing of laboratories interested in participating in an intercomparison exercise and the available phantoms in the Nordic countries was compiled. The list of participant laboratories and contact persons in the order in which the phantom is circulating is shown below in Table 1.

The first priority was given to the in-vivo laboratories at nuclear facilities in the region, second priority to the laboratories with responsibilities in the national emergency response and third priority to other in-vivo laboratories (i.e. universities and hospitals). A questionnaire was circulated to collect information about each facility, their equipment, routine methods and capabilities. The questionnaire, "Whole body counting facility", is found in the Appendix B.

Table 1. List of participant's laboratories in the activity PIANOLIB

Name of the facility	Contact person	Email	Phone	Address
 Forsmark	Staffan Hennigor Felix Kuffner	sig@forsmark.vattenfall.se fix@forsmark.vatenfall.se	+46 173882076 +46 173 821 70	Forsmarks Kraftgrupp AB Dosimetriavdelning FTKR 742 03 Östhammar
 Westinghouse	Mikael Andersson Hans Mellander	andersm@westinghouse.com mellanho@westinghouse.se	+46 21347714	Westinghouse Electric Sweden AB SE-721 63 Västerås
 Ringhals	Dan Aronsson Patrik Konneus Marie Carlsson	Dan.Aronsson@vattenfall.com Patrik.Konneus@vattenfall.com Marie.Carlson@vattenfall.com	+46340667365 +46340647315 +46340668252	Ringhals AB Miljö o Radiologi, RSM 432 85 Väröbacka

 Oskarshamn	Christer Solstrand Mats Hjelm	Christer.Solstrand@okg.eon.se Mats.Hjelm@okg.eon.se	+46 705 484441	OKG Aktiebolag 572 83 Oskarshamn
 Studsvik	Charlotta Askeljung	charlotta.askeljung@studsvik.se	+46 155221534	Studsvik Nuclear AB SE-611 82 Nyköping
 Barsebäck	Thomas Åberg	thomas.aberg@barsebackkraft.se	+46 46724480	Barsebäck Kraft AB Box 524 246 25 Löddeköpinge
 IFE Halden	Heidi Andersen	heidia@hrp.no	+4769212184	Institutt for energiteknikk. Tistedalsgt. 20, 1772 Halden
 IFE Kjeller	Ann-Helen Haugen	Ann.helen.haugen@ife.no	+4763806068	Institutt for energiteknikk. Av. Miljø- og strålevern. Instituttveien 18, 2027 Kjeller
 Norge NRPA	Björn Lind	Bjorn.Lind@nrpa.no	+4767162623	Statens strålevern. Grini Næringspark 13. 1361 Østerås
 Danmark SIS	Henrik Roed	hro@sis.dk	+45 44543454	National Institute of Radiation Protection Knapholm 7 DK-2730 Herlev
 NM/PET Rigshospitalet	Søren Holm	sholm@pet.rh.dk	+45 35451681	N Med and PET, Rigshospitalet 3982 Blegdamsvej 9, DK- 2100 Copenhagen
 Iceland	Óskar Halldórsson	oh@gr.is	+354 5525470	Icelandic Radiation Safety Authority Rauðarárstíg 10 IS-150 Reykjavík
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 FOI Umeå	Kenneth Lidström	kenneth.lidstrom@foi.se		FOI Cementvägen 20 901 82 Umeå
 Lund University at Skånes UH	Christopher Råaf Ylva Ranebo	christopher.raaf@med.lu.se ylva.Ranebo@med.lu.se	+46 40331145 +46 40 338676	Medicinsk strål.fysik IKVM Skånes UH SUS SE-205 02 Malmö
 Radiofysik Linköping	Håkan Pettersson	hakan.pettersson@lio.se	+46 13221752	Radiofysikavd, K-Centrum, US 581 85 Linköping
 Stockholm University	Christoph Bargholtz	bargholtz@fysik.su.se	+46 855378680	Department of Physics Stockholm University SE-106 91 Stockholm

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5.1 The regional resources




Table 2 summarizes the regional resources. The Danish institute for Radiation Protection no longer has a whole body counting facility so the participation from Denmark came from the Copenhagen's University Hospital instead. At the Norwegian Radiation Protection Authority, NRPA there is a stationary WBC lab that was not included in this exercise because it is out of function at the moment.
















Some of the participants sent pictures of the measurement setups at their laboratories. Figures 3 to 11 show the measurements set ups at Oskarhamn, Ringhals, Lund University, Gothenburg's University, IFE at Kjeller, Rigshospitalet in Copenhagen, the NRPA mobile lab and SSM lab.


The measurement methods are based on the acquisition of one or several spectral data, depending on the number of available detectors. The ORTEC family tools Maestro and Gammavision are the most used for data acquisition. In some cases Gammavision is also used as the spectral analysis software.

Most of the participants at stationary laboratories correct for the background by counting a blank phantom of the approximately same size as the calibration phantom. In many cases the calibration phantom IRINA is used without the activity rods, thus a blank background is acquired when a calibration is performed. Figures 12 and 13 show two different approaches for the determination of the blank background at Helsinki University and Lund University, respectively.

Table 2. Summary of the regional resources.

Name of the facility	Meas. room	Type and Geometry	Detectors	Routine meas. time	Background meas. time	Routine radio-nuclides *	Calculation of internal activity**
 Forsmark	Low background	Stationary Sitting	1 HpGe 53%	10 min	Empty and blank 14 h		Genie ESP
 Westinghouse	Low background	Stationary lung counter Bed, static detectors	3 HpGe 50%	40 min	Blank 3 days	²³⁵ U	In-house method
 Ringhals	Low background	Stationary Sitting	1 NaI 3x3" (thy) 1 HpGe 66%	8 min	Empty 100000 s	¹³¹ I ⁵⁸ Co, ⁶⁰ Co, ⁹⁵ Nb, ⁹⁵ Zr, ¹³⁷ Cs	Gammavision

 Oskarshamn	Low background Collimated detectors	Stationary Dedicated chair WBC-6000	1 NaI 1x 1.5" (thy) 2HpGe 30%	10 min 10 min	Empty 63 h	¹³¹ I, ¹³³ Ba ⁴⁰ K, ⁵⁴ Mn, ⁵⁸ Co, ⁵⁹ Fe, ⁶⁵ Zn, ⁹⁵ Nb, ⁹⁵ Zr, ¹³⁷ Cs	Genie 2000
 Studsvik	Low background	Stationary Sitting	1 Coaxial Ge 50 %	10 min	Empty 14 h	¹³⁷ Cs, ⁴⁰ K, ⁶⁰ Co	Genie 2000
 Barsebäck	Low background	Stationary Sitting	1 HpGe 55 %	10 min	Empty 10 h	¹³⁷ Cs, ⁴⁰ K, ⁶⁰ Co, ⁵⁴ Mn, ¹²⁵ Sb	Gammavision
 IFE Halden	Low background	Stationary Sitting	1 NaI 3x3"	10 min	Empty 10 min	¹³⁷ Cs, ⁶⁰ Co	Genie 2000
 IFE Kjeller	Low background	Stationary Sitting	1 NaI 6x4"	20 min	Empty 20 min	¹³⁷ Cs, ⁶⁰ Co, ²²³ Ra	Scintivision
 Norge NRPA	Collimated detectors	Field-lab Sitting	1 HpGe 50%	10 min	Empty 1 h	¹³⁷ Cs	Maestro and in-house excel sheet
 NM/PET Rigshospitalet	Low background	Bed, static detector	4 Plastic scintillators 4 NaI 6x4"	600 s 1800 s	Empty and blank (600, 1800 s, respectively)	⁴⁰ K, ⁴⁷ Ca, Zn, ¹¹¹ In, ⁵⁹ F, ^{83,84} Rb ^{99m} Tc	ABACOS Genie 2000
 Iceland	Un-collimated detector	Field lab Palmer geometry	1 NaI 2.5x2.5"	20 min	Empty	¹³⁷ Cs	Gammavision and in house program
 University of Helsinki	Low background	Stationary Sitting	1 NaI 100x200 cm	1000 sec	Empty and blank 40 h	⁴⁰ K, ¹³⁷ Cs, ¹¹ C, ¹⁸ F	Genie 2000 and in-house excel sheet
 Finland STUK	Low background	Stationary Scanning bed static detectors	3 HpGe 25-50%	1000 sec	Blank 12 h	¹³⁷ Cs, ⁴⁰ K, ⁶⁰ Co, ^{110m} Ag, ¹²⁴ Sb	Maestro and in-house spectrum analysis
	Low background	Mobile unit; sitting geometry	2 HpGe 85%	1000 sec	Blank 12 h	¹³⁷ Cs, ⁴⁰ K, ⁶⁰ Co, ^{110m} Ag, ¹²⁴ Sb	Maestro and in-house spectrum analysis
 FOI Umeå	Collimated detectors	Field-lab Mix geom. chair/arc	1 NaI 2x2" (thy) 1HpGe 50%	1000 sec 1000sec	Empty and blank 15 h	¹³¹ I, ¹³³ Ba ¹³⁷ Cs, ⁴⁰ K, ⁶⁰ Co, ¹⁵² Eu	Gammavision
 Lund University at Malmö UH	Low background	Stationary Bed, static detectors	3 NaI plastic	1000 sec	Empty and blank	¹³⁷ Cs, ⁴⁰ K	Maestro and in-house method
 Radiofysik Linköping	Collimated detectors	Stationary Scanning/ static bed with scanning detectors	2 NaI	30 – 60 min	Empty	^{99m} Tc, ¹²³ I, ¹⁸ F	In house
 Stockholm University	Low background Collimated detectors	Stationary Scanning bed with static detectors	6 NaI	20 min	Blank 1 h	⁴⁰ K	In-house
 University of Gothenburg	Low background	Stationary Scanning/ static detector static bed	2 NaI 5x4" 1 NaI 5x1/4" 4 NaI plastic 91x76x24 cm ³	varying	Empty	⁴⁰ K, ^{99m} Tc, ²¹¹ At, ¹³⁷ Cs, ⁶⁰ Co	Accuspec and in-house manual calculation

 Sweden SSM	Low background	Stationary Sitting in reclined position	1 NaI (thy)	30 min	Empty Blank Irina neck 30 min	¹³¹ I, ¹³³ Ba	In-house MAESTRO- based code
			3 NaI 5x4"	30 min	Empty Blank IRINA 30 min	¹³⁷ Cs, ⁴⁰ K, ⁶⁰ Co	
			1 HpGe for use in emergency situations	30 min	Blank Livermore 30 min	Nuclide ID purposes based on ¹⁵² Eu cal.	Genie 2000

*Note that different MDA apply to the detectable radionuclides

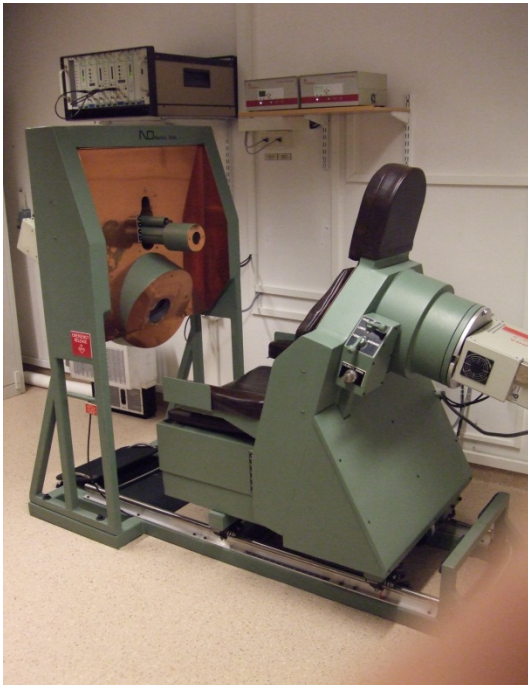


Figure 3. Oskarhamn's equipment (picture courtesy of Mats Hjelm, OKG AB)



Figure 4. Ringhal's equipment (picture courtesy of Dan Aronson, Ringhals AB)

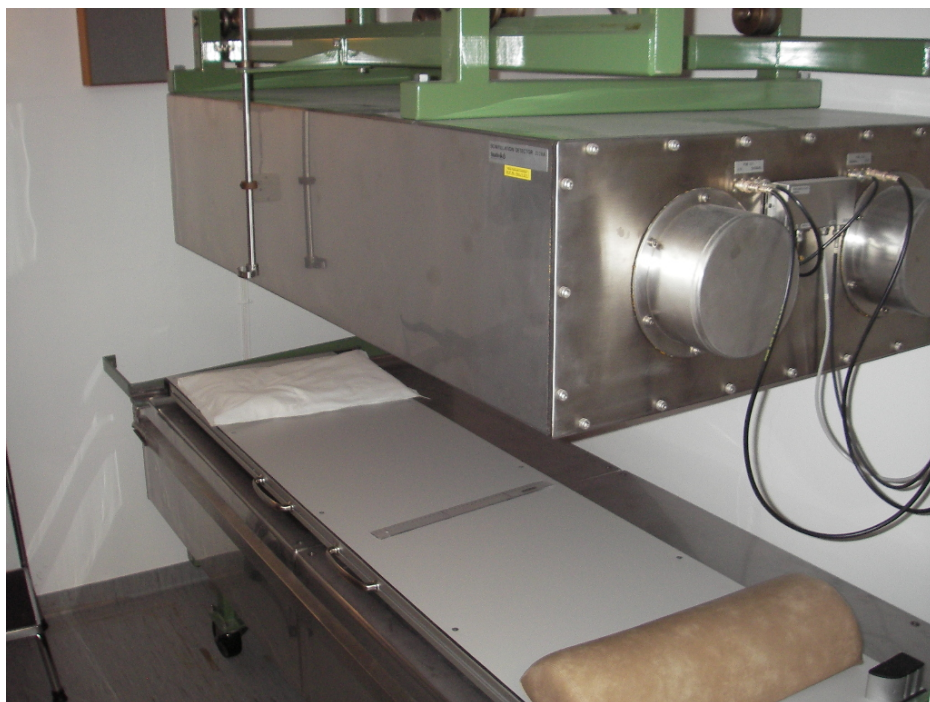


Figure 5. Set up from Lund's University at Skåne University Hospital, Malmö (picture courtesy of Christopher Rääf, Assistant Prof., Medical Radiation Physics, SUH)



Figure 6. NaI-system at the Dept. of Radiation Physics, University of Gothenburg (picture courtesy of Mats Isaksson, Prof., Radiation physics, University of Gothenburg)



Figure 7. Measurement set up for the PIANOLIB exercise at the Institutt for energiteknikk, Kjeller (picture courtesy of Ann-Helen Haugen, Health and Safety Dept., IFE Kjeller)



Figure 8. Counting system 1 with plastic scintillators at Rigshospitalet in Copenhagen; the phantom IRINA m lies in the bed for the PIANOLIB measurements (picture courtesy of Holger Jensen and Soren Holm, PET Rigshospitalet)



Figure 9. Counting system 2 with NaI crystal scintillators at Rigshospitalet in Copenhagen (picture courtesy of Holger Jensen and Soren Holm, PET Rigshospitalet)

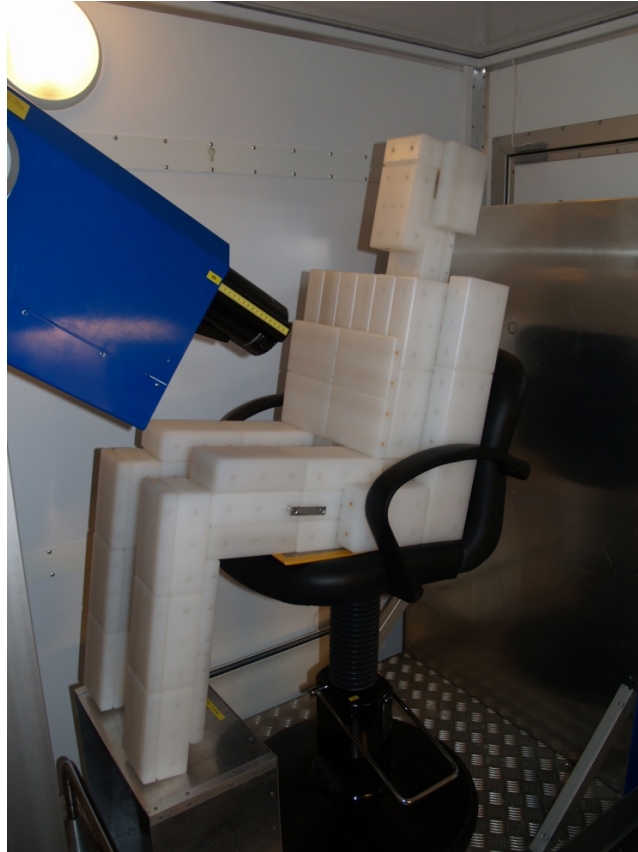


Figure 10. Measurement set up for the PIANOLIB exercise at the mobile lab of the Norwegian Radiation Protection Authority – NRPA (picture courtesy of Bjorn Lind, NRPA)



Figure 11. In-vivo WBC facility at the Swedish Radiation Safety Authority (picture courtesy of Bosse Alenius, SSM).

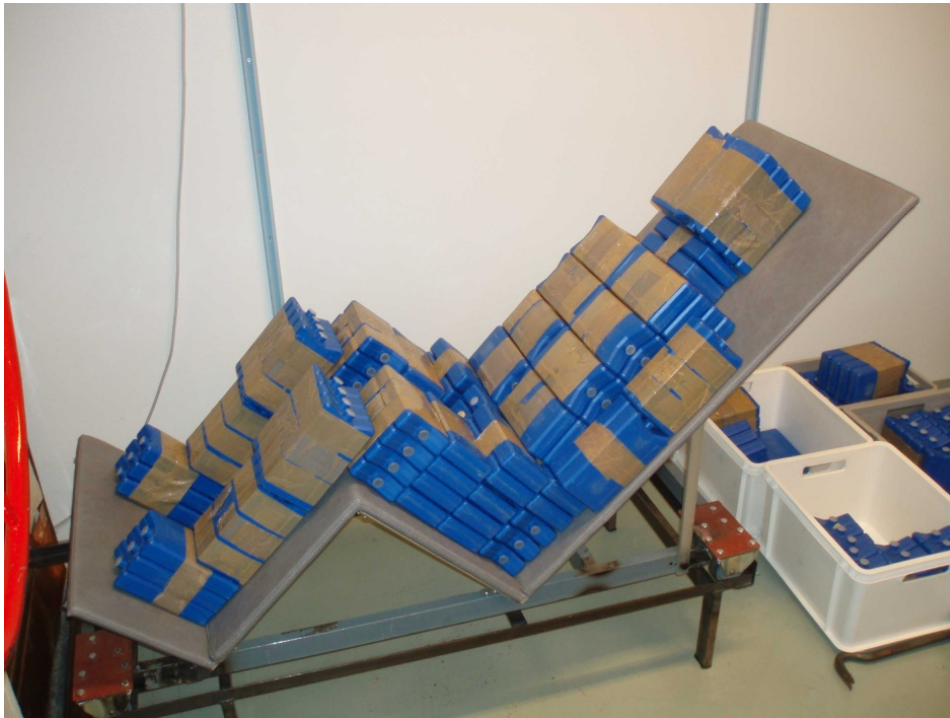


Figure 12. A set of plastic bottles with water are mounted to build the blank phantom at Helsinki University (picture courtesy of Markus Nyman, Helsinki Univ.)














Figure 13. Blank phantom approach at Skåne University Hospital (picture courtesy of Christopher Rääf, Assistant Prof., Medical Radiation Physics, SUH).









The activities for the calibrated radionuclides are assessed following in-house methodology that in most of the cases is documented for only internal use. Published documentation on how the calculation of the activities are done for the calibrated radionuclides at a specific facility is found, for example, in the works from Stockholm University and in a recent review from SSM, (Radenkovic, 2009) and (del Risco Norrlid and Östergren, 2010).

5.2 The regional capabilities and competence

Table 3 summarizes the capabilities in the region in terms of expertise on the specific routine in-vivo method, availability of in-vitro measurements, dose assessment possibilities and tools. Regarding dose assessment the laboratories with this possibility and expertise use all the ICRP models as the theory framework.

Table 3 Compilation of the competence and capabilities for in-vivo measurements and internal dose assessment in the region

Name of the facility	Experience on the in-vivo method	Quality status of the in-vivo laboratory*	Internal dose assessment/ Expert name	Internal dose assessment tool	Are in-vitro meas. results used in dose assessment?	Possibility for in-vitro meas. / Expert name
 Forsmark	> 10 years	Approved by National authority	Yes	IMBA Professional	No	–
 Westinghouse	1 – 5 years	Approved by National authority	Yes/ Mikael Andersson Hans Mellander	IMBA Professional	Yes	Yes, external lab: ALS Scandinavia.
 Ringhals	> 10 years	Approved by National authority	Yes / Marie Carlson Patrik Konneus	IMBA Professional	Yes	Yes, locally
 Oskarshamn	> 10 years	Approved by National authority	Yes	IMBA Professional	No	–
 Studsvik	> 10 years	Certified Accredited ISO 9001, 14001	Yes / Markos Koufakis	IMBA Professional	Yes	Yes, locally / Hans Sörman
 Barsebäck	> 10 years	Approved by National authority	Only preliminary**	IMBA Professional	No	–
 IFE Halden	> 10 years	–	Yes / Tore Walderhaug	IMBA Professional Ludep	Yes	Yes, locally
 IFE Kjeller	> 10 years	–	Yes / Tore Ramsøy Ann-Helen Haugen	IMBA Professional Ludep	Yes	Yes, locally
 Norge NRPA	5 - 10 years	–	No / Lavrans Skuterud Hårvard Tørring	IMBA Professional	No	–
 NM/PET Rigshospitalet	> 10 years	The hospital is accredited	No	–	–	–
 Iceland	< 1 year	–	No	–	No	–

 University of Helsinki	> 10 years	–	No	–	No	–
 Finland STUK	> 10 years	Accredited ISO 17025	Yes / Jussi Huikari Maarit Muikku Sauli Pusa	IMBA Professional	Yes	Yes, locally / Pia Vesterbacka
 FOI Umeå	> 10 years	Certified	No	IMBA Professional Ludep	No	–
 Lund University at Malmö UH	1 - 5 years	–	Yes / Christopher Rääf	IMBA Professional	No	–
 Radiofysik Linköping	< 1 year	–	Yes / Håkan Petterson, Magnus Gårdestig	IMBA Professional	No	–
 Stockholm University	< 1 year	–	No	–	No	–
 University of Gothenburg	> 10 years	–	No	–	No	–
 Sweden SSM	1 – 5 years	SSM is certified for ISO 9001, 14001	Yes / Lilian Norrlid	IMBA Professional	Yes	Partially Yes, locally / Inger Östergren

* WBC laboratories at nuclear facilities in Sweden need approval from the national authority, SSM. The procedure for approval follows the regulation SSM FS 2008:51 (SSM, 2008).

**Barsebäck has agreement with Ringhals on this matter.

6. Conclusions and outlook

The activity PIANOLIB builds upon the history of NKS activities in the area of in-vivo measurements and internal dose assessment. In this context the activity, continuing in 2011 has the goal of maintaining competence in the region and evaluating the regional needs for achieving internationally acceptable levels of quality assurance in whole body counting.

All the information gathered on the facilities in form of questionnaires and the exchange of information regarding the intercomparison have been registered at SSM-diarium, allowing for possible to come back to the information in the future.

The inventory within the activity has showed that the regional whole body counting assets has relatively diminished compared to the last time an inventory of the kind was made. For example, there are no longer a WBC lab at SIS in Denmark and the facility at Gothenburg's University is out of function in hold for a modernisation.

The majority of the stationary facilities, with the exception of the lab at Westinghouse and the lab at Ringhals have not been modernized in some time now, maybe 10 years, where new detectors and electronics have been installed. Both the field laboratories as the stationary ones are equipped with sophisticated whole-body counting systems with Ge-or NaI-detectors. The key measurement equipment, the detectors, do have long operational life. As long the detector perform stably the only reason for a replacement is to get more sensitive detectors offering the possibility of a lower minimum detectable activity.

However, in the last ten years the standard for the electronics has definitely moved onto completely digital and the packed-all-in-one approach for the processing of the electronic signal from the detector (front-end, preamplifier, amplifier and multichannel analyser in one box). This means that likely after the next ten years no longer will be possible to replace or serve analog electronics and we will need to move away from the classical signal processing NIM standard towards the fully digital solutions.

The regional competence is good and still retains experienced staff, but it is clear that a new generation is coming that needs training and exchange of experiences. This is why we think it is important to keep the practice of intercomparison and NKS continues to be the best framework for supporting this. Future activities involving this network of specialists could focus on evaluating the regional performance for iodine-131 in thyroids and intercomparison and or training regarding dose assessment.

The phantom library website has been introduced as a new tool for facilitating communication among labs and for enabling a transparent loan system of phantoms used in calibrations. The PIANOLIB activity continues in 2011 with the completion of the intercomparison and evaluation of the results. A workshop is planned in 2011 with the aim to gather participants for strengthening the regional network and to deciding future actions.

7. Acknowledgements

We like to specially thank all the participant laboratories for the nice cooperation during 2010.

We are grateful to the developer in charge of the programming for the phantom library website, Henrik Hansen at Webhouse, to Inger Östergren from SSM for her comments on the phantom library website and to SSM Registration's function for all the help with feeding the diarium.

NKS conveys its gratitude to all organizations and persons who by means of financial support or contributions in kind have made the work presented in this report possible.

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Appendix A. WBC facility questionnaire

NKS-B PIANOLIB

Questionnaire on your WBC facility and your routine method

(Return to registrator@ssm.se before 2010-09-30; subject SSM2010/1121)

Name of the facility:

Date:

- I. Type of facility: Stationary laboratory Field laboratory
- II. Radio nuclides routinely measured in your facility:
How do you handle radionuclide for which you don't have calibrations? Explain briefly:
- III. Shielding at your facility: Low background? Collimated detectors?
- IV. Type of detector (s): Number of detectors:
Size or percent rel. eff (cm or %):
- V. Choose the geometry of your set up:
- Scanning bed, static detector(s)
 - Scanning detector (s), static bed
 - Standing subject
 - Chair, static detector (s)
 - Bed, static detector (s)
 - Other (specify):

Send us pictures of your setup to registrator@ssm.se; subject SSM2010/1221.

VI. State the routine measurement time for the background (s):

Are background measurements performed:

without "blank phantom"

with "blank phantom"

Both

State the routine measurement time for human subjects:

VII. What do you use for analysis and calculation of the activities?

Commercial software; which:

In house analysis tool; describe:

VIII. Have you the responsibility for internal dose assessment at your lab?

YES

NO

If YES please, answer the following:

Model(s) on which the assessment strategy is based:

Calculation software or tool:

Name of the expert in dose assessment:

Are results from in-vitro measurements also used for internal dose assessment?

YES

NO

Tell us which kind of in-vitro measurements are performed:

Tell us if these in-vitro measurements are performed:

in your lab

in your organisation by other labs; which and contact person:

outside your organisation; where:

IX. Experience on your method

- Less than one year
- Between one and five years
- Between five and ten years
- More than ten years

X. Is your laboratory Certified Accredited?

Explain

XI. Additional comments

Appendix B. Phantom questionnaire

NKS-B PIANOLIB

Phantom questionnaire

(Return to registrator@ssm.se before 2010-09-30; subject SSM2010/1121)

1. Do you think that your laboratory will profit of a phantom library website?

Yes

No

2. Does your laboratory has own phantoms?

Yes

No

3. List the names of the phantoms in your lab

4. Send us by email (registrator@ssm.se; subject: SSM2010/1221)

a. A picture of each phantom set

b. The documentation for the reference radioactive material of each phantom (certificate)

Title	In-vivo whole body measurement of internal radioactivity in the Nordic countries
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ISBN	978-87-7893-310-2
Date	February 2011
Project	NKS-B / PIANOLIB
No. of pages	23
No. of tables	3
No. of illustrations	13
No. of references	7
Abstract	<p>The PIANOLIB activity aims to harmonize the calibrations of the measurement equipment in the region and to evaluate the quality status of this kind of measurement by means of a proficiency test exercise. In this report the first results of the PIANOLIB activity are presented, that is, a compilation of existent regional resources for in-vivo whole body measurement and the phantom library website. In 2010 the project PIANOLIB collected the relevant information about the regional facilities, distributed the exercise instructions and managed the circulation of the phantom IRINA among the participant laboratories. The inventory within the activity has showed that the regional whole body counting assets has relatively diminished compared to 2006, the last time an inventory of the kind was made. Both the field laboratories as the stationary ones are equipped with sophisticated whole-body counting systems with Ge-or NaI-detectors. The regional competence is good and still retains experienced staff, but it is clear that a new generation is coming that needs training and exchange of experiences. It is important to keep the practice of intercomparison and NKS continues to be the best framework for supporting this kind of activity.</p>
Key words	Whole body counting, measurement quality