NCS 015-001 Delft, May 7, 2015

ANNUAL REPORT 2014

Objective

The Nederlandse Commissie voor Stralingsdosimetrie (NCS, Netherlands Commission on Radiation Dosimetry) was established on the 3rd of September 1982 with the main objective of promoting the appropriate use of radiation dosimetry, both for radiation research and for practical applications. The NCS is chaired by a board of scientists, installed in consultation with the supporting societies:

- Nederlandse Vereniging voor Radiotherapie en Oncologie (NVRO, Dutch Society for Radiotherapy and Oncology);
- Nederlandse Vereniging voor Nucleaire Geneeskunde (NVNG, Dutch Society for Nuclear Medicine);
- Nederlandse Vereniging voor Klinische Fysica (NVKF, Dutch Society for Medical Physics)
- Nederlandse Vereniging voor Radiobiologie (NVRB, Dutch Radiobiological Society);
- Nederlandse Vereniging voor Stralingshygiëne (NVS, Society for Radiological Protection of the Netherlands);
- Nederlandse Vereniging Medische Beeldvorming en Radiotherapie (NVMBR, Dutch Society for Medical Imaging and Radiotherapy);
- Nederlandse Vereniging voor Radiologie (NVvR, Radiological Society of the Netherlands);
- Société Belge des Physiciens des Hôpitaux/Belgische Vereniging voor Ziekenhuisfysici (SBPH/BVZF, Belgian Hospital Physicists Association);
- Nederlandse Vereniging van Klinisch Fysisch Medewerkers (NVKFM, Dutch society of Medical Physics Engineers)

To pursue its aims, the NCS has the following tasks:

- Participation in dosimetry standardization and promotion of dosimetry inter-comparisons;
- Drafting of dosimetry protocols;
- Collection and evaluation of physical data related to radiation dosimetry;
- Maintain or establish links with national and international organizations concerned with ionizing radiation;
- Promulgate information on new developments in the field of radiation dosimetry.

Website: http://www.radiationdosimetry.org

Board

On December 31, 2014 the members of the board of the NCS were:

Dr. J.B. van de Kamer	chairman	(NVRO)
T.W.M. Grimbergen	vice chairman	(NVS)
Dr. J.A. de Pooter	secretary	(VSL)
Dr. A. Rijnders		(SBPH/BVZF)
J.M.J. Hermans	treasurer	(NVKFM)
Dr. J. R. de Jong		(NVNG)
Dr. P. Sminia / Dr. K. Franken		(NVRB)
Dr. A. Spilt		(NVvR)
Dr. Ir. F.W. Wittkämper		(NVKF)
M.K. Zeeman		(NVMBR)

The board of the NCS met four times in 2014, on 9 January, 10 April, 6 July, and 30 September. The main subjects raised at the board meetings were:

- Monitoring the progress of activities by the subcommittees and the platform;
- Initiate the publication of NCS-reports;
- Development of new activities.

Dr. Ann van der Plaetsen has decided to end her membership of the NCS board by the 10th of April 2014. Ann has been a member of the NCS board for 4 years. The board wants to thank her for her valuable contribution and commitment in these years. The SBPH/BVZF will be represented by Dr. Alex Rijnders from the 10th of April 2014. In 2014 no NCS reports have been published, 4 new subcommittees have been installed:

- IMRT & VMAT Audit
- QA of Afterloaders for Brachytherapy
- Radiation Doses & Risk Estimation for Medical Diagnostics and Research
- Code of Practice and recommendations for Total Body Irradiation and Total Skin Irradiation

Subcommittees

1. *Subcommittee on Quality Assurance and Quality Control for Intracranial Stereotactic Treatment; Process Management & Treatment Technique*

A rapidly growing number of radiotherapy centres in The Netherlands and Belgium are being equipped for stereotactic radiotherapy, i.e. stereotactic surgery (SRS) and stereotactic radiotherapy (SRT). In radiotherapy centres the development is focused on imaged guided "frameless" high-dose high precision techniques with standard and dedicated treatment devices, e.g. Novalis, Cyberknife and Gamma Knife. "Frameless" here means "without an invasive or relocatable localizer and treatment frame fixed on the skull of the patient with the aim to fix the patient on the treatment couch". In a free-market concept in health care stereotactic treatment with a Gamma Knife might become popular for non-radiotherapy centres due to its apparent simplicity relative to linac-based stereotactic treatment systems.

In stereotactic treatments very high fraction doses are delivered while a high accuracy in (re)positioning of the tumour with respect to the isocenter is required. Irrespective of devices used. Therefore, stereotactic treatments require higher accuracy levels in equipment and processes compared to standard radiotherapy treatments. This requires more attention to the quality assurance of both treatment devices and treatment process than for other complex treatments. Experiences from well-established stereotactic treatment centres learn that the introduction and maintenance of stereotactic radiotherapy in the clinic means the acceptance, commissioning and QA of a stereotactic treatment system as an entity, both in devices and in process. So, on one side this includes the acceptance, commissioning and QA of the hardware (e.g. linac, mMLC, cone, frames, couch), and software (TPS), as well as the imaging-system and systems for detection and (re)position tumour at isocenter. On the other side QA of the treatment process itself is important, but often overlooked; manpower trained at expert-level is required, working as a team and embedded in a well-structured organization.

The goal of the subcommittee is to compose a report that provides recommendations for Belgian and Dutch medical physicists on dosimetry procedures and quality assurance for add-on stereotactic equipment, dedicated fully integrated systems and the treatment process. The subcommittee was started in January 2006. In 2014 the last points were discussed; the report will be finished in spring 2015. The title has changed to: *Quality Assurance and Quality Control for intracranial Stereotactic treatment; Process management & Treatment technique.*

Members of this NCS subcommittee:

Stan Heukelom (VUmc, Amsterdam, chairman)
Hans Marijnissen (Erasmus MC, Rotterdam),
An Nulens (UZ Gasthuisberg, Leuven)
Geert Pittomvils (UZ, Gent)
Esther Raaijmakers (Instituut Verbeeten, Tilburg)
Dirk Verellen (UZ-Brussel, Brussel)
Thierry Gevaert (UZ-Brussel, Brussel)
Sandra Vieira (Champalimaud Centre for the Unknown, Lisboa, Portugal),
Nienke Holtzer (NKI/AvL, Amsterdam)
Joep Hermans (Maastro Clinic, Maastricht, representative from the NCS-board).

2. *Subcommittee on Guidelines for Quality Assurance of Helical Tomotherapy*

Helical Tomotherapy is a modality for radiation therapy treatment with integrated systems for

treatment planning, imaging, image registration and dose delivery. It has several differences compared to conventional linear accelerators, which imply that general Quality Assurance guidelines are not always applicable or sufficient. For example, current dosimetry protocols, based on the absorbed dose (NCS 18, AAPM TG-51), require calibration measurements under reference conditions. These reference conditions cannot be met. New methodologies are proposed in literature and are currently under discussion. Other specific QA issues concern the acceptance testing and commissioning of the integrated system, verification of dose planning and delivery, mechanical QA and patient safety.

Since the publication of TG148 on Tomotherapy Quality Assurance (Langen et al, Med.Phys. 2010) new functionality has been added to the system, like the dose control system, a new type of linac and target, the VoLO optimization and dose calculation using GPU architecture, calibration of the MVCT HU units to density, TomoDirect, TomoEdge and TQA. The goal of this report is to provide an updated guideline for QA and dosimetric calibration of the Helical Tomotherapy system.

The subcommittee is in the process of writing draft chapters and reviewing the results. Especially for the new features TomoEdge and TQA the committee is gathering information and experience which will be used in the development of the guideline. In 2014 Jeroen van de Kamer has replaced Ann Van der Plaetsen as the representative from the NCS board.

The report will cover the following topics:

- Treatment delivery – mechanics - TQA
- Dosimetry
- Treatment planning
- Imaging and set up verification
- Miscellaneous (adaptive, patient transfer and DQA)

Members of this NCS subcommittee:

Vincent Althof (Radiotherapiegroep, Deventer, chairman)
Bie De Ost (UZA/ZNA, Antwerpen, secretary)
Nick Reynaert (Centre Oscar Lambret, Lille)
Koen Tournel (UZ-Brussel, Brussel)
Jeroen van de Kamer (NKI/AvL, Amsterdam, representative from the NCS-board)
Edmond Sterpin (UCL, Brussel)

3. Subcommittee on QA for rotational IMRT

The aim of the subcommittee is to produce a report with guidelines for introduction and maintenance of safe and high quality rotational IMRT (or VMAT) techniques in clinical practice. The report will be based on the experience from Belgian and Dutch institutes as well as on available literature.

Four subcommittee meetings have been organized in 2014. The core of our report will consist of three chapters: “VMAT machine QA”, “VMAT plan QA” and “VMAT treatment planning”. Each of these chapters was assigned to two or three members. Besides the meetings, the authors of a certain chapter have met to work on their chapter.

After the subcommittee meeting in September, the separate chapters of the report were merged, and the report was send to three external reviewers: James Bedford (Royal Marsden Hospital, London, UK), Siete Koch (MST, Enschede, NL) and Geert Pittomvils (UZ Gent, BE). During the last months of 2014, the report was updated with the comments from the reviewers. In January 2015 there will be a final subcommittee meeting to discuss the changes and finalise the report.

In 2014, no results were disseminated in the form of publications or contributions to symposia.

Members of this NCS subcommittee:

Anton Mans (NKI/AvL, Amsterdam, chairman)
Mark Arends (RIF, Leeuwarden, secretary)
Jochem Wolthaus (UMC-U, Utrecht)
Marjan Admiraal (VUmc, Amsterdam)
Danny Schuring (CZE, Eindhoven)
Rob Louwe (Wellington & Wairarapa, New Zealand)
Heidi Lotz (UMCG, Groningen)
Lia Vugts (Instituut Verbeeten, Tilburg)
Michel Öllers (Maastro Clinic, Maastricht)
Jeroen van de Kamer (NKI/AvL, Amsterdam, representative from the NCS board)

4. Subcommittee on quality assurance of cone-beam CT

Cone-beam CT scanners integrated with linear accelerators have become increasingly important tools for image guidance of radiotherapy treatments. The application of cone-beam CT based image guidance is very diverse, ranging from bony anatomy based offline correction protocols to online stereotactic tumour based correction strategies. Although most institutions have presently implemented QA procedures for CBCT, the frequency and methods vary widely.

The aim of the subcommittee is to develop uniform guidelines for the commissioning and quality assurance of cone x-ray based image guidance systems on conventional linacs, i.e. cone-beam CT (XVI, OBI), and portal imagers. The guidelines will be based on current literature as well as clinical experience from the subcommittee members.

Two meetings of the committee have been held in 2014, the first in Groningen, and the second in Alkmaar. These meetings were mainly focused on discussing the drafts and methodology for dosimetry QA, where the latter has proven to be quite complex. A draft version of the following chapters has now been written: geometry QA, Image quality and dosimetry. All are based on both literature (e.g. AAPM TG 104, 142, 148, 179) and clinical experience from the contributing institutes.

For the coming year the goal will be to finalize the dosimetry, geometry, and image quality parts of the report, and have final drafts for the remaining topics.

Members of the subcommittee

Peter Remeijer (NKI/AvL, Amsterdam, chairman)
Martijn Eenink (RCWEST/LUMC, secretary)
Willy de Kruijf (Instituut Verbeeten, Tilburg)
Kirsten Deurloo (MCA, Alkmaar)
Niek van Wieringen (AMC, Amsterdam)
Heleen van Herpt (UMCG, Groningen)
Marianna Sijtsema (UMCG, Groningen)
Martijn Kusters (RadboudUMC, Nijmegen)
Koos Geleijns (LUMC, Leiden, advisor CT dosimetry)
Joep Hermans (Maastro Clinic, representative of the NCS board)

5. Subcommittee on IMRT & VMAT Audit

The subcommittee conducts a voluntary audit of IMRT and VMAT/RapidArc delivery modalities in

the radiotherapy institutes in the Netherlands.

For a limited set of RT plans, defined by the committee, the dose distribution computed by an institution's treatment planning system is compared with the dose measurements performed by the audit team at the institution's linear accelerators. This is done independently from the treatment planning optimization process. Each plan is measured by an ionization chamber (pinpoint), Gafchromic film and a 2D ionization chamber array (Octavius, PTW).

Additionally, the results are compared to the QA measurements done by each institute according to their local protocol.

Since February 2014 the subcommittee met 7 times. From February to September the preparation phase took place. The measuring protocol was written, the audit logistics determined and the treatment plans were prepared. In October the measurement sessions started and 10 institutes were audited. The audit method will be presented as poster on the 3rd ESTRO forum, and will be discussed in a discussion session on dosimetry audits.

Members of the subcommittee are:

Enrica Seravalli (UMC-U, Utrecht)
Anette Houweling (AMC, Amsterdam)
Marion van Gellekom (ARTI, Arnhem)
Jochem Kaas (NKI/AvL, Amsterdam)
Erik Loeff (Erasmus MC, Rotterdam)
Thom Raaben (MST, Enschede)
Marc Kuik (MCA, Alkmaar)
Jacco de Pooter (VSL, Delft, representative from the NCS board)
Wilfred de Vries (UMC-U, Utrecht)

6. Subcommittee on QA of Afterloaders for Brachytherapy

The subcommittee has been set up 2014. Goal of the subcommittee is to prepare a code of practice for Quality Assurance of Ir-192 afterloaders for HDR and PDR brachytherapy, as used in the Netherlands and Belgium. In 2014 the subcommittee had 4 meetings in which critical steps in the whole process of brachy-therapy with afterloaders were identified. These steps included, among others, determination of the source strength, accuracy of the reconstructed source position and dose delivery throughout the treatment. While applicators are considered extensions of the afterloader, QA of applicators was discussed as well. These discussions were very fruitful.

Driven by actual discussions in the Netherlands, concerning the QA of applicators and transfer tubes, the subcommittee will publish a (preliminary) chapter on this topic in the first quarter of 2015.

Members of the subcommittee are:

Jacco Steenhuijsen (CZE, Eindhoven, chairman)
Marja Harbers (MST, Enschede)
Aswin Hoffmann (Maastro clinic, Maastricht)
Astrid de Leeuw (UMC-U, Utrecht)
Rita Reymen (GZA-Sint Augustinus Wilrijk/Antwerpen)
Alex Rijnders (Europa Ziekenhuizen, Brussel, representative from the NCS board)

7. Subcommittee on Code of Practice and recommendations for Total Body Irradiation and Total Skin Irradiation

The goal of this NCS subcommittee is to investigate the status of treatment protocols and quality control for total body and total skin irradiation in the Netherlands and Belgium. Most centres use AAPM reports 17 and 23 as a starting point, but deviate from these protocols after a few decades. Recent technological evolution allows new treatment and treatment planning techniques, creating a need for a guidance report for individual centres in order to compare their current way of practice to the state of the art practice. In this report, we will focus on the state of the art concerning:

- Clinical requirements: dose prescription, dose homogeneity, tolerance of critical organs
- Treatment techniques: patient positioning and fixation, beam specifications, beam attenuators
- TBI/TSI commissioning: measurement techniques
- Treatment planning: TPS validation
- Pre-treatment verification: dose prescription, dose homogeneity, beam absorbers
- In-vivo verification: imaging, dose verification, skin doses
- Risk analysis

Additionally we will give some recommendations for future developments.

After a start up meeting on October 2nd we have organised a follow up meeting with two main goals; to prepare a questionnaire for the radiotherapy departments and to draft an overview of the used TBI and TSI treatment methods at the different centres represented in the committee. A first draft of tasks selection within the committee is also finalised at the second meeting of November 6th.

Members of the subcommittee are:

Geert Pittomvils (UZ Gent, Gent, chairman)
Wim Jansen (LUMC, Leiden, secretary)
Maxime Coevoet (Saint Luc UCL, Brussels)
Nicolas Hermand (UZ Leuven, Leuven)
Phil Koken (VUmc, Amsterdam)
Heleen van Herpt (UMCG, Groningen)
Daan Martens (NKI/AvL, Amsterdam)
Lars Murrer (Maastro Clinic, Maastricht)
Peter van der Hulst (UMCG, Groningen)
Ruud van Leeuwen (RadboudUMC, Nijmegen)
Francoise Vanneste (Saint Luc UCL, Brussels)
Jeroen Van de Kamer (NKI/AvL, Amsterdam, representative of the NCS Board)

8. Subcommittee on Radiation Dose & Risk Estimation of Medical Diagnostic and Research Procedures

The aims of this NCS subcommittee are (1) to define threshold radiation doses regarding the risk of deterministic effects and to estimate stochastic effects in humans exposed to ionizing radiation, (2) to provide guidelines for diagnostic and interventional procedures in patients and healthy volunteers participating in scientific medical research, and (3) to define additional measures for those cases where the threshold values are exceeded. Threshold radiation doses (mSv/mGy) will be derived from the literature, e.g. using ICRP and BEIR reports. Based on these threshold values and taking into account several variables like radiation dose, age at exposure,

gender and life expectancy, risk estimations will be presented. The subcommittee will also propose guidelines for interventional procedures that inevitably exceed the threshold values, both for clinical practice and for healthy subjects or patients participating in medical research. A follow-up working group will define those interventions for which additional measures, e.g. specific training or protocols, are required.

The subcommittee was initiated on August 27th, 2014, setting the outlines of the committee aims and of the report to be prepared. At the next meeting, on December 17th, the first draft of the report as well as further steps to be taken were discussed. Also, it was decided to combine efforts with a working group from the NVNG on national dose and risk guidelines. The subcommittee aims and activities are presented on the NCS website.

Members of this NCS subcommittee:

Peter Sminia (VUmc, Amsterdam, Chairman, representative of the NCS board)
Marloes Zeeman (NVMBR, Utrecht, representative of the NCS board)
Klaas Franken (AMC, Amsterdam, representative of the NCS board)
Marcel Greuter (UMCG, Groningen)
Arno van de Wiel (Ministerie van VWS, Den Haag)
Frank de Lange (RadboudUMC, Nijmegen)
Ali Vegter (NVMBR, Utrecht, representative of the NCS Platform)
Adriaan Lammertsma (VUmc, Amsterdam, representative of NVNG)
Aart Spilt (Kennemer Gasthuis, Haarlem, representative of the NCS board)
Marcel Wiegman (RadboudUMC, Nijmegen)

Advisory platforms

The Netherlands Commission on Radiation Dosimetry covers a wide range of expertise through the participating scientific societies. In 1999 NCS platforms were established on dosimetry for radiology and nuclear medicine and dosimetry for radiotherapy. The tasks of these platforms are to give advice on specific research projects initiated by the Government. In case of future needs the NCS can be approached for consultation through its secretary under the condition of modest coverage of NCS experts in terms of attendance fee and travel costs for meetings.

1. Advisory platform on Radiation Protection in Hospitals

The goals of the platform are:

- Giving advice to both government and the hospital community regarding the radiation legislation and regulation within the sphere of competence of the NCS.
- Coaching and initiating the making and implementation of practical guidelines for the compliance and implication of existing and new Radiation Safety regulations in the spheres of interest of the NCS. The platform operates from within the hospital community for the hospital community for the irradiating professions, working in university hospital, large community hospitals and/or independent institutes.

The platform has gathered once in Utrecht at the office of the NVMBR (meeting room kindly provided by the NVMBR), on November 26.

<u>Changes in the composition of the subcommittee</u>

- Resignations:
  - Koos Geleijns, NVKF (chairman)
  - Roel Claessens, NVNG
  - Aart van der Molen, NVvR
  - Dirk Zweers, NVMBR
- New members:
  - Christiaan van Swol, NVKF (chairman)
  - Jan Habraken, NVNG
  - Alie Vegter, NVMBR
  - Niels Veltman, NVNG

<u>Progress made in 2014</u>

After a delay for more than six months a new chair has been appointed together with some new members. Running projects were continued and a new project inventory was drawn up.

Running projects:

- Risk analysis in nuclear medicine, radiology and radiotherapy: final document in preparation
- Protective equipment (apron, goggles, collar, shielding): a new project group will be formed
- Feasibility study on international norms for radioactive hospital waste: a platform member will join the project group

Members of the advisory platform are:

Christiaan van Swol (representative of the NVKF, chairman)
Paul Jonkergouw (representative of the NVS, secretary)
Jan Habraken (representative of the NVNG)
Marja Harbers (representative of the NVKFM)
Jeroen van de Kamer (representative of the NCS board)
Bradley Pieters (representative of the NVRO)
Kirsten Schimmel (representative of the NVZA)
Alie Vegter (representative of the NVMBR)
Niels Veltman (representative of the NVNG)

NCS FINANCIAL OVERVIEW 2014

	Income (€)	**Costs (€)**
Savings-account on Januari 1, 2014	36933.13	
Current-account on Januari 1, 2014	6535.07	
Project-account on Januari 1, 2014	82.70	
Contribution Netherlands Society for Radiology (NVvR) 2014	600.00	
Contribution Netherlands Society for Medical Physics (NVKF) 2014	400.00	
Contribution Netherlands Society for Radiotherapy and Oncology (NVRO) 2014	800.00	
Contribution Netherlands Society for Nuclear Medicine (NVNG) 2014	200.00	
Contribution Netherlands Society for Radiological Protection (NVS) 2014	400.00	
Contribution Netherlands Radiobiological Society (NVRB) 2014	100.00	
Contribution Dutch society of Medical Physics Engineers (NVKFM) 2014	100.00	
Contribution Netherlands Society for Medical Imaging (NVMBR) 2014	300.00	
Contribution Belgian Hospital Physicists Association (BHPA) 2014	200.00	
Income Vmat/Rapidarc audit	26250.00	
costs Vmat/Rapidarc audit		4835.89
Banking costs project account		122.15
Interest savings-account	477.20	
Banking costs current account		20.81
Costs web site		1629.81
Costs meetings NCS board		1275.00
Costs NCS subcommities		471.99
Divers		2.89
Savings-account on December 31, 2014		37410.33
Current-account on December 31, 2014		6234.57
Project account on December 31, 2014		21374.66
Total	**73378.10**	**73378.10**

NCS BUDGET 2015

	Income (€)	**Costs (€)**
Contributions scientific societies	3100.00	
Interest savings-account	500.00	
Banking costs		150.00
Costs of board and subcommittees meetings		1950.00
Website maintenance etc		1500.00
Total	**3600.00**	**3500.00**