NCS 020-002 Delft, May 28, 2020

ANNUAL REPORT 2019

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

expanded with a representative from the Dutch Metrology Institute VSL.

To achieve its aims, the NCS carries out the following tasks: participation in dosimetry standardisation, promotion of mutual comparisons of dosimetry, drafting of dosimetry protocols and the collection and evaluation of physical data related to dosimetry. Furthermore, the commission shall establish or maintain links with national and international organisations concerned with ionising radiation and promulgate information on new developments in the field of radiation dosimetry.

Website: https://www.radiationdosimetry.org

Board

On December 31, 2019 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)
N. de Graaf		(NVvR)
Dr. F. Dekkers		(NVRB)
Dr. Ir. F.W. Wittkämper		(NVKF)
M.K. Zeeman		(NVMBR)

The board of the NCS met three times in 2019 on 24 January, 15 May and 18 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;

In 2019 one NCS reports has been published:

- NCS32 - Quality assurance of cone-beam CT for radiotherapy (https://doi.org/10.25030/ncs-032)

Four new subcommittees have been installed in 2019:

- Subcommittee on Intra operative radiotherapy
- Subcommittee on Clinical application of deformable image registration and auto-segmentation in radiotherapy
- Subcommittee on Radiation Protection and Dosimetry of the Extremities
- Subcommittee on Implementation of pediatric diagnostic reference levels in the Netherlands

Subcommittees

1. Subcommittee on quality assurance of cone-beam CT

The report was completed in 2018. January 2019 the report has been published on the NCS website.

Members of the subcommittee
Peter Remeijer (NKI-AVL, Amsterdam, chairman)
Kirsten Deurloo (MCA, Alkmaar, secretary)
Heleen van Herpt (UMCG, Groningen)
Martijn Hol (LUMC, Leiden)
Martijn Kusters (UMC St Radboud, Nijmegen)
Greet d'OlieSlager (BVI, Tilburg)
Marianna Sijtsema (UMCG, Groningen)
Niek van Wieringen (AUMC/AMC, Amsterdam)
Koos Geleijns (LUMC, Leiden, advisor CT dosimetry)
Joep Hermans (MAASTRO, Maastricht, representative of the NCS board)

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

The goals 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 this 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.

The workgroup had two meetings during this year. Based on the RKF themamiddag in Nijmegen and the previous drafts major progression was achieved in the redaction of the report. In order to improve the frequency of meeting, meeting using skype from a few different sites became the standard meeting form.

Members:
Geert Pittomvils (UZ Gent, Gent, chairman)
Wim Jansen (Radiotherapiegroep, Arnhem, secretary)
Laurien Daniels (AUMC, Amsterdam)
Damien Dumont (Cliniques Universitaire Saint Luc, Brussel)
Phil Koken (AUMC, Amsterdam)
Lars Murrer (Maastro, Maastricht)
Peter Van der Hulst (UMCG, Groningen)
Ruud Van Leeuwen (Radboud UMC, Nijmegen)
Jeroen Van de Kamer (NKI-AvL, Amsterdam, representative of the NCS Board)

3. Subcommittee on Dosimetry for Scanned Pencil Beam Proton Therapy

International codes of practice for reference dosimetry and recommendations for measurement of beam characteristics in proton therapy (TRS-398, ICRU 78) are mainly focused on passive scattering delivery technology. These reports do not address specific issues of pencil beam scanning.

The aim of the subcommittee is to develop uniform guidelines for the absolute and relative

dosimetry of the pencil beam scanning modality with continuous and pulsed proton beams. Currently three facilities are operational; ZonPTC Maastricht, HPTC Delft and GPTC Groningen in the Netherlands. ParTICLe Leuven in Belgium is scheduled to start patient treatment early 2020.

The report aims to be essentially in-line with the recommendations of the IAEA TRS-398 international code of practice. First drafts of chapters are being updated and the aim is to finalize these in 2020. During 2019 Petra Trnkova has relinquished the chair position but stays part of the subcommittee and Marc-Jan van Goethem has taken up the chair position. The subcommittee has two new members Hugo Palmans and Stephan Both who is replacing Arturs Meijers.

Members of the committee are:

Marc-Jan van Goethem (UMCG, Groningen, chairman)
Gloria Vilches Freixas (MAASTRO, Maastricht, secretary)
Marco Schippers (PSI, Villligen CH)
Petra Trnkova (Medaustron, Vienna AT)
Frank Verhaegen (MAASTRO, Maastricht)
Enrica Seravalli (UMCU, Utrecht)
Steven Habraken (HPTC/ErasmusMC, Delft)
Hugo Palmans (Medaustron, Vienna and National Physical Laboratory, Teddington)
Stephan Both (UMCG, Groningen)
Jacco de Pooter (VSL, Delft, representative of the NCS board)

4. Subcommittee on Quality Assurance of Treatment Planning Systems

Treatment planning has considerably evolved over the last decades. We see, for example, a growing use of automated tools to generate treatment plans and adaptive planning strategies. On the other hand, ancient techniques such as virtual simulation and the use of wedges have become obsolete. This leads to new questions regarding the quality assurance and commissioning of treatment planning systems.

In 2019 the subcommittee has met three times. The subcommittee decided on the schedule to write the report. The aim is to finish the report in 2020. In the meetings, we discussed topics that are of interest for the writing of the report, such as the status of scripting, validation measurements, and tips to make most of the collaborative writing of the report.

In November, the actual writing started during a two-day event in Leuven. This meeting proved to be very fruitful, giving a good start to the first concept of the chapters, ending the year according to our anticipated schedule.

Members of the subcommittee are:

Rik Westendorp (Radiotherapiegroep, Deventer, chairman)
Danny Schuring (Catharina Ziekenhuis, Eindhoven, secretary)
Jorrit Visser (AUMC/AMC, Amsterdam)
Kimmie de Bruin (AUMC/VUMC, Amsterdam)
Erik van der Bijl (NKI-AVL, Amsterdam)
Younes Jourani (Jules Bordet, Brussel)
Antoine Delor (UC-Louvain, Brussel)
Roel Kierkels (Radiotherapiegroep, Deventer)
Chin Loon Ong (Haga Ziekenhuis, Den Haag)
Tara van de Water (RIF, Leeuwarden)
Wouter Crijns (UZ, Leuven)
Joan Penninkhof (Erasmus MC, Rotterdam)
Gijsbert Bol (UMCU, Utrecht)
Jeroen van de Kamer (NKI-AVL, Amsterdam, representative from the NCS board)

5. Subcommittee on MRI QA for radiotherapy

Magnetic Resonance Imaging (MRI) is increasingly used in the process of radiation therapy (RT). A concern of integrating MRI into RT-planning is the spatial accuracy of these images, as they are affected by magnetic field inhomogeneities, magnetic susceptibility artefacts, chemical shifts and non-linearities in the gradient fields. Since these effects are system and patient dependent, dedicated procedures for quality assurance (QA) and quality control (QC) of MRI for RT are mandatory.

The subcommittee has been established in 2017. The goal of this subcommittee is to develop a code of practice for MRI QA/QC which is dedicated to RT purposes. In 2019, the subcommittee had two meetings. A set of tests for system quality assurance has been defined. The content of the report is formulated and there has been progress in writing of the chapters. Aswin Hoffman has left the subcommittee.

Members of the subcommittee are:

Zdenko van Kesteren (AUMC/AMC, Amsterdam, chairman)
Marloes Frantzen-Steneker (NKI-AVL, Amsterdam, secretary)
Ellen Brunenberg (Radboud UMC, Nijmegen)
Joost Kuijer (VUmc, Amsterdam)
Steven Petit (Erasmus MC, Rotterdam)
Mariska de Smet (BVI, Tilburg)
Rob Tijssen (Catharina Ziekenhuis, Eindhoven)
Pieternel van der Tol (Radboud UMC, Nijmegen)
Arjan Verduijn (UMCU, Utrecht)
Jeroen van der Kamer (NKI-AVL, Amsterdam, representative of the NCS board)

6. Subcommittee on Code of Practice and Recommendations for Stereotactic Body Radiotherapy

The purpose of the committee is to provide the basic requirements and guidelines for providing safe and high-quality SBRT treatments according to state-of-the-art international standards. The aim is to make a practical report that can readily be used with clear requirements and recommendations.

In 2019 the committee has organized six meetings. Group members have made considerable progress with the main chapters, and these were discussed during the meetings. Also, some relevant topics and literature were discussed during the meetings.

Members of the subcommittee are:
Johan Cuijpers (AUMC/VUmc, Amsterdam, chairman)
Anke van Mourik (NKI-AvL, Amsterdam)
Marloes Steneker (NK-AvL, Amsterdam)
Anna Pethoukova (HMC, Den Haag)
Richard Canters (MAASTRO, Maastricht)
Marcus Wendling (Radboud UMC, Nijmegen)
Siete Koch (MST, Enschede)
Rens Vingerhoets (NWZ, Alkmaar)
Chrysi Papalazarou (Erasmus MC, Rotterdam)
Petra Kroon (UMCU, Utrecht)
Jeroen van de Kamer (NKI-AvL, representative of the NCS board)

7. Subcommittee on Quality control for linear accelerators

The goal of the subcommittee is to produce a report to supersede the NCS reports 8 and 9 on linac QA. Rather than simply providing an updated list of tolerances and tests the subcommittee aims to produce a report in which;

- tests and tolerances are put in the context of operation of the entire linac
- a transition from uniform tolerances to a system of Statistical Process Control is promoted
- a new framework of beam parameters is provided that is equally applicable to both flattened and non-flattened beams

The subcommittee aims at releasing a pre-publication of the chapter on beam parameters in order to facilitate implementation in commercial and 'in-house developed' analysis software. This pre-publication is nearing completion.

Elfried Kok left the subcommittee in the spring of 2019. Two new members have been recruited: Erik Roijen and Daan Hoffmans. In 2019 the subcommittee convened three times.

Members of the subcommittee are:
Bas Gobets (LUMC/RdG, Leiden/Delft, chairman)
Thijs Perik (NKI-AVL, Amsterdam, secretary)
Hendrik Piersma (MST, Enschede, secretary)
Daan Hoffmans (AUMC, Amsterdam)
Erik Roijen (MAASTRO, Maastricht)
Jan van Santvoort (HMC, the Hague)
Theo van Soest (UMCU, Utrecht)
Richard Tiggelaar (AUMC, Amsterdam)
Jochem Wolthaus (UMCU, Utrecht)
Frits Wittkämper (NKI-AVL, Amsterdam, representative NCS board)

8. Subcommittee on Intra operative radiotherapy

IORT refers to the delivery of a high dose at the time of surgery to a specific target while healthy structures are displaced or shielded. This treatment technique involves a multidisciplinary approach and a close interaction between surgery and radiotherapy. In clinical practice different dedicated devices are used: mobile electron linear accelerators, a low-energy X-ray machines and brachytherapy. This leads to a diverse combination of equipment with specific dosimetric characteristics, quality assurance protocols, sterilization procedures, dose calculation, safety and risk assessment, specific care paths, and a special work environment. Therefore, the NCS initiated a subcommittee that focuses on the current

practice on IORT.

In this report the current procedures in use are discussed, and suggestions and guidelines will be proposed with the aim to standardize the clinical implementation across the different techniques and centres.

Four meetings of the committee have been held at different hospitals of the members. The first two meetings were focused on chapters and dividing tasks. The subsequent meetings were dedicated to preparing, organizing and discussing a TLD audit among the members. The subcommittee performed a TLD audit on all IORT treatment devices. The chair will be taken over by Stephane Simon (Bordet). An abstract with the results of the multicentre TLD audit on different types of IORT treatment machines has been published for the 11th ISIORT conference, June 19-20, 2020.

Members of the subcommittee
- Anna Petoukhova (Medisch Centrum Haaglanden, Den Haag)
- Inger-Karine Kolkman-Deurloo (Erasmus MC, Rotterdam)
- Marleen Piessens (OLV ziekenhuis Aalst)
- Nicolas Hertsens (AZ Groeninge, Kortrijk)
- Stephane Simon (Bordet, Brussel), Chair
- Dianne Weug (Catharina ziekenhuis, Eindhoven), advisor
- Jeltsje Cnossen (Catharina ziekenhuis, Eindhoven), advisor
- Jeroen van de Kamer (NKI-AvL, Amsterdam), representative of the NCS board
- Wim Dries (Catharina ziekenhuis, Eindhoven), Secretary
- Piet Stevens (Iridium kankernetwerk, Antwerpen)

9. Subcommittee on Clinical application of deformable image registration and auto-segmentation in radiotherapy

Sophisticated auto-segmentation and deformable image registration (DIR) toolboxes have become commercially available for clinical use in radiation oncology. A variety of clinical applications make use of both techniques. Still, their validity is not guaranteed in all circumstances and therefore one needs to be cautious when applying them in clinical use. These applications include auto-segmentation, contour propagation, re-irradiation and dose accumulation; also DIR typically plays a role in off-line and on-line plan adaptation.

This NCS subcommittee aims to give an overview of literature, possibilities and pitfalls of different techniques and provide guidance to commissioning and acceptance for various clinical applications.

The subcommittee officially started in May 2019 and is meeting both at regular intervals on a physical basis and holds telephone conferences to monitor progress. Currently an overview of the relevant literature is studied, and an investigation of the use cases used in clinical practice is finalized.

Members of the subcommittee are:
- Wouter van Elmpt (MAASTRO, Maastricht, chairman)
- Erik van Dieren (MST, Enschede, secretary)
- Sasha Ivashchenko (LUMC, Leiden)
- Alexis Kotte (UMCU, Utrecht)
- Charlotte Brouwer (UMCG, Groningen)
- Andras Zolnay (Erasmus MC, Rotterdam)
- Peter Remeijer (NKI-AVL, Amsterdam)
- Miguel Palacios (AUMC/VUMC, Amsterdam)
- Jeroen van de Kamer (NKI-AVL, Amsterdam, representative from the NCS board)

10. Subcommittee on Radiation Protection and Dosimetry of the Extremities

The skin and in particular the extremities may be exposed to significant amounts of radiation, especially in workplaces where open radioactive sources are being produced or applied and in interventional radiology applications. Although several international recommendations have covered this topic (such as the ORAMED study, ISO 15382 and Annex E of ICRP-106), up to now there is little harmonization in the dosimetry and protection of the extremities in practice.

The aim of this NCS subcommittee is to develop guidelines with respect to the dosimetry and protection of the extremities, with special attention to applications of open radioactive sources and exposures in interventional radiology. The guidelines will be based on current literature as well as the experience of the participating members of this subcommittee.

There were two meetings in 2019. The kick-off of the subcommittee was on 30 September 2019. During the first meetings the following content was defined:

Recommendations for monitoring the extremities:

- Summary or overview of the international recommendations.
- How to adequately estimate the maximum extremity dose (application of correction factors, dependence of the dosimeter on the radiation quality)
- Guidance on what situations require monitoring
- Recommended monitoring location

Guidance on the calculation of extremity dose:

- Tools that can be used for calculation of the extremity dose
- Extremity dose due to beta radiation and contamination

Members of the subcommittee are:

Robert Kollaard (NRG, Arnhem, chairman)
Ischa de Waard (RIVM, Bilthoven, secretary)
Theo Adriaensen (Amphia Hospital, Breda)
Tom Grimbergen (Mirion Dosimetry Services, Arnhem, representative from the NCS board)
Frank de Lange (Radboud UMC, Nijmegen)
Emmie Meijne (UMCG, Groningen)
Mark van Mierlo (GE Healthcare, Eindhoven)
Filip Vanhavere (SCK.CEN, Mol, Belgium)
Alie Vegter (Treant Hospital, Stadskanaal)
Bart Vermolen (Gelderse Vallei Hospital, Ede)
Robert Westland (AUMC, Amsterdam)

11. Subcommittee on Implementation of pediatric diagnostic reference levels in the Netherlands

Diagnostic reference levels (DRLs) have been recommended by the International Commission on Radiological Protection (ICRP) as an advisory measure to improve optimization of patient protection, by identifying high patient dose levels which might not be justified on the basis of image quality requirements. The implementation of DRLs in the Netherlands has been performed in a three-phase project carried out from 2006 - 2012. In the 2012 guidelines DRLs have been defined for only 4 pediatric examinations (PiDRLs), x-thorax, x-pelvis, CT-head and micturating cystourethrogram.

Given the current lack of PiDRLs in the Netherlands, the NCS and NVKF strongly recom-

mended to start a project to establish national DRLs for pediatric examinations. In the current project Dutch hospitals will be asked to upload their dose information on pediatric diagnostic and interventional procedures to a central database. Radiography, fluoroscopy and Computed Tomography procedures will be included. Not only dedicated hospitals for pediatric medical care will be involved, but also more general academic and peripheral hospitals will be involved. The aim is to use the data from at least 8 hospitals with a total database of >1000 examinations on children. In addition, a proposal will be made for hospitals how to use the established national PiDRLs, even in cases where small numbers of children are being examined. The first meeting of this committee was 7 November 2019.

Topics to be covered

- Definition of categories of patients (age, length, weight)
- Setup and filling of a project database for dose data
- Analysis of the project database and comparison to the European PiDRL
- Establishing national PiDRLs
- Development of methods how to use the established national PiDRLs
- Presentation of the report and communication to health care professionals

Members of the subcommittee are:

Lida Dam - Vervloet (Isala, Zwolle, Chair)
Geert Streekstra (AUMC/AMC, Amsterdam, Secretary)
Martijn Boomsma (Isala, Zwolle)
Marcel Greuter (UMCG, Groningen)
Laurine Keulemans (VWS, Den Haag)
Bart Mangnus (AUMC/AMC, Amsterdam)
Carola van Pul (Maxima Medical Center, Eindhoven)
Jenny Schaar (UMCG, Groningen)
Alie Vegter (Treant Hospital, Stadskanaal)
Nanko de Graaf (Erasmus MC, Rotterdam, representative NCS board)

Advisory platform

The Netherlands Commission on Radiation Dosimetry covers a wide range of expertise through the participating scientific societies. In 1999 NCS platforms were established. Currently only the advisory platform on Radiation Protection in Hospitals is active. The tasks of the platform is 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

In 2010 the NCS platforms was reinitiated with the aim to provide practical advice regarding legal aspects concerning the use of radiation in the clinical environment. For this, the platform is represented by the participating societies, expanded with the Dutch Society on Pharmacy in Hospitals. To achieve this goal, the platform has frequent contact with the Dutch Government.

The Platform advises on radiation safety laws and regulations. It establishes practical guidelines for existing and new laws and regulations. The Platform maintains close contacts with the Dutch ministries of VWS (Ministry of Health, Welfare and Sport) and SZW (Ministry of Social Affairs and Employment) and the ANVS (Authority for Nuclear Safety and Radiation Protection). The Platform plays a key role in effective and efficient implementation of European directives into national law.

The Platform had three meetings in 2019 and several consultations by mail. Activities in 2019 include:

- Reporting dose in patient files according to the Bbs (collaboration with VWS)
- Revision of the General Risk Analysis and calculation sheets for Radiology, Nuclear Medicine and Radiotherapy (collaboration with iSZW)
- Nuclear waste
- Clearance level for artificial isotopes
- Accreditation for radiation protection experts
- Cremation after 125-I therapy
- Guideline for organizing radiation protection in hospitals (committee of VWS and ANVS)

The platform published a Communication on reporting dose in patient files on request of the ministry of Health (VWS). In addition, the platform published a new format for risk analysis for employees due to radiation and accompanying calculation sheets for Radiology, Radiotherapy and Nuclear Medicine. An up-to-date overview of the activities of the platform can be found at: https://radiationdosimetry.org/platform/activities

Members of the NCS platform are:

Peter Brands (NVKF, chair)
Kitty Hoornstra (NVS, secretary)
Herman Pieterman (NVvR)
Niels Veltman (NVNG)
Alie Vegter (NVMBR)
Jan Habraken (NVNG)
Bradley Pieters (NVRO)
Marja Harbers (NVKFM)
Neanke Bouwman (NVZA)
Jeroen van de Kamer (NVRO, representative from the NCS board)

NCS FINANCIAL OVERVIEW 2019

	Income (€)	Costs (€)
Savings-account on January 1, 2019	38147.68	
Current-account on January 1, 2019	11201.43	
Project-account on January 1, 2019	14144.18	
Contribution Netherlands Society for Radiology (NVvR)	600.00	
Contribution Netherlands Society for Medical Physics (NVKF)	400.00	
Contribution Netherlands Society for Radiotherapy and Oncology (NVRO)	800.00	
Contribution Netherlands Society for Nuclear Medicine (NVNG)	200.00	
Contribution Netherlands Society for Radiological Protection (NVS)	400.00	
Contribution Netherlands Radiobiological Society (NVRB)	100.00	
Contribution Dutch society of Medical Physics Engineers (NVKFM)	100.00	
Contribution Netherlands Society for Medical Imaging (NVMBR)	300.00	
Contribution Belgian Hospital Physicists Association (BHPA)	200.00	
Banking costs project account		90.00
Interest savings-account	10.65	
Banking costs current account		84.98
Costs web site		544.50
Costs meetings NCS board		797.01
Costs NCS subcommittees		986.53
Income NCS subcommittee IORT	8000.00	
Savings-account on December 31, 2019		38158.33
Current-account on December 31, 2019		33942.59
Project account on December 31, 2019		0.00
Total	74603.94	74603.94

NCS BUDGET 2020

	Income (€)	***Costs (€)***
Contributions scientific societies	3100.00	
Interest savings-account	0.00	
Banking costs		200.00
Costs of board and subcommittees meetings		3000.00
Website maintenance etc		600.00
Total	**3100.00**	**3800.00**