Comparison of the lowest level radiation protection courses in Germany and The Netherlands

Greuter MJW[1], Haagen JHP[2], Van Dongen OADM[3], Vahlbruch JW[4], Koletzko G[5], Schouwenburg M[6], Boersma HF[7]

[1] University Medical Center Groningen, University of Groningen, PO Box 30.001, 9700 RB Groningen, The Netherlands

[2] MCA Gemini Group, PO Box 501, 1800 AM Alkmaar, The Netherlands

[3] Nederlandse Aardolie Maatschappij, a company within Shell, PO Box 28.000, 9400 HH Assen, The Netherlands

[4] Institut für Radioökologie und Strahlenschutz, Gottfried Wilhelm Leibniz Universität, Hannover, Germany

[5] Landesanstalt für Personendosimetrie und Strahlenschutzausbildung, Köpenicker Strasse 325 Haus 41, 12555 Berlin, Germany

[6] Reactor Instituut Delft, Delft University of Technology, Mekelweg 15, 2629 Delft, The Netherlands

[7] Arbo- en Milieudienst – Radiation Protection Unit, University of Groningen, Visserstraat 47-49, Groningen,The Netherlands

Corresponding author:

M.J.W. Greuter, PhD
University Medical Center Groningen, University of Groningen
Department of Radiology, Medical Physics EB44
PO Box 30.001
9700 RB Groningen
The Netherlands
T: +31 50 36 14712 / 14263
F: +31 50 36 11798
M: m.j.w.greuter@umcg.nl

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Abstract

Introduction

A considerable variation exists in Europe in radiation protection education and training arrangements. This diversity creates an obstruction to the mobility of radiation protection (RP) officers and radiation workers (RW) in the EU. Therefore, as an initiative of the EUropean Foundation on Training and Education in RP (EUTERP), this study aimed to make a comparison between the lowest level RP courses in Germany and The Netherlands.

Methods

In Germany the technical RP course by the Institut für Radioökologie und Strahlenschutz of the Hannover University and the medical RP course by the Landesanstalt für Personendosimetrie und Strahlenschutzausbildung in Berlin was used. The course content of both courses was compared to the Dutch level 5A/B courses.

Results

The Dutch courses teach on average the minimum required subjects compared to the German expertise levels. Because the German courses have a modular setup, each German expertise level cannot be considered equivalent to the Dutch level 5A/B. Although the courses lecture national legislation to the same extent, the coverage of national legislation cannot be considered identical. Further, the German system requires relevant practical experience and incorporates a system of refreshing courses.

Discussion

Apart from relatively small differences in the covered items, the main difference is the covering of national legislation and the German practical experience requirement. Therefore, in order for technical and medical RPOs and RWs from Germany to be recognized in The Netherlands and vice versa, these differences have to be addressed in additional courses and/or additional practical experience.

When these additional requirements are met, technical and medical RPOs can benefit from mutual recognition of education and training programs on radiation protection. This study might therefore provide a suitable basis for mutual recognition of the lowest level of RP courses in The Netherlands and Germany resulting in mutual recognition of RPOs.

Introduction

The freedom of movement between member states of persons and services constitutes one of the objectives of the EU. This implies the possibility of pursuing a profession in a member state other than the one where these persons have acquired their professional qualifications. There exists a considerable variation in the approaches of European countries to the radiation protection education and vocational training arrangements for radiation protection. Furthermore, there exists diversity in the qualifications and diplomas necessary for the recognition of radiation protection experts as defined by the European Union's Basic Safety Standards Directive 96/29/Euratom. This diversity creates an obstruction to the mobility of radiation protection experts in the EU.

Therefore, the EUropean Foundation on Training and Education in Radiation Protection (EUTERP) has been established. The main objective of EUTERP is to support harmonization in the field of education and training systems for radiation protection experts and to improve integration of radiation protection education and training systems into general vocational training and education infrastructures.

In line with the main objective of EUTERP, a bilateral initiative for mutual recognition of Radiation Protection Education and Training between two member states was formulated in order to compare the radiation protection courses in Germany and The Netherlands pursuing free movement of radiation protection professionals of comparable level in either country. The aim of this project was to compare the lowest level radiation protection courses in both countries: level 5A/B in The Netherlands and their German equivalents. This level is relevant for the majority of Radiation Protection Officers and an important category of radiation workers.

Methods

Technical comparison

Because in Germany the requirements for Radiation Protection courses in the field of technology are based on two separate ordinances (Radiation Protection Ordinance, and the Roentgen Ordinance), comparison of lower level radiation protection courses in the field of technology has been done for courses for radiation protection with radioactive sources and for X-ray devices separately.

For German requirements, the “Technical Expert Knowledge Directive concerning the handling of sealed and open radioactive sources and accelerator systems” (“Fachkunde-Richtlinie Technik nach

Strahlenschutzverordnung"), the Technical Expert Knowledge Directive concerning the handling of X-ray tubes ("Fachkunde-Richtlinie Technik nach Röntgenverordnung") as well as the learning objectives catalog ("Lernzielkatalog") as defined by the Working Group Education of the German society for Radiation Protection ("Fachverband für Strahlenschutz") were used as reference.

For Dutch requirements the formal set of standard permits ("standaard vergunningen"), used to prescribe requirements for the use of radioactive sources and devices, including training and expertise requirements, as well as the book "Praktische stralingshygiëne" of Brouwer and Van den Eijnde, used by several course providers in the Netherlands were used as reference.

Medical comparison

"Praktische stralingshygiene" was used as a basis for the Dutch medical radiation protection courses 5A/B. This book is being used by all but one course organizers. The "Grundkurs im Strahlenschutz fur Ärzte und Medizinphysiker" of the LPS in Berlin was used as a basis for the German Medical Radiation Protection course.

Results

The Dutch courses teach on average the minimum required subjects compared to the German expertise levels. However, because of the modular nature of the German system, each German expertise level cannot be considered equivalent to the Dutch level 5A/B. Although the German and Dutch courses both lecture national legislation to the same extent, the coverage of national legislation cannot be considered identical. Further the German system not only comprises of training, but also requires relevant practical experience which needs to be gained independent whether a German or Dutch certificate is used. Also the German system, unlike the Dutch, has a system of refreshing courses. In order for Dutch certificates to be recognised, these refreshing requirements should be met too.

Technical comparison

With additional training in local legislation as a prerequisite, table 1 gives an overview of possibilities for bilateral recognition of courses in radiation protection. The chapters of the Dutch radiation protection course 5A/B is compared to the German course modules as defined by the Radiation Protection Ordinance and the Roentgen Ordinance [1].

Table 1 Comparison of the Dutch radiation protection course 5A/B and German courses. The numbers refer to the chapters and paragraphs in the Dutch course book. Dutch courses with are not covered by a German module are shown in italics.

Dutch radiation protection course 5A/B						**German Modules**	
						Radiation Protection Ordinance	**Roentgen Ordinance**
1	Structure of the atom and decay	1.1	Structure of an atom			GG, GH	RM, RG, RH
		1.2	Stability of atomic nuclei			GG, GH	RM, RG, RRM, RG, RH
		1.3	Radionuclides			GG, GH	RM, RG, RH
		1.4	Decay and the law of decay			GG, GH	RM, RG, RH
		1.5	Quantities and units of activity and energy			GG, GH	RM, RG, RH
		1.6	Modes schemes of decay	1.6.1	Modes of decay when there is an excess of neutrons	GG, GH	n.a.
				1.6.2	Modes of decay when there is a shortage of neutrons	GG, GH	n.a.
				1.6.3	Alpha decay	GG, GH	n.a.
				1.6.4	Gamma decay, internal conversion	GG, GH	n.a.
				1.6.5	Spontaneous fission	GG, GH	n.a.
				1.6.6	Decay-schemes	GG, GH	n.a.
				1.6.7	Parent-daughter relations	GG, GH	n.a.
2	Sources, X-ray equipment and neutron radiation	2.2	Sealed sources	2.2.2	Requirements for sealed sources	GG, GH	n.a.
				2.2.3	Applications of sealed sources	GG, GH	n.a.
		2.3	Open Sources	2.3.2	Applications of open source	OG, OH	n.a.
		2.3	X-Radiation	2.4.1	Generation of X-rays	n.a.	RM, RG, RH
				2.4.2	X-ray imaging	n.a.	RM, RG, RH
				2.4.3	*Irradiation: teletherapy*	*n.a.*	-
		2.5	Neutrons			GG, GH	n.a.
3	Interaction of radiation with matter and shielding of radiation	3.2	Interaction of alpha-radiation			GG, GH	
		3.3	Interaction of beta radiation			GG, GH	
		3.4	Interaction of gamma radiation			GG, GH	
		3.5	Shielding of radiation	3.5.1	Shielding of beta radiation	GG, GH	n.a.
				3.5.2	Shielding of gamma radiation	GG, GH	n.a.
				3.5.3	Overview of frequently used and / or well-known radionuclides	GG, GH	n.a.
4	Radiation detection	4.1	Introduction			GG, GH	RG, RH, Z2, QS
		4.2	Ionization detectors	4.2.1	Gas-filled ionization detectors	GG, GH	RG, RH, Z2, QS
				4.2.2	Solid state detectors	GG, GH	RG, RH, Z2, QS
		4.3	Scintillation detectors	4.3.2	Solid state scintillators	GG, GH	RG, RH, Z2, QS
				4.3.3	Liquid scintillators	GG, GH	RG, RH, Z2, QS,

		4.4 X-ray imaging		n.a.	QS
		4.5 Application of detection equipment in radiation protection	4.5.1 Source identification	OG, OH	n.a.
			4.5.2 Quantitative counting (determining activity)	OG, OH	n.a.
			4.5.3 Determination of radiation level	GG, GH	RG, RH
			4.5.4 Measurement of radioactive contamination	OG, OH	n.a.
			4.5.5 Monitoring at the gate	GG, GH	n.a.
		4.6 Counting error and sensitivity		GG, GH	RH
		4.7 Overview of detectors used in radiation protection		GG, GH	RG, RH
5	Quantities and units in radiation protection	5.2 Definitions of quantities and units	5.2.2 Exposure	GG, GH	RM, RG, RH
			5.2.3 Absorbed dose	GG, GH	RM, RG, RH
			5.2.4 Equivalent dose	GG, GH	RM, RG, RH
			5.2.5 Effective dose	GG, GH	RM, RG, RH
			5.2.6 Committed dose	GG, GH	RM, RG, RH
		5.3 Orders of magnitude for the effective dose		GG, GH	RM, RG, RH
		5.4 Old and new names for quantities and units		-	-
6	Biological effects of Radiation	6.2 Effects at molecular and cellular level		GG, GH	RG, RH
		6.3 Effects on humans		GG, GH	RG, RH
		6.4 Deterministic effects		GG, GH	RG, RH
		6.5 Stochastic effects		GG, GH	RG, RH
		6.6 Hereditary effects		*GH*	*RH*
		6.7 Effects on the unborn child		*GH*	RH
		6.8 Evaluation of the risks		GG, GH	RG, RH
7	Regulations	7.1 Terminology		GG, GH	RM, RG, RH
		7.2 The system of dose limitation		GG, GH	RM, RG, RH
		7.3 Justification		*GG, GH*	RM, RG, RH
		7.4 Optimization, ALARA		GG, OG	RM, RG, RH
		7.5 Dose limits		GG, GH	RM, RG, RH
		7.6 Legislation	7.6.1 International guidelines	GH	RG, RH
			7.6.2 The structure of the legislation	GG, GH	RM, RG, RH
			7.6.3 Radiation Protection Ordinance	*GG, GH*	RM, RG, RH
			7.6.4 Other rules and regulations	*GG, GH*	RM, RG, RH
8	Safety measures for sealed sources and X-ray equipment	8.2 Protective measures for sealed sources	8.2.1 Organisational measures	GG, GH	n.a.
			8.2.2 Measures in the workplace	GG, GH	n.a.
			8.2.3 Measures for industrial radiography	GG, GH	RH, Z2
		8.3 Safety measures for X-ray equipment	8.3.1 Organizational measures	n.a.	RG, RH
			8.3.2 Measures in the workplace	n.a.	RG, RH
			8.3.3 Measures for specific applications	n.a.	RG, RH
9	Dosimetry in practice	9.1 Dose from external exposure	9.1.2 The inverse square law	GG, GH	RG, RH
			9.1.3 Absorption and range of beta radiation	GG, GH	n.a.
			9.1.4 Accurate calculation for gamma-emitters	GG, GH	n.a.
			9.1.5 Rules of thumb for beta and gamma exposure	GG, GH	n.a.
			9.1.6 Examples for X-ray equipment	n.a.	RG, RH
		9.2 Dose as result of internal contamination		OG, OH	n.a.
		9.3 Dose as a result of external contamination		OG, OH	RG, RH
		9.4 Examples of doses from external exposure and internal contamination		GG, GH	RG, RH
10	Safety measures for open sources	10.2 Organizational measures		OG, OH	n.a.
		10.3 Reducing activity		OG, OH	n.a.
		10.4 Containment		OG,OH	n.a.
		10.5 Removal of airborne contamination		OG,OH	n.a.
		10.6 Preventing uptake		OG, OH	n.a.
		10.7 Contamination check and decontamination		OG, OH	n.a.

		10.8 Topics	10.8.1 Radionuclide laboratories	OG, OH	n.a.
			10.8.2 Iodine	-	n.a.
			10.8.3 Tritium	-	n.a.
			10.8.4 Labeled compounds	-	n.a.
			10.8.5 External irradiation	GG, GH	n.a.
			10.8.6 Patients treated with radionuclides	OG, OH	n.a.
11	Radioactive waste	11.1 Regulations		GG, GH	n.a.
		11.2 Collection of radioactive waste	11.2.1 Solid radioactive waste	GG, GH	n.a.
			11.2.2 Liquid waste	-	n.a.
			11.2.3 Counting-vials	-	n.a.
		11.3 Processing and storage of radioactive waste		GG, GH	n.a.
		11.4 Reduction of radioactive waste		GG, GH	n.a.
A	*Mathematics*	*A.1 Powers*		-	-
		A.2 Graphs		-	-
B	*Statistics of counting*	*B.1 The statistical error*		-	-
		B.2 Combining errors		-	-
		B.3 Error in a sum or difference		-	-
		B.4 Error in a product or quotient		-	-

Medical comparison

The results of the comparison of the German medical radiation protection course and the Dutch radiation protection course 5A/B are shown in Table 2.

Table 2 Comparison of the equivalence of the medical radiation protection courses in the Netherlands and Germany. The numbers refer to the chapters and paragraphs in the German and Dutch course books. German chapters with are not covered by a Dutch chapter are shown in italics.

German medical radiation protection course		**Dutch**
1 Physical principles of radiation protection	1.1 Construction of the atomic nucleus	1.1
	1.2 Types and characteristics of ionizing radiation	1.6.1-4
	1.3 Radioactivity	1.4, 1.5, 3.2-4
	1.4 X-rays	2.4.2, 3.4
2 Dose units and Measurement techniques	2.1 Energy dose D	5.2.3
	2.2 Organ dose HT	5.2.4
	2.3 Effective dose E	5.2.5
	2.4 Body dose	5.3
	2.5 Dose rate	5.2.3
	2.6 Dose measurement	4.5.3-4
	2.7 Installation	
	2.8 Legal basics	4.5.3-4
	2.9 Physical radiation protection control	4.5.3-4
	2.10 Measurement principles and detectors	4.1
	2.11 Principles of operation	4.2.1-2, 4.3.2
	2.12 Measuring instruments for the site dosimetry	4.2.1
	2.13 Measuring instruments for measuring the contamination	4.5.4
3 Radiation protection act		7.1-5, 7.6.3
4 Radiobiological bases and radiation risk		6.2-5
5 Natural and artificial radiation exposure		1.3
6 Occupational health care, accidents, malfunctions		7.6.3
7 Nuclear Medicine		2.3.2
8 Legal basics of radiation protection		7.6.2-4, 8.1-3
9 Practical radiation protection, dose calculation and measurements	9.1 Distance law for point sources	9.1.2
	9.2 Context of dose, dose rate and time	
	9.3 Attenuation of a shield	3.5.2
	9.4 Calculating the dose rate for gamma emitters	9.1.4
	9.5 Calculating the dose rate for X-rays	
10 Dose measurements II		
11 Measurement of nuclear radiation		3.5.1-2
12 Basics of structural and device-related radiation protection		8.3.1-2
13 Radiation accidents in medicine		
14 Introduction to radiation therapy		2.4.4

Discussion

The comparison between the basic Dutch and German technical radiation protection course shows that the Dutch technical radiation protection courses 5A/B teach the minimum required subjects compared to the relevant German expertise levels [1,2]. However, because the German system of expertise levels is set up modular, each German expertise level cannot be considered equivalent to the Dutch level 5A/B. On the other hand, when the specific topics of each specific expertise level are reviewed, the expertise level can be considered sufficient to reach required expertise level for that specific task.

The comparison between the basic Dutch and German medical radiation protection course shows that especially the chapters 10 (open sources) and 11 (waste management) are not covered in the German medical course. In addition, the sections about beta radiation are not covered in the German medical course. The following specific subjects were covered in the Dutch medical course, but not in the German medical courses: stability of nuclei, N/Z ratio, spontaneous fission, decay schemes, mother daughter relationship, neutrons, liquid scintillators, identification of radiation sources and determination of activity, gate control, hereditary effects, comparison with other hazards, international guidelines, beta radiation, dose external and internal radiation, open sources, waste management, mathematics, and measurements and measurement errors. These specific subjects are only covered in courses where the knowledge of these subjects is necessary for the field of work. The German medical course has a very thorough treatment of medical exposure, medical equipment and associated radiation risks and accidents. In the Dutch 5A course medical equipment is only covered marginally. In addition, the German medical course has some demonstrations of ionizing radiation, x-ray tubes and measurements of dose, which are not covered in the Dutch medical course.

First, the main difference between the Dutch and German basic medical and technical radiation protection courses is the national legislation. Although both study the national legislation to the same extent (although the international legislation is only studied briefly in the German course), the national legislation is not identical. Therefore, whenever a German expertise level is accepted to be equivalent to the Dutch requirements or vice versa, additional training on the national legislation should always be imperative.

Secondly, the German system not only comprises of theoretical training, but also requires relevant practical experience (Sachkunde). Obviously, this formal experience needs to be gained in order for a Dutch expertise level of radiation protection to be recognized in Germany. However, it should be possible to recognize practical experience gained in The Netherlands to contribute to the German Sachkunde.

Finally, the German system has, unlike the Dutch, a system of refresher courses. In order for a Dutch certificate to be recognised in Germany, also these requirements for refresher courses should be met.

Conclusion

A comparison between the lowest level of technical and medical radiation protection courses in The Netherlands and Germany shows that, apart from some relatively small differences and accents in the covered items, the main difference is the covering of national legislation and the German requirement of Sachkunde. Therefore, in order for technical and medical radiation protection officers and radiation workers from Germany to be recognized in The Netherlands and vice versa, these differences have to be addressed in an additional course and/or additional practical experience.

When these additional requirements are met, technical and medical RP officers can benefit from a mutual recognition of education and training programs on radiation protection. This study might therefore provide a suitable basis for mutual recognition of the lowest level of RP courses in The Netherlands and Germany resulting in mutual recognition of various categories of RPOs.

References

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