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CATEGORIZATION OF EXPOSED EMPLOYEES, ASSESSMENT OF THE EXPOSURE AND HEALTH SURVEILLANCE OF A-WORKERS

INTRODUCTION

In the Dutch '*Basic Safety Standards Radiation Protection Act*' ('*Besluit basisveiligheidsnormen stralingsbescherming*' or *Bbs*) a legal framework is established for professional exposure of employees, as well as the responsibilities of the employer on whose authority the exposure occurs.

In this procedure the conditions for the categorization, the assessment of exposure as well as the health surveillance of exposed employees are outlined. In addition, it's established which related tasks and responsibilities are assigned to the various officials involved in the radiation protection organization of the institutes to which the Complex License Randwyck is collectively granted.

PURPOSE

The purpose of this internal procedure is the formulation of a uniform policy for the categorization, the assessment of exposure as well as the health surveillance of exposed employees of all the institutes participating in the Complex License Randwyck.

CATEGORIZATION AND DOSE LIMITS

Legal framework

The *Bbs* (*§ 7.1.1*, *Section 7.2* and *Appendix 1*) states, among other things:

- *Exposed employee*: employee who during working hours, as a result of actions, may be subjected to exposure that can lead to a dose higher than any of the dose limits stated in *Article 7.3*.
- In advance of performing work activities, the employer classifies each exposed employee as A- or B-worker, for the purpose of individual monitoring and health surveillance.

The following criteria apply for the classification of exposed employees:

1. An A-worker is an exposed employee, who during one calendar year:
   a. may receive an effective dose[1] (E), at which $6 < E < 20$ mSv, and with consideration of this:
   b. may receive an equivalent dose (H_T), at which
      - $15 < H_{eye\ lens} < 20$ mSv,
      - $150 < H_{skin} < 500$ mSv, averaged over any exposed skin surface of 1 cm^2, or
      - $150 < H_{extremities} < 500$ mSv.
2. A B-worker is an exposed employee, who during one calendar year:
   a. may receive an effective dose (E), at which $1 < E < 6$ mSv, and with consideration of this:
   b. may receive an equivalent dose (H_T), at which
      - $H_{eye\ lens} < 15$ mSv,
      - $50 < H_{skin} < 150$ mSv, averaged over any exposed skin surface of 1 cm^2, or
      - $50 < H_{extremities} < 150$ mSv.
3. For employees aged between 16 and 18 years, who because of their education are required to carry out actions, the dose limits for exposure during one calendar year apply as stated for B-workers (see 2.).

[1] In case of internal contamination, the committed effective dose is assigned to the year of intake.

Extra precautionary measures in relation to professional exposure are to be taken for pregnant employees:

4. For pregnant employees working conditions are to be set up in such a way that the equivalent dose for the unborn child as a result of work is as small as reasonably possible, and that it is improbable that this dose will exceed 1 mSv from the notification until the end of the pregnancy.
5. During this period, employees who breastfeed do not carry out actions that contain a relevant risk of radioactive contamination of the body, based on risk analysis.

Exemption of current dose limits can only be granted by the 'Autoriteit Nucleaire Veiligheid en Stralingsbescherming' (ANVS), at the request of the employer, in exceptional circumstances with the exception of radiological emergency situations.

Tasks and responsibilities

The base for categorization of employees is the risk analysis of the work actions being performed. With this analysis a prognosis is made of the exposure of employees, arranged by occupational group, in the regular working situation and within foreseen circumstances in which unintended exposure can occur. This prognosis is based on the nature and the number of performed actions.

The risk analysis is made by the supervising Radiation Protection Officer (Dutch: 'Toezichthoudend Medewerker Stralingsbescherming' or TMS), under the responsibility of the coordinating Radiation Protection Expert (Dutch: 'Stralingsbeschermingsdeskundige' or SBD) of the institute.

The Radiation Protection Unit (Dutch: 'Stralingsbeschermingseenheid' or SBE) reviews the risk analysis, and, in case of agreement, grants a written internal approval (Dutch: 'schriftelijke interne toestemming' or SIT) for the described actions. With the agreement of the risk analysis the proposed categorization of employees is also established.

It has to be taken into account that exposed employees may be working at more than one department, which implies that the risk analyses of several applications need to be considered in determining the right prognosis for exposure and subsequent categorization.

The TMS and/or SBD need to supervise this.

In case of an internal contamination, it is to be determined by the TMS and/or SBD in which way a best possible assessment can be made of the extent of the exposure (committed effective dose), e.g. by way of external measurement, measurement of excreta or calculation. The TMS and/or SBD report this to the SBE, which takes care of adding this committed dose to the 'National Dose Registration and Information System' (Dutch: 'Nationaal Dosis Registratie- en Informatie Systeem' or NDRIS).

Other situations occur, in which the prognosis for the exposure of employees in one calendar year results in a value smaller than the dose limits as stated in *Article 7.3* of the *Bbs*, i.e. an effective body dose of 1 mSv, an equivalent dose of 15 mSv for the eye lens and 50 mSv for the skin, on average over any exposed skin surface of 1 cm^2. In those cases the employees in question are <u>not</u> categorized as exposed employees.

ASSESSMENT OF EXPOSURE

Legal framework

As stated by the *Bbs* (*§ 7.1.2*), the employer has the obligation to offer exposed employees a suitable, personal dose control device that's acquired from an approved dosimetric service. In addition, regular assessment of the amount of exposure of exposed employees, based on the data acquired by the dose control device, should be ensured.

If a possibility exists that a relevant internal dose can be received under normal working conditions, a suitable system for dose control should be available.

Only in special cases exemption can be granted by the ANVS.

In the case of exposure to ionizing radiation as a result of an accident or a radiological emergency, the employer has the obligation to determine the effective or equivalent dose received by the employee.

Execution

Within the institutes of the Complex License Randwyck, personal subscriptions for dose control of exposed employees are acquired from an approved dosimetric service.

Within the subscriptions a distinction is being made between exposure to photon radiation (X-ray applications) and exposure to both photon and electron radiation (applications with open sources).

Control methods may be used to determine the exposure to extremities, such as during preparation of radiopharmaceuticals.

The possible exposure to ionizing radiation of guests, students and course participants, is registered by electronic personal dosimeters (EPD).

Employees who, based on risk analysis, are not categorized as exposed employees, do not receive a personal dose control device. In this case TMS and/or SBD, in consultation with the SBE, take measures to verify the calculations in the risk analysis, and to check if no exposure occurs that exceeds the dose limits stated in *Article 7.3* of the *Bbs*. These measures may for example comprise regular measurements of the level of exposure at relevant spots in the work environment. The exact measures to be taken are established with the granting of the SIT.

For applications that carry a risk of internal contamination, like the treatment and nursing of patients therapeutically treated with iodine, regular exposure controls in the form of thyroid measurements are applied.

In the case of unintended incidents, it can be decided, based on the most probable exposure pathway, to take measurements of urine samples, external measurements and/or to make scans.

In terms of prevention, EPD are also used when performing new actions or applications of ionizing radiation.

During radiological and cardiological interventions systems are used which during exposure, using colour coding, give an indication of the dose rate at the current position.

Tasks and responsibilities

The employer facilitates the purchase of subscriptions for personal dose control devices. The TMS take care of managing these subscriptions and ensure that every exposed employee has a dose control device, and wears it correctly.

The provision for additional measures, like checking the exposure of extremities, task dosimetry, or determining exposure in unintended or accidental situations, takes place in consultation with the institute's SBD.

It is the SBD's duty to ensure that the measured exposure of exposed employees is in accordance with the prognosis of their exposure as calculated in the risk analysis. This also applies to checking dosimetric measurements that are performed as an alternative for personal dosimetry, meant for non-exposed employees. Deviations are to be reported to the SBE.

The SBE supervises the execution of this policy, and has a controlling role in the level of exposure of employees, both in regular and non-regular situations. If dose limits are exceeded, the SBE takes care of reporting to the government.

The registration of data of exposed employees needs to comply with the provisions in *§ 7.1.3* of the *Bbs*; data are to be saved at least 30 years after a person finishes the actions, or as much longer until the person to whom the data relate reaches or would have reached the age of 75.

HEALTH SURVEILLANCE

Legal framework

The *Bbs* (*§ 7.1.4*) obliges the employer to provide in health surveillance of A-workers. Specifically, this concerns, among other things:

1. a medical examination that takes place before the appointment as A-worker with the aim of verifying if an employee is suited for his function;
2. regular inspections which check, at least once a year, whether the A-worker is still suited for executing his function;
3. a medical examination that takes place whenever there is reason due to an exposure which exceeds dose limits, an accident, or a radiological emergency situations.

Execution

The institutes participating in the Complex License Randwyck have signed a contract with a (government registered) physician, who can perform the medical examinations and inspections as described above. The physician determines whether an A-worker is either suited, conditionally suited, or unsuited to perform his work activities, and manages the medical files.

The regular examination consists of a survey which is sent by the physician to the involved employees. In addition, employees can apply for a blood test and, if desired, request a consultation with the physician. For interventional radiologists and cardiologists an eye test is also offered, focusing on possible cataract formation. Participation in this examination is on a voluntary basis.

For B-workers and employees not categorized as exposed employees, the regular occupational health regime applied in the institutes is followed.

Tasks and responsibilities

The employer facilitates the aforementioned medical examinations. The TMS manages the file with A-workers and makes this available to the SBE.

Subsequently, the SBE registers the persons categorized as A-workers for the medical examination with the physician. The latter informs the A-workers personally about the results of their medical examination or regular check. The SBE is informed through an anonymized report containing findings and advice. The report is discussed with the TMS and/or SBD, as well as in the medical radiation safety commissions. If applicable, individual or organizational measures are taken by TMS and/or SBD in consultation with the SBE, based on findings in the report.

The A-workers are responsible for complying with the call for medical examination or regular check. If they do not respond to the call and repeated call, the General Coordinating Expert (Dutch: ‘Algemeen Coördinerend Deskundige’ or ACD) informs the employer of this in writing.

LIST OF ABBREVIATIONS

Dutch		English	
ACD	algemeen coördinerend deskundige	-	general coordinating expert
ANVS	Autoriteit Nucleaire Veiligheid en Stralingsbescherming	-	Authority for Nuclear Safety and Radiation Protection
Bbs	Besluit basisveiligheidsnormen stralingsbescherming	-	-
EPD	elektronische persoonlijke dosimeter	-	electronic personal dosimeter
NDRIS	Nationaal Dosis Registratie- en Informatie Systeem	-	National Dose Registration and Information System
SBD	stralingsbeschermingsdeskundige	RPE	radiation protection expert
SBE	stralingsbeschermingseenheid	RPU	radiation protection unit
SIT	schriftelijke interne toestemming	-	written internal permit
TMS	toezichthoudend medewerker stralingsbescherming	RPO	radiation protection officer

REFERENCES

- Besluit basisveiligheidsnormen stralingsbescherming: https://wetten.overheid.nl/BWBR0040179/2018-07-01
- Complex License Randwyck