Order no. 180/2002

of 05/09/2002
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approving the Norms on Individual Dosimetry

According to :
• The Government Decision **no. 17/2001** on the organization and functioning of the Ministry of Waters and Environment Protection, published in the Official Law Bulletin of Romania, Part I, no. 14 of 10 January 2002;
• Art. 5 of Law **no. 111/1996** on safe development of nuclear activities, republished,
Of the President of the National Commission for Nuclear Activities Control issues the following Order:

Art. 1. – The Norms on Individual , provided in the Annex which is an integral part of this Order.
Art. 2. – This Order shall be published in the Official Bulletin of Romania, Part I.
Art. 3. – Norms mentioned in Art. 1 shall entry into force on the 1st January 2003.
Art. 4. – The Division Applications with Ionising Radiation Sources, Division Nuclear Safety, Division Quality Assurance and Licensing of Operators, Division Surveillance of Cernvoda NPP, Division Development and Resources and the independent Sections of the National Commission for Nuclear Activities Control shall fulfil the provisions of this Order.

President of the National Commission for Nuclear Activities Control,
Lucian Biro

Bucharest, 5 September 2002.
No. 180.

Norms on Individual Dosimetry

CHAPTER I

General Provisions

ARTICLE 1

Scope

(1) These norms set the requirements referring to the individual dosimetry, the individual dosimetry systems and the requirements regarding the appointment of the approved individual dosimetric services.
(2) The requirements of these norms complete the requirements stipulated by the Fundamental Norms on Radiological Safety (NFSR) for individual dosimetry.

ARTICLE 2

Definitions

The definitions and abbreviations used in these norms are the ones stipulated in NFSR and in attachment no. 1 to these norms,

ARTICLE 3

Regulatory Authority

(1) In compliance with the provisions of Law no.111/1996, republished, with the subsequent changes, the National Commission for the Control of the Nuclear Activities (CNCAN) is the competent national authority in the nuclear field that exerts the attributions of regulation, authorization and control.
(2) CNCAN authorizes the systems of individual dosimetry and appoints the individual dosimetric services approved in compliance with the Norms on the appointment of the bodies notified for the nuclear field, approved by the Order of the President of CNCAN no.219/1999, published in the Official Law Bulletin of Romania, Part I 87 of 28 February 2000.
(3) CNCAN monitors and controls the individual dosimetric services.

ARTICLE 4

Dosimetry Systems for Individual Monitoring

(1) The systems of dosimetry are used with the purpose of evaluating the individual penetrating dose equivalent, H(p)(10) and the individual superficial dose equivalent, H(p)(0,07).
(2) The following types of dosimetry systems may be used with the purpose of the individual monitoring provided that they meet the requirements of these norms:
a) systems of dosimetry with film;
b) thermoluminiscent systems of dosimetry
c) electronic digital systems of dosimetry

ARTICLE 5

General Requirements for Individual Dosimetric Services

The individual dosimetric service shall ensure the following:
a) determination of the measurands;
b) types of radiation and radionuclides measured;
c) the used measurement methods;
d) calibration (standardization) conditions;
e) drawing up the reports of dose allocation;
f) data management.

ARTICLE 6

Quality Assurance

The individual dosimetric service shall submit to CNCAN a program of Quality Assurance implemented in compliance with the Norms on Quality Assurance in the nuclear field or with the requirements of ISO/IEC 17025, SR-ISO 9000 series and EN 45000 series, as appropriate.

ARTICLE 7

Dosimetry of the Occupationally Exposed Workers

(1) The doses received by the occupationally exposed workers shall be evaluated for each exposed person and registered by the authorization holder in compliance with attachment no. 12 to these norms.
(2) In case of category A occupationally exposed workers, the doses due to external exposure shall be evaluated monthly.
(3) In case of category B occupationally exposed workers, CNCAN may require the dose evaluation for each occupationally exposed worker under the same conditions as in the case of category A occupationally exposed workers, under the conditions of art. 58 of NFSR.
(4) CNCAN shall approve, as appropriate, the periods of time and the evaluation method of the internal exposure, as follows:
a) in the authorization process;
b) in the appointment process.
(5) CNCAN may require the use of a second system of dosimetry, as appropriate.
(6) CNCAN may exempt from the provisions of paragraphs (1) and (2) in the process of practice authorization, in case that there exists an additional system of dosimetry or another proper equivalent system for the dosimetry surveillance.

ARTICLE 8

Dosimetry of the Population (Non- occupationally exposed workers)

(1) In case of non - occupationally exposed workers that work in unities where nuclear activities are carried out, CNCAN shall establish the measurement method and the dose allocation for each case.
(2) The provisions of paragraph (1) shall also be applied to the persons that work in unities that do not carry out nuclear activities, but that are exposed to natural radiation sources, in compliance with the provisions of chapter VII of NFSR.

ARTICLE 9

Evaluation Methods for Radiation Doses

(1) The effective doses shall be evaluated by means of the operational variables.
(2) For individual dosimetry in case of external irradiation, the operational variables are:
a) the individual penetrating dose equivalent, H(p)(10).
a) the individual superficial dose equivalent, H(p)(0,07).
(3) In case of internal irradiation, the operational variable is the committed effective dose, $E_{50,}$ calculated by means of the standard patterns and of the dose factors specified in attachment no. 10 to these norms, in the 4-C1 and 4-C2 tables of attachment no. 4 of the NFSR.
(4) The total effective dose represents the dose sum resulting from the individual dose in depth, H(p)(10), for a certain monitoring period and the committed effective dose, E_{50}, corresponding to the incorporation of the respective period.

(5) If the dosimetric service notices the exceeding of the dose limits values stipulated by NFSR or of other values set by CNCAN when performing the routine dosimetry surveillance, the effective dose and the equivalent doses received by other bodies shall be re-evaluated by an expert authorized by CNCAN, in collaboration with the regulatory authority. The value of the re-evaluated dose shall be registered instead of the value that resulted from the routine individual monitoring.
(6) In these norms, the environmental dose refers to:
a) the variable H*(10) – the environmental dose equivalent in case of the high penetrating radiation;
a) the variable H*(0.07) – the environmental dose equivalent in case of low penetrating radiation;
These variables are used for the environment monitoring and the area measurements.
(7) The report shall be drawn up for the last 12 months.

CHAPTER II

Technical Requirements for Systems of Dosimetry

SECTION 1

General Technical Requirements for Systems of Dosimetry

ARTICLE 10

General Requirements

(1) The systems of dosimetry shall ensure traceability compared to the national and international standards and allow the determination of the operational variables for individual dosimetry in case of external irradiation and intake (internal dosimetry) with the accuracy required by these standards.
(2) The systems of dosimetry used shall hold a Radiological Safety Authorization (ASR) issued by CNCAN in compliance with the Norms on Radiological Safety – Authorization Procedures.

ARTICLE 11

Requirements Regarding the Conditions of the Routine Measurements

The deviation of the value of the measured dose, H(m), from the reference value H(r), of the operational variable for photones that occurs under routine conditions must fall within the deviation limits set in the graphics stipulated in attachment no. 2 (Trumpet Curves) to these norms.

ARTICLE 12

Specific Requirements

(1) The dosimetry systems shall meet the requirements referring to:
a) individual dosimeters for photons;

b) individual dosimeters for beta radiations;
a) individual dosimeters for neutrons;
d) extremity dosimeters for photons;
e) extremity dosimeters for beta radiation.
(2) The requirements stipulated under paragraph (1) are stipulated in the attachments no. 3-7 to these norms.
(3) The deviation of the measured dose value from the reference value, under the reference conditions set by these norms, shall not exceed ± 10% in case of a source for which the measurement uncertainty is below 5%.
(4) CNCAN may accept greater deviations provided that such reference source does not exist.

ARTICLE 13

Additional Requirements for the Authorization of the Digital Electronic System of Dosimetry

(1) The system of individual electronic dosimetry shall comply with the provisions of the norms of the International Commission of Electrical Engineering (CIE) or it shall have passed the equivalent type tests.
(2) It shall be proved that the dosimetry data cannot be deleted before being transferred to the data bank of the individual dosimetry body.
(3) The dependence of the dose measurements on the dose debit for a radiation pulsating field shall also be specified, if case may be.
(4) The dosimeters shall comply with the requirements required by the work place where they are used.
(5) The requirements imposed by the dosimetry surveillance.

ARTICLE 14

Inter-comparing Measurements

(1) The inter-comparing measurements approved by CNCAN are meant to check the measurement accuracy under the reference conditions stipulated in these norms.
(2) Provided that the values of the dose measured under reference conditions have a higher degree of deviation than the one stipulated under art. 12 paragraph (3) and (4) compared to the reference values, the dosimetry body shall establish the real deviation field and if needed, it shall perform a new calibration of the dosimetry systems.
(3) Provided that complementary tests are executed for an inter-comparing, the requirements regarding the range of values of the measured variable deviation compared to the reference one must be fulfilled.

SECTION 2

Specific Technical Requirements

ARTICLE 15

Reference Conditions

The reference conditions are defined as follows: Irradiation phantom described under art. 16, doses with values that fall within 2 mSv and 10 mSv and the following radiation field:

a) for photons: Cesium source – 137;
b) for electrons: Strontium source - 90/ytrium - 90;
c) for neutrons: Americium source – berilium.

ARTICLE 16

Irradiation Phantom

(1) The irradiation phantom for individual dosimetry consists of a parallelepiped vessel made of methyl polymethacrylate/PMMA (plexiglass), having the following sizes: 30 cm x 30 cm x 15 cm. The thickness of the walls is of 2,5 mm for the front side and 10 mm for the other sides. The vessel shall be filled with water.
(2) The irradiation phantom for extremities consists of a plexiglass stem having a 19 mm diameter and a 300 mm length.
(3) CNCAN may accept the use of equivalent phantoms.

ARTICLE 17

Physical Quantities

(1) The operational variables of individual dosimetry are deducted by means of the conversion factors stipulated in attachment no. 8 to these norms, from the following physical quantities:
a) kerma in the air for photons [K(a)];
b) dose taken up in air [D(a)] or the fluence (Φ) for electrons;
c) fluence (Φ) for neutrons.
(2) The measurement systems must prove metrological traceability compared to the national standards for the quantity set defined under paragraph (1).

ARTICLE 18

Irradiation Geometry for Photons and Neutrons for Calibration

(1) The radiation field must be centered perpendicularly on the input side of the phantom.
(2) The reference point is the measurement center of the dosimeter.
(3) The distance between the source and the phantom must have values between 0,3 m and 2 m.
(4) The phantom must be placed inside the space angle where the beam of radiation is distributed.

ARTICLE 19

Irradiation Geometry for Beta Radiation for Calibration

(1) The radiation field must be centered perpendicularly on the input side of the phantom.
(2) The reference point is the measurement center of the dosimeter.
(3) The distance between the source and the phantom must be greater than 20 cm and lower than 50 dm.
(4) The phantom must be placed inside the space angle described by the beam of radiation.

ARTICLE 20

Fields of Reference Radiation

The fields of the reference radiation corresponding to the conversion factors stipulated in attachment no. 8 to these norms must comply with the norms ISO 4037 (beam of photons), ISO 6980 (beams of beta radiation) and ISO 8529-3 (beams of neutrons).

ARTICLE 21

Conditions for the Control of the Energetic Dependence

The energetic dependence is controlled by means of irradiating the dosimeters on the phantom stipulated under art. 16, at a reference value of the operational variable that falls within 2 and 10 mSv.

ARTICLE 22

Conditions for Controlling the Dependence on the Beam Direction

The dependence on the beam direction is controlled by means of irradiating the dosimeters on the phantom stipulated under art. 16, for different energies under different angles, at a reference value of the operational variable that falls within the limits 2 and 10 mSv.

ARTICLE 23

Conditions for the Control of Repeatibility

Repeatibility is controlled under reference conditions and it is executed by the determination of the dispersion of the dose values on several dosimeters irradiated under the same conditions.

ARTICLE 24

Fading

The fading effect on the dose measurement must be determined under normal conditions of use for a period of measurement.

ARTICLE 25

Tests of Type, Performance, Routine and Quality Assurance for Dosimetry Systems

The dosimetry systems must comply with the requirements of the tests stipulated in attachment no. 11 to these norms.

CHAPTER III

External Exposure

SECTION 1

Monitoring Methods

ARTICLE 26

Wear of the Dosimeter

(1) The wear of the dosimeter is mandatory during the entire work program of the occupationally exposed workers that monitored from a dosimetry point of view.
(2) The dosimeter for the entire body must be worn at the thorax level, on the chest or on the abdomen. The pregnant women shall wear the second dosimeter at the abdomen level.

ARTICLE 27

Wear of Several Dosimeters

(1) The persons dosimetrically monitored must wear several dosimeters in case that the dose value given by a single dosimeter is not representative due to the lack of homogeneity of the radiation field.
(2) The radiation protection experts evaluate the effective dose on the basis of the partial body doses.
(3) The evaluation method shall be approved by the regulatory authority in the authorization process of the respective practice.

ARTICLE 28

Additional Instruments with Alarm Threshold and Dosimeters for Extremities

CNCAN may require:
a) the use of an acoustic alarm instrument provided that the exceed of the allowed dose debit in the variable or non-homogenous radiation fields may exist;
b) The use of a direct reading dosimeter in order to optimize the activities carried out;
c) the wear of an extremity dosimeter in case that the extremity dose may exceed 25 mSv/year.

ARTICLE 29

Wear of the Extremity Dosimeter

The extremity dosimeter must be worn, if possible, in places where doses with high values are expected.

ARTICLE 30

Wear of the Protection Apron

a) In case the protection apron is worn, the dosimeter shall be placed under the apron.
b) CNCAN may require that two dosimeters should be worn when the work involves high doses.
c) The second dosimeter must not be worn but for the moments when the protection apron is used and it shall be placed over the protection apron; the dosimeter must have a distinctive sign.
d) The total individual dose, with two dosimeters, shall be calculated thus:
H(total)(10) = H(under)(10) + a x H(over)(10)
H(total)(0.07) = H(under)(0.07) + a x H(over)(0.07)
Where:
H(under) represents the dose given by the dosimeter under the apron;
H(over) represents the dose given by the dosimeter over the apron;
a = 0,1 if the apron does not protect the thyroid;
a = 0.05 if the apron protects the thyroid;

CHAPTER IV

Internal Exposure (Intake)

SECTION 1

Provisions Referring to the Dosimetry Performance(Monitoring Methods)

ARTICLE 31

Intake Monitoring

(1) The individual surveillance of intake shall be performed by measuring the activity accumulated in the body or the bio assay (excretion products).
(2) The measurement method must meet the requirements stipulated in attachment no. 10 to these norms.
(3) CNCAN may approve any other method under the provisions of art. 32 paragraph (1) point b).

ARTICLE 32

Measurement Methods

(1) The surveillance of the intake shall be executed by means of:
a) simple measurement (tri measurement), in compliance with the provisions of CNCAN;
b) measurement performed by means of an adequate system and the intake evaluation by an authorized dosimetry body, appointed by CNCAN.
(2) The results of the tri measurement shall not be used for the determination of the dose.

(3) The intake measurement must be performed when the tri measurement results are above the measurement threshold specific to a radionuclide.

ARTICLE 33

Measurement Intervals

(1) The measurement intervals for a few radionuclides are specified in attachment no. 10 to these norms.
(2) In case of radionuclides that are not specified in attachment no. 10 to these norms, the surveillance intervals shall be chosen in such way, that even if the intake occurred at the beginning or at the end of the interval, the measurement should not lead to an under-estimation or overestimation with a ratio greater than 3.
(3) In case of radionuclides whose half-value life is very short (less than a day), the intake surveillance shall be performed by means of frequent tri measurements, e.g. each day of work.

ARTICLE 34

Measurement of Intake in Case of a Radionuclide Mixture

(1) Provided that it can be admitted that a radionuclide mixture is stable, the measurement of the intake can be limited to the measurement of a director radionuclide.
(2) The determination of the dose starting from the measurement of the director radionuclide must be documented.

ARTICLE 35

Measurement of the Activity Concentration in the Air

In particular cases, in the authorization process of practice, with the approval of CNCAN, the measurement of the activity concentration in the air of the work environment may replace the individual surveillance of intake.

ARTICLE 36

Measurement in case of Particular Radionuclides

In case that there is no authorized body appointed by CNCAN to measure the intake for a radionuclide, CNCAN shall decide on the body that shall perform the measurement, shall draw up the procedures (measurement frequency and method) and the corresponding analysis types that must be taken.

SECTION 2

Minimum Requirements for the Bodies that Perform Tri Measurements and the Conditions Required for the Appointment of the Authorized Bodies for the Intake Measurement

ARTICLE 37

Tri Measurements

(2) The requirements referring to the tri measurements are approved by CNCAN on a case by case basis in the authorization or appointment process.
(2) They comprise minimum requirements referring to measurement, calibration, metrological traceability, as well as Quality Assurance.
(3) The results of the tri measurements shall be registered.

ARTICLE 38

Appointing Bodies of Individual Dosimetry for the Intake Measurement

(1) The appointment of the individual dosimetry body for the intake measurement shall be granted provided that it complies with the following conditions:
a) the responsible person of the individual dosimetry body is an authorized expert;
b) the individual dosimetry body sall be properly organized and have enough and properly trained personnel;
c) it shall be properly equipped;
d) it shall have an implemented program of Quality Assurance;
e) the intake measurement shall be performed in compliance with the regulations in force referring to the defined radionuclides;
f) the activity shall be carried out in compliance with these norms.
(2) The excretion analysis, the activity measurement, respectively the measurement of the radioactivity concentration, must be performed with a deviation lower than 20% from the reference values, for an activity between 10 and 100 times the measurement threshold stipulated in attachment no. 10 to these norms.
(3) In case of direct measurements, the activity measured on a phantom approved by CNCAN must be performed in compliance with the provisions of attachment no. 10 to these norms on a range between the measurement threshold and 100 times the value of the measurement threshold. The measured value must not deviate from the reference value with more than 20% in this range.
(4) The measurement systems must have a proper technical status and must comply with a standard admitted by the metrological regulations in force.

SECTION 3

Standard Patterns for Calculations

ARTICLE 39

Standard Calculations

(1) The calculation of the committed effective dose shall be performed in compliance with attachment no. 9 to these norms or by any other method, if this is scientifically documented.
(2) The radionuclide specific data that must be used for the calculation are given in attachment no. 10 to these norms, in the 4-C1 and 4-C2 tables of attachment no. 4 to the NFSR.

(3) For the dose calculation under routine conditions, it is admitted that the intake occurred at the middle of the surveillance interval. Provided that the moment of intake is known, that moment shall be considered.
(4) If it can be demonstrated that the radioactive substance has a metabolism different from the standard pattern, under the form it is used, if CNCAN approves it, the best adjusted pattern shall be used with the purpose of the evaluation in the given case.

CHAPTER V

Other Provisions

ARTICLE 40

List of the Approved Individual Dosimetric Services

CNCAN shall publish the list of the approved individual dosimetric services appointed by CNCAN, in the Official Law Bulletin of Romania, Part I bis, and it shall update it.

ARTICLE 41

Obligations of the Approved Individual Dosimetric Services

(1) Beside the technical requirements and the requirements of Quality Assurance, the approved services have the following obligations:
a) ensuring the registrations of the results of the individual monitoring on paper and electronic medium, in compliance with the provisions of NFSR and with the provisions of point 1.2 of attachment no. 13 of these norms.
b) archiving all the documents that lie at the basis of the individual dose assignment and the dose registrations for the time period stipulated in NFSR;
c) drawing up reports regarding the dose exceeding or any other change regarding the registrations, that shall be immediately notified to CNCAN, in compliance with point 1.4.2.1 lit. c) and d) of attachment no. 13 to these norms.
d) submitting semester reports to CNCAN , in compliance with point 1.4.2.1 lit. b) of the attachment no. 13 to these norms, and annual reports regarding the dose registrations, drawn up in compliance with point 1.4.2.1 lit. e) of attachment no. 13 to these norms.
(2) In case that the legally constituted person, the authorization holder, is dissolved, the documents that contain the results of the individual monitoring shall be taken over by the approved dosimetric service that ensured the individual monitoring.
(3) In case that an approved dosimetric service is dissolved, it is compelled to deliver to the regulatory authority – CNCAN- the record documents of the individual monitoring for all the registered persons.

ARTICLE 42

Dosimetry of Persons in Interventions Cases

(1) The person dosimetry in intervention cases and the dose limits are those stipulated in art. 114 lit. c) of NFSR.
(2) Dosimetry can be performed by:
a) the approved dosimetric service, appointed by CNCAN;

b) the unities authorized by CNCAN that execute the intervention. In case that the intervention levels are exceeded, electronic dosimeters may be used provided that they prove metrological traceability.
(3) If an intake occurs, one must proceed to a surveillance in compliance with the stipulations of art. 31, and the unity that performed the intervention action may request the execution of special tri measurements.
(4) It can be renounced to the individual dose measurement for fields that are sufficiently known and homogenous, provided that they are determined by calculation.

ARTICLE 43

Measurement of the Main Components of a Mixed Radiation

(1) If it can be demonstrated that for a person the effective dose referring to the intake or to the external photon or neutron irradiation cannot exceed 10% of the total annual dose, it can be renounced to the individual dosimetry of this radiation component, provided that CNCAN approves it.
(2) If the skin dose does not exceed 25 mSv/year, it can be renounced to the individual surveillance of this component with the approval of CNCAN.

ARTICLE 44

Loss or Deterioration of the Personal Dosimeter

(1) In case of loss or deterioration of the used personal dosimeter, the person responsible for the radiological safety together with the authorized expert shall lead the necessary investigations in order to determine the causes and shall assign the dose for the person holding the dosimeter.
(2) The approved dosimetric service and CNCAN shall be notified on the loss or deterioration of the dosimeter, including on the causes and the assigned values of dose.

ARTICLE 45

Prolongation of the Surveillance Period

(1) The surveillance period may be prolonged over the authorized one, with the approval of CNCAN, provided that:
a) the surveillance shall be additionally performed by means of an individual direct reading dosimeter;
b) the dosimetry of the work environment shall be executed by giving the dose debit or if there is any possibility of sonorous warning.
(2) The authorization holder must prove to the regulatory authority that the measurement systems specified under paragraph (1) lit. a) prove metrological traceability and that they have an implemented system of Quality Assurance.

CHAPTER IV

Conditions regarding the Appointment

ARTICLE 46

Conditions Necessary to the Appointment and Approval

(1) Each individual dosimetric service must be appointed by the regulatory authority.
(2) The appointment is granted provided that the following conditions for approval are fulfilled:
a) the responsible person of the individual dosimetric service is an expert in radiation protection;
b) the individual dosimetric ervice has a proper organization, enough and properly trained personnel;
c) the measurement system complies with the national and international standards (traceability). Traceability is established by the metrological regulations in force for each case and it is checked by a standards and calibration laboratory appointed by CNCAN.
d) the conditions under art.41 are fulfilled.
(3) The appointment shall be granted if the provisions of the Order of the president of CNCAN **nr. 219/1999** for approving the Norms on the appointment of the bodies notified for the nuclear field published in the Official Law Bulletin of Romania, Part I, no. 87 of 28 February 2000 are fulfilled.

ARTICLE 47

Application Request for the Appointment as Approved Dosimetric Service

The application request for the appointment as approved dosimetric service shall contain data referring to:
a) name of the applicant as legally constituted person;
b) headquarters, fax, telephone;
c) the person empowered to represent him.

ARTICLE 48

Documents that Accompany the Application for the Appointment as Approved Dosimetric Service

(1) The applicant shall attach to the application for appointment a documentation that shall contain:
a) documents that should certify the data stipulated under art. 47;
b) a detailed description of the activity for which the appointment is requested, including the ways of fulfilling the provisions of these norms;
c) the Quality Assurance Manual, with its related procedures, in compliance with the requirements of the applicable standards;
d) the list of the specific devices used, with the metrological certifications and checking;
e) the list of the standards and the reference documents specific to the activity for which the appointment is requested;

f) the list of the specialized personnel that caries out the activity for which the appointment is requested;
f) the proof that the taxes and tariffs stipulated by the regulation in force regarding taxes and tariffs have been paid up;
(2) If the applicant proves that he is authorized by a body notified in the nuclear field, he shall attach to the application of appointing the approval as dosimetric services only the approval certificate and the proof that the taxes and tariffs stipulated by the regulation in force regarding taxes and tariffs have been paid up.

ARTICLE 49

Duration of Appointment as Approved Dosimetric Service

The approved dosimetric service shall be appointed for a three year period of time.

ARTICLE 50

Prolongation of the Duration of the Approval Appointment

(1) The appointment duration may be prolonged on the holder's request.
(2) The application for the prolongation of the duration of the appointment as approved individual dosimetric service shall fulfill the provisions of art. 48 and shall be filled in by the holder at least one month before the expiry of the validity period stipulated under art. 49.
(3) Provided that paragraphs (1) and (2) are observed, the appointment of the approved dosimetric servicies may be further performed under the conditions of the old appointment, until the new appointment issued by CNCAN.

ARTICLE 51

Ceasing of the Appointment as Approved Dosimetric Service

(1) The appointment as approved dosimetric service ceases in the following cases:
a) expiry of the validity of the appointment or approval provided that the holder did not fill in a new application or did not observe the provisions of art. 50 paragraph (2);
b) the holder's renunciation to the appointment as approved service;
c) the justified rejection of CNCAN regarding the prolongation of the appointment;
d) bankruptcy of the company;
(2) Within 45 days of the ceasing of the appointment, the dosimetric service shall deliver to CNCAN the records of the individual monitoring for all the persons registered in their records for the entire period of operation.

CHAPTER IV

Transitory and Final Provisions

ARTICLE 52

The applicant or the authorization holder as approved dosimetric service shall make available the required documents to the CNCAN control or surveillance team and he shall ensure the

access to the places where the activities for which the appointment as approved dosimetric service is requested or has been obtained are carried out.

ARTICLE 53

These norms shall enter into force on the 1st of January 2003.

ARTICLE 54

Within 6 months of the date when these norms enter into force, the dosimetric service that ensures the individual dosimetry shall notify CNCAN on the way of fulfilling their provisions and shall request the appointment as approved dosimetric service.

ARTICLE 55

Within 6 months of the date when these norms enter into force, the standards and calibration laboratories that ensure the calibration of the individual dosimetry systems shall obtain from CNCAN the appointment as notified laboratories of dosimetry calibration.

ATTACHMENT No. 1(to norms)

1. Minimum detectable activity (AMD)
The slightest activity of a radionuclide that can be detected in an assay with a 95% percentage, 5% being considered for error of type I (a radionuclide is decided to be present, when actually it is not) and for the error of type II (a radionuclide is decided to be present, when actually it is not)

2. Quality Assurance
Planning, surveillance, control and the measurements taken in case of execution of a product or of performance of an activities with the purpose of complying with the requests regarding quality .

3. Radioactive concentration
The activity of the volume unit; the unit of measure is given in Bq/m^3.

4. Reference Conditions
The conditions where the values of the influence factors as well as the parameters of the measurement instruments lead to a correction factor whose value is of 0,1. Under reference conditions, there are no corrections necessary for the calibration factor.

5. Routine conditions
The conditions under which the accuracy and precision of a dosimetry measurements system is tested for a single energy, usually of the calibration source, ^{137}Cs or ^{60}Co for the photon dosimeters. The precision (standard deviation of a single measurement) and the accuracy (average deviation from the conventionally true value) are tested for the different levels of the dose. The results of the tests must comply at least with the accuracy criterion stipulated by the trumpet curves. Under such conditions, the test helps to the normalization of the system global sensitivity and shall be regularly repeated at least one a month.

6. Radioactive contamination

The contamination of any material, surface, environment or of any person with radioactive substances; in case of the human body, the radioactive contamination includes both the external contamination of the skin and the internal contamination, regardless of the intake way.

7. Stability control

The measurement of the parameters at determined intervals of time with the purpose of highlighting their variation compared to the reference values.

8. Dosimeters

Instruments for measuring the environment dose or the individual dose

9. Detection radiology examination

Radiological control executed regularly on a great number of persons; the preventive control performed by work medicine shall not be considered detection examination.

10. Intake

The penetration of the radioactive substances in the human body by ingestion, inhalation or by penetration of the skin or wounds.

11. Ingestion

Penetration of the radioactive substances in the human body by digestive way.

12. Inhalation

Penetration of the radioactive substances in the human body by respiratory passages.

13. Type tests

Complex tests for a dosimetry system that allow the highlighting of all the error and uncertainty sources when measuring a dose and quantifying the important elements that contribute to the global error and that allow the description of the dosimetry system type.

14. Independent tests

Participation in tests executed by the calibration laboratories, that represents the reference.

15. Chronic intake

Chronic absorption of the radioactive substances in the human body by ingestion, inhalation or by penetration of the skin or wounds.

16. Reference instruments

They are secondary standards calibrated with primary standards by a national laboratory or a laboratory appointed by the regulatory authority that holds the admitted standards, or secondary standards if they are national standards.

17. Actuating quantity

Quantity that can influence the precisions or uncertainty of a measurement.

18. Intake measurement

Evaluation of the committed effective dose E_{50} on the basis of the measurements of the body activity or of the excretions.

19. Tri measurement (test)

Measurement procedure used with the purpose of highlighting an intake without determination of the corresponding effective dose. In case that the value of the threshold set before is exceeded, the determination of the committed effective dose is required.

20. Registration level

The value formally defined for the dose that must be registered within a monitoring program.

21. Minimum test level (NMI)

Quantity of radioactive material that the dosimetry body is able to measure in order to participate in the program of independent tests.

22. Director nuclide

The representative nuclide of a nuclide mixture which the determination of the dose refers to.

23. Appointed dosimetry body

Body responsible with the calibration and control of the instruments of individual dosimetry surveillance and the reading or interpretation of their indications, or for the radioactivity measurements in the human body or in biological tests or for the dose evaluation and assignment; its ability to function is recognized by CNCAN.

24. Effective half-value life

It represents the harmonic average between the biological half-value life and the physical half-value life.

$$T(1/2eff) = \frac{T(1/2biol) * T(1/2fiz)}{T(1/2biol) + T(1/2fiz)}$$

25. Fading

The difference between the measured value and the reference value that occurs during the period of time that elapses between the irradiation and evaluation, in rapport to the reference value; it is expressed in % months. In case of a photo dosimeter it measures the loss of the contrast of the dosimetry film.

26. Response (R)

The ratio between the measured value and the true conventional value of the dose.

27. Secondary standard

The standard whose value is established in relation with the primary standard accompanied by a document that should certify its traceability.

28. National standard

The standard recognized by means of a national official decision that sets the basic values for the respective country. Generally the national standards are primary standards.

29. Third standard

The standard whose value is established in relation with the secondary standard.

30. Reference source

It is the secondary standard source calibrated in relation with primary standards or by an authorized laboratory that holds proper standards.

In case the reference source is not a standard source, it must be calibrated in relation with a secondary or third standard.

31. Primary standard

A high quality metrological standard for a certain field. The primary standards are maintained in the national laboratories for:

a) research in the metrological field;

b) participation in international inter-comparing actions within laboratories that hold primary standards.

32. Reception test

The control of a product prepared for delivery or delivered in order to determine whether the technical and safety requirements are met with the purpose of use.

33. Traceability

The characteristic of a measurement or standard result of being associated to the reference determinations, generally to the national and international standards by means of a comparison chain with determined certainties.

34. Control

The official control and confirmation that a radiation measurement instrument (measurement device) complies with the legal requirements.

Abbreviations:

1. AQ—Quality Assurance
2. CIE – International Commission of Electric Engineering
3. CNCAN – National Commission Nuclear Activities Control
4. CQ – Quality Control
5. ICRP – International Commission for Radiological Protection
6. ICRU – International Commission for Radiology Units
7. ISO – International Organization of Standardization
8. NFSR – Fundamental Norms on Radiological Safety
9. NSR – PA Norms of Radiological Safety – Authorization Procedures
10. ASR – Authorization of Radiological Safety

ATTACHMENT No. 2(to norms)

TRUMPET CURVES

The higher and lower limits allowed for the ratio Measured dose/Conventionally true dose, function of the dose equivalent H(p)(10) and H(s)(0,07)

a) for H(p)(10)

a) for H(p)(0.07)

The higher limit is given by the relation:

$$R(s) = 1,5 \left[1 + \frac{H_0}{2H_0 + H(r)}\right]$$

The lower limit is given by the relation:

$$R(inf) = \frac{1}{1,5}\left[1 - \frac{2H_0}{H_0 + H(r)}\right], \text{ pentru } H(r) >= H(m)$$

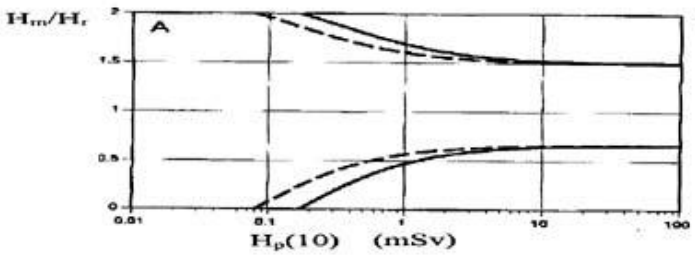
R(inf) = 0 for H(r) < H(m);

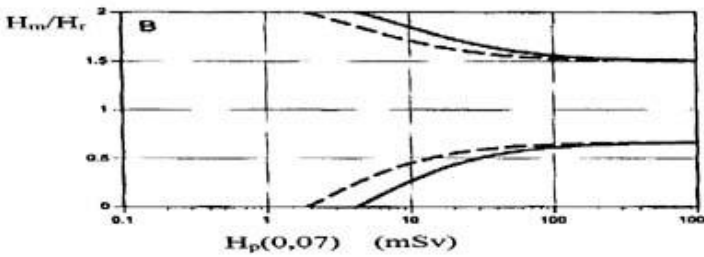
H(r) – the reference value of the operational variable;

H(m) - the value of the dose measured under routine conditions

H_0 – the lowest value of the dose that can be measured.

The value of H_0 cannot exceed the registration level.





GRAPHIC

Reference: "Radiation Protection 73" Technical recommendation for monitoring individuals occupationally exposed to external radiation Report, EUR 14852 EN, 1994

ATTACHMENT No. 3(to norms)

REQUIREMENTS REGARDING THE INDIVIDUAL DOSIMETERS FOR PHOTONS

1. Measured quantity:
H(p)(10) and H(p)(0,07).
2. The lower dose that it can measure:
In compliance with annex 2
3. Measurement range:
H_0 up to 0,5 Sv for the reference radiation.
4. Linearity:
Deviation < 15% for values between 1 mSv andi 5 Sv.
5. Energetic dependence:
For photons with energy between 20 keV and 5 MeV.
Complying with the conditions of annex 2
6. Dependence on direction: < 20% up to 60°
For energies > 6 keV.
7. Repeatibility:
Standard deviation S <= 10% for H(p)(10) and H(p)(0,07).
8. Fading: effect < 10%/month
Reference: "Ordonnance sur la dosimetrie individuelle (Ordonnance sur la dosimetrie)" 814.501.43, Suisse, October 1999

ATTACHMENT No. 4(to norms)

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***)** Annex no. 4 is reproduced in the facsimile.

REQUIREMENTS REGARDING DOSIMETERS FOR BETA RADIATION

1. Measured quantity:
H(p)(0,07).
2. The lowest value of the dose that it must measure:
H_0 = 1 mSv.
3. Measurement range:
de la H_0 până la 5 Sv.
4. Linearity:
deviation < 15% for values between 1 mSv and 5 Sv.
5. Energetic dependence:
For beta radiation of TI-204 or Kr-85.

$$0,1 <= \frac{H(m)}{H(r)} <= 2,0 \text{ for } H(p)(0,07);$$

In case that the system has been calibrated with photon radiation, additional requirements that are to be applied for beta radiation of Sr-90/Y-90 are imposed:

$$0.5 <= \frac{H(m)}{H(r)} <= 2,0.$$

6. Repeatibility:
Standard deviation S < 10%
7. Fading: effect < 10%/month
Reference: "Ordonnance sur la dosimetrie individuelle (Ordonnance sur la dosimetrie)" 814.501.43, Suisse, October 1999

ATTACHMENT No. 5(to norms)

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***)** Annex no. 5 is reproduced in the facsimile.

REQUIREMENTS REGARDING THE INDIVIDUAL DOSIMETERS FOR NEUTRONS

1. Measured quantity:
H(p)(10).
2. The lowest value of the dose that it must measure:
H_0 = 0.5 mSv.
3. Measurement range:
from H_0 up to 5 Sv.
4. Linearity:
deviation < 30% for range between 1 mSv and 5 Sv.
5. Energetic dependence:
For the radiation spectrum where the dosimeter is used.

$$0.3 <= \frac{H(m)}{H(r)} <= 3.0 \text{ for } H(p)(10);$$

6. Repeatibility:
Standard deviation S < 50%
7. Fading:
effect < 30%/month
Reference: "Ordonnance sur la dosimetrie individuelle (Ordonnance sur la dosimetrie)" 814.501.43, Suisse, October 1999

ATTACHMENT No. 6(to norms)

REQUIREMENTS REGARDING THE DOSIMETERS USED FOR MEASURING THE EXTREMITY DOSE AT THE PHOTON RADIATION

1. Measured quantity:
H(p)(0,07).
2. The lowest value of the dose that it must measure:
H_0 = 1 mSv.
3. Measurement range:
from H_0 up to 5 Sv.
4. Linearity:
deviation < 15% for the range between 1 mSv and 5 Sv.
5. Energetic dependence:
For photons whose energy falls within the range 10 keV and 300 keV, up to 1,5 MeV, under conditions of secondary electrostatic equilibrium.

$$0.5 <= \frac{H(m)}{H(r)} <= 2.0 \text{ for } H(p)(0.07);$$

6. Dependence on direction:
< 20% up to 60° for energies > 60 keV.
7. Repeatibility:
Standard deviation S <= 15%
8. Fading: effect < 10%/month
Reference: "Ordonnance sur la dosimetrie individuelle (Ordonnance sur la dosimetrie)" 814.501.43, Suisse, October 1999

ATTACHMENT No. 7(to norms)

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***)** Annex nr. 7 is reproduced in the facsimile.

REQUIREMENTS REGARDING THE DOSIMETERS USED FOR MEASURING THE EXTREMITY DOSE AT THE BETA RADIATION

1. Measured quantity:
H(p)(0,07).
2. The lowest value of the dose that it must measure:
H_0 = 1 mSv.
3. Measurement range:
from H_0 up to 5 Sv.
4. Linearity:
deviation < 15% for range between 1 mSv and 5 Sv.
5. Energetic dependence:
For beta radiation of TI-204 or Kr-85.

$$0.1 <= \frac{H(m)}{H(r)} <= 2.0 \text{ for } H(p)(0.07);$$

In case the system has been calibrated with photon radiation, the additional requirement for the beta radiation of Sr-90/Y-90 shall be applied.
6. Repeatibility:
Standard deviation S < 15%
7. Fading: effect < 10%/month
Reference: "Ordonnance sur la dosimetrie individuelle (Ordonnance sur la dosimetrie)" 814.501.43, Suisse, October 1999

ATTACHMENT No. 8(to norms)

CONVERSION FACTORS

1. Conversion factors for photons:
Conversion factors of the kerma in the air for the individual dose in depth H(p)(10) and of the superficial individual dose H(p)(0,07) applicable to an individual dosimeter placed on a parallelepipedic phantom.

Quality/ source	Average energy (keV)	Conversion factors (Sv/Gy)									
		h(p)(10; alpha) for an alpha angle of					h(p)(0.07; alpha) for an alpha angle				
		0	15	30	45	60	0	15	30	45	60
N-15	12						0,96	0,95	0,95	0,95	0,96
N-20	16						0,98	0,98	0,98	0,98	0,97
N-25	20	0,55	0,54	0,50	0,41	0,28	1,03;	1,03;	1,03;	1,02;	1,02
N-30	24	0,55	0,54	0,50	0,41	0,28	1,10	1,10	1,10	1,09	1,07
N-40	33	1,17	1,15	1,12	1,02	0,85	1,27	1,26	1,26	1,23	1,19
N-60	48	1,65	1,63	1,59	1,47	1,27	1,55	1,54	1,53	1,49	1,42
Am-241	59	1,89	1,87	1,83	1,72	1,50	1,72	1,71	1,69	1,65	1,57
N-80	65	1,88	1,86	1,83;	1,71	1,50	1,72	1,70	1,70;	1,65;	1,58
N-100	83	1,88	1,87	1,82	1,73	1,53	1,72	1,70	1,70	1,66	1,60
N-120	100	1,81	1,79	1,76	1,68;	1,51	1,67	1,66;	1,65	1,62;	1,58
N-150	118	1,73	1,71	1,68	1,61	1,46	1,61	1,60;	1,60	1,58;	1,54
N-200	164	1,57	1,56	1,55	1,49	1,38	1,49	1,49	1,49	1,49;	1,46
N-250	208	1,48	1,48	1,47	1,42	1,33	1,42	1,42	1,42	1,43	1,43
N-300	250	1,42	1,42	1,41	1,38	1,30	1,38	1,38	1,38	1,40	1,40
Cs-137	662	1,21	1,22	1,22	1,22;	1,19	1,21	1,21	1,22	1,23	1,26
Co-60	1250	1,15	1,15	1,15	1,16	1,14	1,15;	1,15	1,15;	1,16	1,14
Ti (Target)	5140	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11	1,11

Reference: ICRP 74, ISO 4037-3.

2. Conversion factors of the kerma in the air for the superficial individual dose H(p)(0,07) applicable to the extremity dosimeter placed on a rods phantom

Quality	Mean energy(keV)	Conversion factor h(p)(0,07) Sv/Gy
N-15	12	0,95
N-20	16	0,98
N-25	20	1,00
N-30	24	1,03
N-40	33	1,07
N-60	48	1,11
Am-241	59	1,14
N-80	65	1,15
N-100	83	1,17
N-120	100	1,17
N-150	118	1,17
N-200	164	1,16
N-250	208	1,15
N-300	250	1,14

Cs-137	662	1,12

Reference: ISO 4037-3; Grosswelt, Radiation Protection Dosimetrie No. 59/1995, page 165-179.

3. Conversion factors for neutrons:
Conversion factors h(p) Φ (10, alpha of the Φ neutron influence in the individual dose in depth H(p)(10) applicable to an individual dosimeter placed on a parallelepipedic phantom.

Neutron source/Neutron energy (MeV)	hp Φ (10; alpha) in pSv cm^2 for an alpha angle of				
	0°	15°	30°	45°	60°
^{252}Cf (D_2O-moderator)	110	109	109	102	87,4
^{252}Cf	400	397	409	389	346
^{241}Am-Be (alpha, n)	411	409	424	415	383
Thermal neutrons	11,4	10,6	9,11	6,61	4,04
0,024	20,2	19,9	17,2	13,6	7,85
0,144	134	131	121	102	69,9
0,250	215	214	201	173;	125
0,57	355	349	347	313	245
1,2	433	427	440	412	355
2,5	437	434;	454	441	410;
2,8	433	431	451	441	412
3,2	429	427	447	439	412
5,0	420;	418	437	435	409
14,8	561	563;	581	572	576
19,0	600	596;	621	614	620
30	515;	515;	515;	515;	515;
50	400	400	400	400	400
75	330;	330;	330;	330;	330;
100	285	285	285	285	285

Reference: ISO 8529; ICRP 74.
Note: In case of values lower than 30 MeV, the conversion factors are identical to the ones used for the obtainment of H(p)(10).

4. Conversion factors for electrons:

Energy (MeV)	Conversion factors H(p)(10)/Φ (nSv • cm^2)
0,10	1,661
0,15	1,229
0,20	0,834
0,30	0,542
0,40	0,455
0,50	0,403
0,60	0,366
0,70	0,344

0,80	0,329
1,00	0,312
1,50	0,287
2,00	0,279
2,50	0,278
3,00	0,276

Reference: ICRP-74.

5. Conversion factors specific to the standard beta radiation:

Source	Conversion factors H(p)(10)/Φ (nSv • cm^2)
Sr/Y-90	1,24
TI-204	1,20
Kr-85	1,16
Pm-147	0,23

ATTACHMENT No. 9(to norms)

INTERPRETATION OF THE INTAKE MEASUREMENT

For the interpretation in normal cases, it is admitted that the intake is due to an inhalation. The committed effective dose $E_{50,}$ operational variable in case of the intake is obtained by multiplying the incorporated activity I with the dose factor for the inhalation, e(inh), in compliance with ICRP 68.

$$E_{50} = e(inh) \times I \quad (1);$$

The fraction activity finding at the time t after the intake by inhalation in an organ or excretion, is given by the function m(t)

$$\mathbf{M(t)} = I \times m(t) \quad (2);$$

Where:

M(t) is the activity in an organ or excretion (measured value).

m(t) the fraction daily eliminated or the retention factor, as case may be (the significance is specified in the tables of annex no.) 10).

The committed effective dose is obtained starting with M(t):

$$E_{50} = e(inh) \times I = e(inh) \frac{M(t)}{m(t)} = M(t) \frac{e(inh)}{m(t)} \quad (3);$$

When the time t between the intake and measurement (special surveillances) is known, the committed effective dose is calculated starting with M(t) by means of formula (3).

When a routine monitoring is performed, it is admitted that the intake occurred at the half of the interval T and it shall be considered t=T/2. T represents the monitoring interval, and t represents the time that elapses from the intake (event) and the first measurements. The committed effective dose is obtained starting with the M quantity and with the values of the tables e(inh)/m(t) thus:

$$E_{50} = e(inh) \times I = e(inh) \frac{M(t)}{m(t)} = M(t) \frac{e(inh)}{m(t)} \quad (4);$$

When there occurs an intake that is obviously higher to the detection limit and the effective period is comparable or gigher to the monitoring interval, it must be borne in mind that this intake will influence the subsequent measurements.
The corrections of the intake are calculated by extrapolating the anterior intake I(a) to the moment of the measurement execution; this is performed by means of the factor m (delta t).
Delta t is the interval of time that lapses between the (assumed) moment of the anterior intake and of the new measurement.
The value M(n) is the corrected value of M(t) stemming from the new intake and it is calculated starting with the value M(a) of the prevoius measurement:

$$M[n(t)] = M(t) - I(a)\, m(t) = M(t) - \frac{M(a)}{m(T/2)} m\ (\text{delta } t) \quad (5);$$

The committed effective dose due to the new intake is calculated by means of formula(4).

$$E_{50}^{n} = M[n(t)] \frac{e(inh)}{m(T/2)} = M(t) \frac{e(inh)}{m(T/2)} - M(a) \frac{e(inh)}{m(T/2)} \cdot \frac{m(\text{delta } t)}{m(T/2)} \quad (6);$$

where the support of the committed effective dose of the precedent intake shall be :

$$E_{50}^{n} = M[n(t)] \frac{e(inh)}{m(T/2)} - E_{50}^{a} \frac{m(\text{delta } t)}{m(T/2)} = M(t) \frac{e(inh)}{m(T/2)} - E_{50}^{a}\, k(\text{delta } t) \quad (7);$$

in case of the routine monitoring, the correction factor

$$k(\text{delta } t) = \frac{m(\text{delta } t)}{m(T/2)}$$ can be calculated starting from the value of m(t).

The lapsed time (delta t) can take the values (n+1/2)T, where "n" is the number of intervals that separate the intake and the measurement moments. The values of m)t= are given in ICRP – 78 under the form of tables and graphics.
If the contribution of the previous intake is greater than 10% of the intake of the last interval, corrections for the dose calculations are necessary.

NOTE:
Any other model or calculation method can be admitted, provided that they are scientifically proved.

ATTACHMENT No. 10(to norms)

SHEETS SPECIFIC TO THE RADIONUCLIDES

Radionuclide List

1. H-3 under the form of HTO
2. C-14
3. P-23
4. P-33
5. S-35
6. Ca-45
7. Cr-51
8. Fe-59
9. Co-58
10. Co-60
11. Sr-85
12. Sr-89
13. Sr-90
14. Tc-99m
15. I-123
16. I-125
17. I-131
18. Cs-134
19. Cs-137
20. Th-232
21. U-235
22. U-238
23. N(p)- (237).
24. Pu-239
25. Am-241

The sheets specific to the radionuclides are established by an unified schema. Each sheet contains 5 parts.
a) In the first part the metabolism of each radionuclide and of its compounds is globally analyzed;
b) In the second part the methods of the intake and tri measurements are given. In case that the measurement threshold is not exceeded it is generally admitted that the annual committed effective dose does not exceed 1mSv:
c) The third part refers to the monitoring period of time;
d) The fourth part contains data that allow the result interpretation;
e) The fifth part allows the interpretation in case of the chronic interpretation.
Reference: 1. Metabolism: ICRP 30, ICRP 78
2. m(t): ICRP78.
3. e(inh): ICRP 60 (identical to BSS and the Directive 96 a UE)

The aero dynamical mean diameter of the aerosols has been admitted as the equivalent of 5 µm..
The tables from 1 to 25 have as reference: "Ordonnance sur la dosimetrie individuelle (Ordonnance sur la dosimetrie)" 814.501.43, Suisse, October 1999

1. H-3 under the form of HTO

1.1. Metabolism:

The tritium under the form of tritiated water can be incorporated by inhalation, ingestion or absorption at the skin level. 97% of the tritium is quickly mixed with the water existing in the body and it is eliminated, mainly by urine within a ten day period of time. The rest of 3% is organically linked and it is eliminated after a 40 day period of time. Thus, the irradiation is practically proportional to the concentration of tritium in urine. The workers that handle luminescent panels or columns are subject to a chronic tritium intake. In this case the equilibrium should be established between the body activity and the urine one and the dose is calculated by means of a chronic intake pattern.

1.2. Measurement methods

Tri Measurement
Direct measurement on an urine test
Measurement threshold: 42 000 Bq/l.
Intake measurement
Measurement of the tritium concentration in an urine test , C(u) in Bq/l.

1.3. The monitoring interval T and the time t that lapses between the occurrence of the event and the first measurement

T(tri) = 30 days T(measurement) = 30 days t(event) = 1 day

1.4. Interpretation in case of unique intake

	T(days)	e(inh)/m(t) (Sv.l/Bq)
E_{50} = C(u) [e(inh)/m(t)] E_{50}: The committed dose for a 50 year period of time in Sv C(u): Measured value in Bq/l e(inh): Dose factor in Sv/Bq m(t): Fraction eliminated daily by urine (= 1,4 l) în l^{-1} t: The time lapsing between measurement and intake, in days If the moment of the intake is not known, that it shall be considered t=T/2 Monitoring interval T=30 days	1	0,78 x 10^{-9}
	2	0.86 x 10^{-9}
	3	0.90 x 10^{-9}
	4	0.75 x 10^{-9}
	5	1.1 x 10^{-9}
	6	1.1 x 10^{-9}
	7	1.2 x 10^{-9}
	15	2 x 10^{-9}
	30	5.3 x 10^{-9}
	45	13 x 10^{-9}

1.5. Correction for a previous intake

Monitoring interval T=30 days

E_{50} = C(u) x 1,4 x 10^{-9} (Sv on surveillance interval)

2. C-14

2.1. Metabolism:

The standard pattern has been developed for the carbon compounds that enter the metabolic process or that are used as energy sources (alimentary carbon). It is admitted that such compunds, in case of inhalation, are100% resorbed in the body and are uniformly distributed in the entire body by means of the blood circulation. They are eliminated 1n/ by urine within a 40 day biological period of time. A great number of organic compounds labeled with the C-14 isotope are not resorbed in the organism and are eliminated mainly by urine with a biological period of several hours, or even a day.

2.2. Measurement Methods

Tri measurement (mandatory for the alimentary carbon)

Direct measurement on an urine test

Measurement threshold: 200 Bq/l.

Daily measurements when the measurement threshold is exceeded. The measurement of the intake is mandatory it the measurement threshold is exceeded for a week.

Intake measurement

Measurement of the C-14 concentration in an urine test , C(u) in Bq/l.

2.3. The monitoring interval T and the time t that lapses between the occurrence of the event and the first measurement

T(tri) = 1 days T(measurement) = 30 days t(event) = 1 day

2.4. Interpretation without taking into account a previous intake

If the biological period is less than 40 days, it shall be proceeded to the specific dose calculation in compliance with art. 39 paragraph 4.

	T(days)	e(inh)/m(t) (Sv.l/Bq)
E_{50} = C(u) [e(inh)/m(t)] E_{50}: The committed dose for a 50 year period of time in Sv C(u): Measured value in Bq/l e(inh): Dose factor in Sv/Bq m(t): Fraction eliminated daily by urine (= 1,4 l) în l^{-1} t: The time lapsing between the measurement and the intake, in days If the moment of the intake is not known, it shall be considered t=T/2 Monitoring interval T=30 days	1	4.3 x 10^{-9}
	2	2.9 x 10^{-9}
	3	29 x 10^{-9}
	4	2.9 x 10^{-9}
	5	3.0 x 10^{-9}
	6	3.0 x 10^{-9}
	7	3.1 x 10^{-9}
	15	3.5 x 10^{-9}
	30	4,5x 10^{-9}
	45	5.8 x 10^{-9}

2.5. Correction for a previous intake

Monitoring interval T=30 days

E_{50} = C(u) x 3,5 x 10^{-6} - E_{50}^a x 0,60

3. P-32

3.1. Metabolism:

About 70% of the inhaled phosphate (absorption class of type M) is quickly eliminated through the respiratory passages, digestive tube (resorption coefficient f_1 = 0,8) and urine The phosphate that enters the blood circulation is 70% resorbed in the muscular tissue and bones.

The retention period of these fractions is determined by the physical period of the phosphor. It is quickly eliminated by urine (19 day period).

3.2. Measurement Methods

Tri Measurement

Measurement of an urine test

Measurement threshold: 200 Bq/l.

Intake measurement

Measurement of the phosphor concentration in an urine test , C(u) in Bq/l.

3.3. The monitoring interval T and the time t that lapses between the occurrence of the event and the first measurement

T(tri) = 30 days T(measurement) = 30 days t(event) = 2 day

3.4. Interpretation without taking into account a previous intake

	T(days)	e(inh)/m(t) (Sv/Bq)
E_{50} = C(u) [e(inh)/m(t)] E_{50}: The committed dose for a 50 year period of time in Sv C(u): Measured value in Bq/l e(inh): Dose factor in Sv/Bq m(t): Fraction eliminated daily by urine (= 1,4 l) în l^{-1} t: The time lapsing between measurement and intake, in days If the moment of the intake is not known, it shall be considered t=T/2 Monitoring interval T=30 days	1	0,011 x 10^{-5}
	2	0.018 x 10^{-5}
	3	0.029 x 10^{-5}
	4	0.043 x 10^{-5}
	5	0.056 x 10^{-5}
	6	0.073 x 10^{-5}
	7	0.090 x 10^{-5}
	15	0.27 x 10^{-5}
	30	0.92 x 10^{-5}
	45	3.1 x 10^{-5}

3.5. Correction for aprevious intake

Monitoring interval T=30 days

E_{50} = C(u) x 2.7 x 10^{-6} - E_{50}^a x 0.09

4. P-33

4.1. Metabolism:

About 70% of the phosphates (absorption class of type M) is quickly eliminated through the nasal passages, digestive tube (resorption fraction f_1 = 0,8) and urine The phosphate that enters the blood circulation is 70% resorbed in the muscular tissue and bones. The retention period of this fraction is determined by the half-value time, then the elimination occurs relatively quickly starting with the muscular tissue by urine (19 day period of time).

4.2. Measurement Methods

Tri Measurement

Direct measurement of an urine test

Measurement threshold 200 Bq/l.

Intake measurement

Measurement of the phosphor-33 concentration in an urine test , [C(u) în Bq/l].

4.3. The monitoring interval T and the time t that lapses between the occurrence of the event and the first measurement

T(tri) = 30 days T(measurement) = 30 days t(event) = 2 day

4.4. Interpretation without taking into account a previous intake

ATTACHMENT 11 (MODIFIED)

Performance testing and Routine testing for Dosimetry systems

1°. Performance testing

- In addition to the type testing of a personal dosimetry system performance testing should be conducted at regular intervals (typically annually).

- Routine external performance tests are aimed at checking the dosimetry reliability and consistency of the application of the method by an identifiable laboratory (system operator, actual identifiable equipment used, identifiable dosemeter calibration factor, read-out system calibration, environmental conditions for readout, etc.)

- Three types of performance test are in general use — the blind test, the surprise test and the announced test:
(a) In a blind test, the dosimetry service provider is not aware of the tests and cannot use selected dosimeters or special evaluation procedures for the tests. One approach is the invention of an independent ‘dummy’ customer and irradiation of the dosimeters under controlled conditions independent of the service provider. Most service providers use a dummy customer for their internal quality assurance performance testing.
(b) In a surprise test, the dosimetry service provider is aware of the tests but does not know the actual test date in advance. It is possible to use selected dosimeters but not to use special evaluation procedures.
(c) In an announced test, the dosimetry service provider is aware of the tests and may use selected dosimeters and special evaluation procedures.

- An intercomparison exercise among dosimetry service providers can be regarded as an announced performance test. Generally the results of such intercomparisons are published but are not identified with the names of the participants.

- The introduction of a dummy customer is one possible routine test. Dosimeters from the dummy customer are exposed to a known dose over each exposure period and undergo the same treatment as the normal dosimeters. A follow-up of the doses reported for this dummy customer gives a good idea of the ongoing performance of the normal dosimeters.

2°. Routine testing

- The purpose of routine testing is to test the accuracy and precision of the dosimetry system for measurement of doses at a single energy, usually that of the calibration source, e.g. 137Cs or 60Co for photon dosimeters. This type of test also serves to normalize the overall sensitivity of the system. Routine tests are normally carried out by the dosimetry service provider, and should be repeated at regular intervals, preferably monthly. In contrast, QA tests to monitor specific aspects of system performance are generally performed every readout day.

- Results of routine tests should be followed up closely, for instance by the use of control charts, where warning and action levels are defined to trigger necessary actions by the dosimetry service provider.

ATTACHMENT 12

The licensee's obligations regarding the registration and reporting results of individual monitoring of radiation exposure

1. In accordance with procedure NFSR 63, the license holder must provide evidence of the individual dosimetry monitoring occupationally exposed personnel Category A or category B to that CNCAN imposed to ensure monitoring.
Monitoring is recorded on individual forms according to the model shown in Table 1.
2. For persons under special authorised exposure, accidental or emergency, the license holder will provide evidence of monitoring on an individual form drawn up in accordance with Part IVa in Table 1.
3. (a) For external workers, registering individual monitoring results will be according with appendix. 2 of the Safety Standards Radiological operational radiation protection of external workers, published in Official Journal of Romania, Part I, no. 764 dated 30 November 2001.
(b) For external workers, the employer of the operator shall keep a separate record according to the form provided in Table. 1.
Table 1:
Individual monitoring forms
Part I
Data of the person monitored
Name..... .....
Forename ..... gender ....
Date of birth..... ..... birthplace . .....
Identity number ....
Company / Institution ....
Registered Office
City ..... district / county ....
EVNUC code number .....
Activity type, classification according to annex. 14
Street .... tel / fax .....
Date and periodically medical final result .....
..... Signature of monitored person
Part II
Total effective dose in all years prior to the opening book:
Period (years) ..... Dose (cumulative) .....
Total effective dose during the current year, prior to the opening book:
Period (d / m / a): ..... Dose: .....

Part III
Year .....

No crt	* Recor-ding date	Data, outcome last periodical medical exams Medical qualification	Radiation external field (X, α, β, n)	Type of internal contami-nation (significant radionuclid)	Dose-external exposure (mSv)	Dose equivalent to 1.eye lens 2.skin 3.extremities (mSv)	Committed Effective Dose employee Through external exposure	Total Effecti-ve dose (mSv)	Signa-ture **	Signa-ture ***
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)

* Records are made monthly
** Signature of the radiation protection officer
*** Signature of monitored person

Part IV

No crt	* Date	Place of production/ action	Radiation external field (X, α, β, n)	Type of internal contami-nation (significant radionuclid)	Dose-external exposure (mSv)	Dose equivalent to 1.eye lens 2.skin 3.extremities (mSv)	Committed Effective Dose employee Through external exposure	Total Effecti-ve dose (mSv)	Signa-ture **	Signa-ture ***
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)

* Signature of the radiation protection officer
** Signature of monitored person

ATTACHMENT 13

1. Archiving of records and reported doses

1.1.General Provision 1.1.1. Dose archiving recordings for occupationally exposed is an essential part of the monitoring of exposure to radiation and the overall objectives of monitoring.
1.1.2. Recordings aim to demonstrate compliance with C.N.C.A.N., efficiency of the ALARA principle, to provide data of the dose distribution, to assess trends regarding the exposure (depending on practices or sources of radiation), to provide data for medical purposes and / or legal, to provide data for epidemiological studies and to contribute effectively to the development of monitoring programs and procedures. Records should be easily saved and protected against loss.
1.1.3. Archiving of recorded doses should be in accordance with national regulations, dosimetry filmmaker recommendations and national dose registry requirements.
1.1.4. The records include results of individual monitoring for both external radiation and internal contamination. Dose recordings must contain the following information:
(A) Information on the individual's identification;
(B) Information on the practice;

(C) Measurements of external dose
• equivalent dose
individual Hp (10)
• equivalent dose
individual Hp (0.07)
(D) Measurements of internal dose – dose E50 actually incurred;
(E) Information relating to (b), (c) and / or (d).

1.1.5. Dosimetry organisms must possess and use an electronic system of maintaining records relating to identification, release of the dosimetry device and stages of dose assessment.

1.1.6. Recording level is the defined formal value for the equivalent dose (or incorporation) resulting from the monitoring program which must be recorded and archived.

1.1.6.1. In accordance with recommendation I3 ICRP accepted by CNCAN the recording level of individual monitoring is 1/10 of the annual limit, corresponding to the period which individual monitoring refers to (for an annual dose limit of 20 mSv, the level of registration is 0.17 mSv).

1.1.6.2. During the assessment of the equivalent dose (or incorporation) if these are below the recorded level, it should not be assigned the zero value and should be recorded specifying a value less than, the recording level (eg >0.17).

1.1.7. If extremity dosimeters are used, separate recordings should be made for each extremity.

1.1.8. Registration for the surveyed area should include: date, time and place, the level of radiation measured and relevant comments on the measurements taken.
The records should identify tools used.

1.1.9. An adequate record of the calibration of the monitoring equipment must contain identification of the equipment, calibration accuracy for each field of use for type / types of radiation being monitored, testing date, identification calibration standards used, the date and signature of the qualified person who performed the tests.

1.1.10. Recordings must be archived for the period specified in NFSR.

1.1.11. Conditions regarding archiving are approved by CNCAN in designation procedure.

1.2. Data System of Dose Recording

1.2.1. The accredited dosimetry organisms should implement a data system of dose recording

It should be made in three levels:

A. The licensees – monitored

B. Place of the activities being monitored

C. Monitoring the occupational exposures

The elements can be different depending on each case.

The elements which can describe the three levels (A,B,C) are as follows:

1.2.2. The licensee’s (license holder) identification elements:

A.1. Name

A2.Code number

A3. Contract

A4. Street number/C.P

A5. Postal code

A6 City

A7. Tax Account

A8. Phone number

A9 Type of practice (according table 1 from app. No.13)

18.2 Identifying elements of the activity place

B1.Name

B.2.Code number

B3. Contract

B4. Street number/C.P

B5. Postal code

B6. City

B7. Phone number

B8 Type of practice

18.3. Individual identification elements

C1Name, Surname

C2.Personal identification number

C3Gender

C4.Date of birth

C5.Conection to the licensee (if possible)

C6 .Activity place

C7.Cessation date of the former licensee activity

C8 .Beginning date of the activity at the actual license holder

C9. Practice classification (according to table 1, app. 14)

C10 .Ocupational exposure category (A or B)

C11. $H_p(10)$(for each assessing cycle)

C12 .$H_p(0,07)$(for each assessing cycle)

C13.Neutrons component from C11 (for each assessing cycle)

C14. E_{50} (and additional specification for the ingested radionuclides)

C15. Dose equivalent for each significant exposure of the extremities

C16. Sum of the equivalent effective dose and the committed effective dose for the surveillance period

C17. Dose assessment of the emergency or accidental exposures

C18.Data from dosimetry laboratories

C19.Cumulation of C16, C17 and C18 data

1.2.3. Recording system should allow identifying and printing according to the practice code, personal identification number and the type of exposure and dose level.

1.3 Archiving

13.1. The recordings archiving is made by the designated dosimetry organisms and by the licensees for a specified time period according to NFSR.

1.3.2. The files evidence from appendix 12 and SIID from appendix 13 should be printed or stored on an electronic device.

1.3.3. There should be implemented a program of periodical check for each stage of archived evidence being written in a register at least 5% of the archive elements.

1.3.4. Should any unconformities occur which show the deterioration of the archived elements, they will be corrected and notified to CNCAN.

1.3.5. Within the archiving data the reports sent to CNCAN will be separately recorded, according to the provisions of Article 72 from NFSR and point 1.4.from appendix 13.

1.3.6. The conditions regarding archiving are approved by CNCAN within the licensee and designation procedures.

1.4. Reporting the dose records

1.4.1 Reporting the dose records is made through:

(a) Reports on the periodically individual monitoring (monthly or on certain terms approved by the regulatory authority)

(b) Reports on the periodically individual monitoring in case of accidental, special authorized and emergency exposures.

(c) Special reports.

1.4.2. The NFSR provisions regarding individual monitoring reporting both for licensees and accredited dosimetry organizations shall be complied with.

1.4.2.1. The accredited dosimetry organisms have the obligation to report to the:

(a) Licensee, the results of the periodically individual monitoring, approved by the regulatory authority

(b) CNCAN, the results of the individual monitoring twice a year, according to the dose recording system specified in app.13

(c)The licensee the results of the individual monitoring, in case of accidental, authorized or emergency exposures as well as when any limits dose exceeding, according to Article 71 from NFSR

(d) Immediately to CNCAN and local health authority on any dose limits exceeding, according to Article 75 from NFSR

(e) CNCAN, the results of the individual monitoring as special annual reports According to Table 1 Table 2 from appendix 13

1.4.2.2. Licensees are required:

(a) To inform each involved person on the individual monitoring results, according to Article 69 of NFSR

(b)To make available for the designated physician the results of the individual monitoring according to Article 70 from NFSR

(c) To report at once the overexposures and abnormal exposures according to Article 72 of NFSR

(d) To report the final result of the overexposure in cases specified under letter c, according to Table 1, part 4, Appendix 12.

Reports are confidential and are to be submitted only to those specified above.

1.4.3. Special reports

1.4.3.1. The accredited dosimetry organisms that performs the systematic individual monitoring of the occupational exposed personnel of category A should issue annual statistics on the collective dose and the number of professional exposed personnel.

1.4.3.2. Each dosimetry organism shall fill in Table no. 1 ”Collective dose on the specified dose range” and Table no. 2 “Number of workers on the dose range “ for the monitored occupational exposed personnel, tables which periodically will be sent to CNCAN, next month following each semester.

1.4.3.3. Instruction for filling in the tables

(a) Classification scheme

It shows the above mentioned international used categories for the occupational exposed personnel.

The category used for a certain practice shall be specified. Some dosimetry organisms can use different categories than those listed in the scheme. In this case their distinct name shall be specified. Classification as “others” should be avoided.

(b) Nuclear Industry field of activity

It is necessary to include all the workers that have as main activity in the field of producing and reprocessing the nuclear fuel, producing nuclear energy in the nuclear electric power facilities, operating or assisting the use of research nuclear reactors, nuclear decommissioning, nuclear material storage, transport of nuclear materials into the nuclear facilities area.

Workers involved in the production of radioactive isotopes for medical and industrial use *are not included.* These workers should be included in the section General Industry.

If other classifications are used in this section, they shall be added in the scheme.

(c) Medical field of activity

It is necessary to include the workers who use open sources in Nuclear Medicine. These ones are not included in Radiology or Radiotherapy fields.

If other classifications are used in this section, they shall be added in the scheme.

(d) General Industry field of activity

The Radiochemical Production category includes the production of radiopharmaceuticals, label compounds and radioactive tracers used in industry, medical field and research.

The production of the radioactive elements used as nuclear fuel is not included here.

Transport category includes workers transporting radioactive material (outside the unit) and those checking security at the airports and borders.

Workers from medical field or university research are not included in the Operating accelerators category.

Only industrial use of accelerators should be included here.

(e)Education, Research, Security Inspection fields of activity

“High Education” category includes the personnel working in universities, polytechnics institutes and other educational institutes.

The employees from university hospitals should be included in the medical section, except for those involved in research activities.

(f)Natural Radioactivity field of activity

It should be notified if the workers in this field of activity are individually monitored and also the monitoring type.

If there is a dose estimation, it should be included in the table and the assessing procedure should be notified.

If there is no individual monitoring for these persons, information on the number of workers and hours/year should be obtained.

(g) Dose Range

The dose range is given on logarithmic scale, including those dose values which are in the limits of the dose range, for example:

-0,50 mSv, should be included in the corresponding domain column for (0,2-0,5);

-0,51 mSv should be included in the corresponding domain column for (0,5-1,0)

If the database does not allow the filing in of these dose ranges, it is necessary to be changed to correlate the data.

It is necessary to specifiy the minimum detectable dose (MDL), as well as the way the doses are calculated under this level. (these equals 0/MDL/approximated)

(h) Number of workers

Items “Number of workers” and “Annual average dose” are divided into two sub-sections:

- “all” meaning all the professional exposed workers, monitored and included in the recording system
- “>MDL” meaning the workers whose dosimeters showed at least a value higher than 0,1 mSv or higher thann MDL.
  S is the abbreviation for *annual collective dose.* The unit measurement om Sv or om mSv should be specified.
  For the collective dose calculation, all the workers doses are summed up.

Table no.1
Collective dose on the dose range

Act ID	Activity\ Dose	MDL 0,1	0,1 0,2	0,2 0,5	0,5 1	1 2	2 5	5 10	10 15	15 20	20 50	> 50	S omSv
N0	Total no. in nuclear domain												
N11	Producing the nuclear fuel												
N12	Enrichment of nuclear fuel												
N13	Reprocessing of the nuclear fuel												
N20	Electric power station												
N21	CNE – own personnel												
N22	CNE – external workers												
N30	Nuclear research centers												
N70	Nuclear decommissioning												
N40	Waste management												
N50	Waste storage												

N60	Transport within the nuclear facilities												
N90	Other use in the nuclear field (to be specified)												
M0	Total no. in medicine												
M10	Radiology												
M11	Interventional radiology												
M12	Cardiology												
M13	Surgical radiology												
M15	Radiology and therapy, hospitals												
M20	Radiotherapy												
M30	Nuclear medicine												
M40	Dental radiology												
M50	Veterinary medicine												
M90	Other medical uses (to be specified)												
110	Industrial radiography												
111	Industrial radiography – fixed units												
112	Industrial radiography – mobile units												
	Well logging												
120	Transport												
130	Radiochemical substances production												
140	Industrial irradiation												
150	Accelerators operating												
160	Chemical industry												
131	Lighting devices												
190	Other industrial uses (to be specified)												
E0	Total (Education, Research, Security)												
E1	High level education												
E2	Radiation research Security and inspection												
R0	Natural radioactivity												
R10	Mining												
R11	- Underground coal mining												
R12	- underground mining other than												
R20	- Uranium mining												
R30	Total civil aviation												
R31	Flight crew												
R32	Personal flight attendant												
R40	Caves or other underground public places												
R50	Water plants												
R90	Other activities with natural sources exposure												
T	Total												

Tabel no.2

Number of workers on specified dose range

Act ID	Activity\ Dose	MDL 0,1	0,1 0,2	0,2 0,5	0,5 1	1 2	2 5	5 10	10 15	15 20	20 50	> 50	N All	N> MDL	S omS v	D_{ave} all	D_{ave} > MDL
N0	Total no. in nuclear domain																
N11	Producing the nuclear fuel																
N12	Enrichment of nuclear fuel																
N13	Reprocessing of the nuclear fuel																
N20	Electric power station																
N21	CNE – own personnel																
N22	CNE – external workers																
N30	Nuclear research centers																
N70	Nuclear decommissioning																
N40	Waste management																
N50	Waste storage																
N60	Transport within the nuclear facilities																
N90	Other use in the nuclear field (to be specified)																
M0	Total no. in medicine																
M10	Radiology																
M11	Interventional radiology																
M12	Cardiology																
M13	Surgical radiology																
M15	Radiology and therapy, hospitals																
M20	Radiotherapy																
M30	Nuclear medicine																
M40	Dental radiology																
M50	Veterinary medicine																
M90	Other medical uses (to be specified)																
110	Industrial radiography																
111	Industrial radiography – fixed units																
112	Industrial radiography – mobile units																
	Well logging																
120	Transport																
130	Radiochemical substances production																
140	Industrial irradiation																
150	Accelerators operating																
160	Chemical industry																
131	Lighting devices																
190	Other industrial uses (to be specified)																
E0	Total (Education, Research, Security)																
E1	High level education																
E2	Radiation research Security and inspection																
R0	Natural radioactivity																
R10	Mining																
R11	- Underground coal mining																
R12	- underground mining, other than coal																

R20	- Uranium mining																
R30	Total civil aviation																
R31	Flight crew																
R32	Personal flight attendant																
R40	Caves or other underground public places																
R50	Water plants																
R90	Other activities with natural sources exposure																
T	Total																