

The control and regulation of occupational exposure through the inspection process in the Czech Republic

Karla Petrová

State Office for Nuclear Safety Prague, Senová_né nám.9, Czech Republic

Karla.Petrova@sujb.cz

Abstract

State Office for Nuclear Safety (SUJB) is an integrated Regulatory Authority of the Czech Republic for nuclear safety and radiation protection with an independent budget and with clearly declared competencies by the Law No.18/1997 Coll. (Atomic Law -last version from 2003 [1]).Organisational scheme of SUJB consists of headquarters and eight Regional centres. SUJB has recently about 60 radiation protection inspectors. Authority of inspectors is stipulated in the provisions of the Atomic Law.

Atomic Law stipulates the responsibility of SUJB for the control, regulation and registration of the occupational exposure on the national level. SUJB officially established the Central Registry of Occupational Exposures (CROE) in 1997 for this purpose. All licensees shall report to SUJB all category A workers with their identification attributes and the results of their individual monitoring. Workers are characterised by their professions. CROE enables to evaluate and control overview of individual doses of registered workers as well as to provide with the statistical evaluation of occupational exposure on the national level. One of the duty of licensee established in recent legislation is to report also every individual dose exceeding 20mSv - dose evaluated in monitoring period or annual individual dose - to SUJB with the result of consequences evaluation and with description of measures adopted. The duty of reporting is also on the side of the personal monitoring services. This reporting serves also for planning of SUJB inspections. However SUJB helps also in searching of the ways of solution in cases when the implementation of ALARA principle is not elementary. Recently, for example, the discussions and meetings with the representatives of industrial radiographers and interventional radiologists have been organised.

Recently CROE is operating as a part of the comprehensive information system in radiation protection which includes also the registers of licensees, sources, approvals and controls.

The use of the registration system for the evaluation of occupational exposure status and trends for inspection purposes and the procedures of SUJB used in the case of any findings not complying with the legislation or with the preconditions defined in the licence are described in the presentation.

1. Licensing and Occupational Exposure Control and Regulation

In accordance with valid legislation which is based on ICRP 60, IAEA BSS and EU BSS licensee shall:

- ensure that radiation protection is a matter of priority;
- ensure that his activities are justified by benefits outweighing risks from these activities;
- maintain a level of radiation protection that the risk to life, health, environment shall be kept as low as reasonably achievable;
- perform of intervention if the exposure can approach levels of acute damage to health, or if such measures are expected to provide more benefit than harm;
- reduce exposure of people so that established limits are not exceeded.

1.1. System of exposure limitation

The basic limits of the effective, or equivalent dose within one calendar year for exposure of workers and individuals of the population as a result of activities leading to exposure are defined in Decree No.307/2002 Coll. on radiation protection – new version issued in 2002 [2].

In special cases, SUJB can approve the exposure of persons, which could exceed, under defined conditions, the basic limits.

1.1.1 Basic limits of occupational exposure

The basic limits for radiation workers (A or B category) are related to the sum of doses from all types of irradiation and under all work activities.

The following limits are established in [2]:

- E (external and internal exposure) < 100 mSv/5 year;
- E (external and internal exposure) < 50 mSv/year;
- H < 150 mSv/year in eye lens;
- average H < 500 mSv/year in 1 cm² of skin;
- average H < 500 mSv/year to arms from fingers to forearms, for legs from feet to ankles.

1.1.2. Optimisation

The optimisation is based on established constraints (as upper boundary of optimisation).

ALARA principle in radiation protection for all activities is seen as acceptable if:

- the total collective effective dose
S 1 Sv/year,
- the individual effective dose of radiation workers
E 1 mSv/year,
- the individual effective dose (for the critical group of people)
E 50 µSv/year,
- the individual effective dose (for the critical group of people) from the radionuclides released into the environment
E 1/20 E_L (E_L - basic general limit);

if these values may be exceeded than:

- the quantitative study shall be carried out to prove optimal radiation protection (monetary alfa values are defined in [2]),
- the risk origin from activities, practice shall be assessed; its comparison to possible alternative approaches shall be made.

During the licensing process SUJB approves the document called “proof” of optimisation as well as the monitoring programme where one necessary part is describing the personal monitoring system on the workplace. SUJB issued also more detailed guidelines for personal monitoring management. Occupational exposure control and all relating necessities and documents are an essential part of routine controls.

1.2. Personal Dose Registration and Reporting

As has been already mentioned, SUJB created as a very effective tool for occupational exposure regulation and control - the central state register – CROE [3].

CROE collects personal and dosimetric data for all monitored workers in the entire country. The register keeps the history of workers' doses and their employment.

The licensee shall keep the personal identification and personal doses (including the characterisation of the exposure) of category A workers to their 75 years at least 30 years after the work termination.

The licensee reports to SUJB, directly or via personal dosimetric service, the personal data on each category A worker, and the data characterising possible exposure, to the extent and in the form stipulated by SUJB, within 1 month from the start of employment or in case of any change of registered data.

The data on personal doses are reported within 2 months of the termination of monitoring period, and the annual overview of personal doses for the preceding year by the end of April of current year. The person who carries out the personal dosimetry must archive the data at least one year after the year to which the data are related.

Data registered in CROE has started officially in 1997 year, but where it was possible also previous years (from 1991) are included. CROE has registered, during its existence, about 35 thousands of workers of 2000 licensees. In a given year, there are active records for about 21 000 workers, and based on the data registered in CROE, it is observed that about 45% of individual effective doses lay below MDL (0.05 mSv in the case of film dosimetry) and the distribution of doses has had a stable trend for five last years. The positive trend could be observed in decreasing of average doses for most exposed groups of workers – industrial radiographers and interventional radiologists. The average dose of all workers is about 0,6mSv and 1.1mSv for those with doses over MDL in 2003. Only few cases exceeding 20mSv appeared in the years 2002 and 2003.

Since 2003 CROE includes, in accordance with new legislation, also separate registration of outside workers and their personal doses received during contracted activities performed in any controlled area. Outside workers are equipped from the beginning of the year 2004 with the personal radiation passport issued by SUJB. The radiation passport consists of two parts, one part is permanent with the possibility of ten years dosimetric results registration and second part with detailed registration of annual doses will be changed every year. The collected parts will be archived in SUJB and will be used also for the control of doses of outside workers registered in CROE. During 2003 SUJB has issued 2 050 personal radiation passports.

1.2.1. Higher Dose Investigation

Following the legislation, the licensee is obliged to report to SUJB immediately each personal dose exceeding 20mSv in given monitoring period or after the evaluation of annual dose. The same duty is also on the side of personal dosimetric services. Licensee is obliged to report also the results of investigation of such event and the measures implemented. The conclusion of investigation has to be confirmed by the radiation protection officer and by the radiation worker concerned. In the case, when measured dose has been evaluated as non-personal, the value is not included in occupational exposure of worker. However frequently repeated cases, when only dosimeter is irradiated from the reason of its irregular use, could be an initiation for the control from the side of SUJB.

In the case, that dose is evaluated as personal, it is necessary, first of all, to ensure that the correction for the attenuation effect of shielding apron was done, where is appropriate. The personal dosimeter is placed in accordance with Czech legislation over the shielding apron. The recalculation is not performed automatically for all values measured. The Decree on

radiation protection requires, that the correction is carried out in accordance with the approved monitoring program in relation with equivalent of Pb of shielding apron used and energy of radiation. SUJB initiated the elaboration of the procedure for recalculation for currently used shielding aprons in the country (0.25mm, 0.35mm, 0.5mm). Based on the experimental results the relationship between energy and Pb equivalent has been established and distributed for routine use. In case of the interventional radiologists, there has to be also paid attention to the equivalent doses and their limits. There was also project sponsored by SUJB concerned to the possible method set up for the estimation of dose to eye lens and thyroid from the measurement with film dosimeter wore on the reference place – left side of the thorax. During the evaluation of annual doses, the licensee should correct all values exceeding the defined reference level and corrected values reports to SUJB. These confirmed values are than registered in CROE. The dose exceeding limit, evaluated as personal and occurred as the consequence of the exceptional event is always registered and treated separately.

Principally said, all doses exceeding the basic limits established for occupational exposure should be a consequence of exceptional events. In case, that the overexposure occurs in course of approved practice and worker follows all determined radiation protection rules, than the question of justification and optimisation arises. This problem is always very actual concerning two professions – intervention radiology and industrial radiography. There we can find certain group of workers with evaluated doses approaching the limit valid till the end of year 2000 – 50mSv. There could be a problem for some of these workers to keep the new limit 100mSv/5years. Within the framework of investigation of all these cases exceeding the established value 20mSv, the measures preventing or decreasing the probability of repetition of such exposure should be set up. If there is not, from the side of relevant licensee, the answer to the reported higher dose, the regional centre of SUJB is pointed out and relevant inspectors should decide the next steps.

In case that evaluated dose exceeds significantly the basic limit, the circumstances are immediately investigated and after discussion with physicians, the preventive measures are adopted when the non-personal dose is not confirmed unambiguously. The responsibility of the further treatment of such worker is than only on the side of the responsible physician.

Based on the data registered in CROE there has been investigated only 1 case exceeding 20 mSv during the year 2003. 12 cases have been reported by the dosimetric services and concluded as non-personal after evaluation. This is very positive trend in comparison with the previous years.

The evaluation of annual doses in 2003 shows 33 cases, when the personal doses exceeded 20 mSv. 13 cases from this amount have been the doses of uranium miners. The control and regulation of their doses is ensured during the year and these doses are not investigated again. 18 cases have fell into the health care branch - all of them have been corrected for the shielding apron. Only 1 case of all arise in industrial radiography. During the year 2003 there have been found also 472 cases (without uranium miners) of personal dose exceeding the investigation level for annual dose 6 mSv. These cases have concerned to 50 licensee – 32 health care organisations (mostly large hospitals), 6 industrial radiography companies, 12 research, service or inspection organisations and nuclear power plants.

2. Inspection procedure and regulation

2.1. General procedure

Three types of inspections are organised by SUJB:

- regional inspections, which are planned and organised by Regional Centres for sources and practices determined by SUJB headquarters,
- inspections carried out by specialised groups of inspectors in given inspection activities (nuclear medicine, medical and industrial used accelerators, special irradiation units with sealed radionuclide sources, etc); these inspections are planned and evaluated at SUJB headquarters,
- associated inspections (*ad hoc* inspection group is compiled from inspectors of different Regional Centres) which are planned and evaluated at SUJB headquarters and are concerned on from point of view radiation protection important facilities (NPP, rad-waste storage, large research centres, etc.).

Inspections of SUJB are carried out by both Regional Centres of SUJB and by specialised inspection teams. The activities of specialised inspection teams are focused on those specific types of ionizing radiation sources and work places with such sources where achieving a higher level of the unification of radiation protection practice in the whole territory of the country is required (e.g workplaces with important and major open radionuclide radiation sources, nuclear power engineering, uranium-mining industry etc.). This system of inspections is supplemented with inspections carried out *ad hoc* by formed inspection teams, particularly for difficult inspection (in terms of expended time and their subject matter) at the workplaces with very significant sources. This procedure was verified in past years as effective as well as the only one possible that enables inspections to be carried out with a limited number of inspectors (they also participate in extensive administrative activities of the office and in other tasks as deemed by law) and keeping the necessary professional level of the inspections.

Internal regulation VDS 043“ Planning, preparation, execution and evaluation of inspections in Radiation protection“ unifies the practice of execution and evaluation of inspections within the whole office as much as possible. The evaluation system of the inspections consists of four degrees based on the following criteria:

Degree 1 - only small inconsistencies were detected that neither impede performance of permitted activities nor endanger safety.

Degree 2 – more serious defects, however the inspected person can, under certain conditions, proceed with activities resulting in exposure.

Degree 3 - big inconsistencies impeding safe operation; some activity resulting in exposure must usually be limited or suspended until corrective measures are taken.

Degree N - the planned inspections was not executed or was not evaluated

The inspections are carried out according to approved half-year plans based on the principles as follows:

- the inspection shall be carried out at least once every two years at all workplaces with important sources used in industry;
- the inspection of important ionizing radiation sources shall be systematically preferred to the inspections of simple sources, particularly in the field of health services;
- with simple sources, inspections at the “problem” workplaces, where deficiencies can be expected, shall preferably be carried out;

- regarding natural sources, attention shall be paid to the suppliers assuring public water supply and the manufacturers of building materials.

2.2. Control of occupational exposure

The control of occupational exposure is managed through the control of personal monitoring program – approved documentation during the licensing process - and control of results of personal monitoring. This control is practically a regular part of each inspection. The guideline for the licensees has been worked out with the detailed recommendations how to fulfill the general requirements of the legislation regarding the personal monitoring management. This guideline contains

- the basic rules for personal dose limitation, categorization of workers, definition and determination of reference levels,
- description of methods of personal dosimetry used in the country
- specific requirements for the personal monitoring of workers in selected workplaces
- evaluation and registration of personal doses of outside workers
- the requirements for registration and reporting of personal doses to Central register
- the procedure for the higher doses investigation
- the basic requirements for personal dosimetric services and the list of dosimetric services approved by SUJB

As a part of this guideline the basic outlines of personal monitoring program and the documents for communication with SUJB are included.

Based on the evaluation made from CROE, the inspectors – regional centers – are provided with the list of the workplaces and names of workers exceeding the investigation levels and next inspections are planned also with the respect to this list. In the case of a suspicion of malevolent use of personal dosemeters or in the case of repetition of the cases of higher doses in one workplace or for one workers – the regional centers are asked to organize inspection immediately. When higher personal dose is reported during the year, relevant inspectors are kept informed.

For the purpose of unified and harmonized inspection process the special internal SUJB guidelines are issued as a tool for the inspectors.

Thus, within all of them, the guideline for the control of personal monitoring program performance during the inspection as well as the dosimetric service control have been issued.

In the field of supervision of artificial, natural ionizing radiation sources and control of activities resulting in exposure, in 2002 a total of 1,428 inspections were carried out, of which 1,225 inspections were executed by Regional Centers of SUJB. Separately, 132 inspections were performed by the specialized inspection groups on the field of natural sources, nuclear power engineering, nuclear medicine, unsealed sources and radiotherapy.

86,6% of the total inspections focused to the control of artificial ionizing sources were evaluated by the degree 1 or 2.

In the field of natural ionizing radiation sources approx. 85 % of inspected entities were evaluated with degrees 1 or 2. A predominant cause of degree 3 evaluation with checked persons managing ionizing radiation sources is the absence of the licence issued pursuant to § 9 of the Atomic Act; the permit is issued to an entity which over the course of time changed form or was transformed into another entity.

2.3. Regulation of Occupational Exposure

The Department of Regulation of Exposure (DRE) as a part of radiation protection section of SUJB is responsible for the control, registration and regulation of occupational exposure to ionizing radiation. Direct responsibility of this department is to operate the CROE, to license and control all dosimetric services operating in the country, to organize the national comparisons in personal dosimetry, to register and to investigate the cases of higher personal doses, to ensure methodically the approval of personal monitoring programmes, to issue personal radiation passports. DRE also organise the seminars focused to the exposure regulation (e.g. for radiographers and radiologists) and secures the co-operation with the Ministry of Health in the case of significant overexposure (with the danger of deterministic effects) of workers or in the case of suspicion for such overexposure. DRE co-ordinate the participation of SUJB in ISOE and in EAN and also in the model projects organized by the IAEA and relating to the occupational exposure control and optimisation.

As was already mentioned the routine control of the personal monitoring programme is on the side of inspectors in regional centres or on the side of specialised inspections groups during the inspections on the workplaces. Minor findings not complying with the valid legislation or with the approved documentations as a part of an issued licence are solved by the inspector through the protocol of the control where this findings are described and the deadline for the improvement is stated. More serious cases connected with the overexposure of workers are treated usually by the ad hoc inspection team.

Frequent required remedies or provisions concerning the occupational exposures could be divided into two groups as administrative or systematic failings in the system of personal monitoring. As administrative could be seen for example - regular record keeping of personal doses, the report of investigation of higher doses, the improvement of system of information to workers about their personal doses. As systematic could be identified - the change of the work management (important e.g. for radiographers), the use of additional protective tools, the use of additional personal dosimeter, the change of monitoring period, etc.

Based on the evaluation of the cases of higher radiation exposure the most cases are a result of the break of the rules prescribed. But there were only rare cases in last years with really overexposed workers – e.g. the internal contamination of workers during the dismantling of contaminated glove boxes when the monitoring of activity on the workplace was ignored or high doses to hands during the preparation of radiopharmaceuticals for PET examination when only one person was handling with the high radioactivity preparing RAF for administration.

3. Conclusions

The role of the regulatory authority in the process of optimisation could be seen in methodological guidance and management of the control and regulation of personal doses – the general requirements are established in the legislation, the monetary value of averted dose serves as a specific tool for the quantification analyse. SUJB issues the guidelines appointed to the licensees and serve for the effective and practical monitoring programmes and provides with the consultations on this field when necessary. Subsequently operating the central register of occupational exposure SUJB monitors and regulate the trends of personal doses and their compliance with the limits and reference levels established. In the frame of the routine controls SUJB performs the control of the fulfilment of the monitoring programme and requires remedy of found inconsistencies. SUJB acts also as an instructor and educator in selected areas.

Finally it could be stated that the level of the personal doses of radiation workers in the Czech Republic is very positive and only rare excess of established limits were identified in many

last years. The problem of occupational exposure regulation is not identified recently as a principal problem and the system of control and regulation on this area is seen as appropriate enough.

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